2008 LCCMR Recommendations Summary
M.L. 2008, Chapter 367

All Funds

Subd. 3 - Land and Habitat *(17 appropriations*)* *($500,000 - 2006 Transfer included)*	**$16,317,000**
Subd. 4 - Water Resources *(9 appropriations)*	**$3,516,000**
Subd. 5 - Natural Resource Information *(8 appropriations)*	**$2,365,000**
Subd. 6 - Environmental Education *(2 appropriations)*	**$1,099,000**
Subd. 7 - Emerging Issues Account *(1 appropriation)*	**$155,000**
TOTAL	**$23,452,000**

* There are 17 appropriations which include 37 individual projects that are a part of Subd. 3a "Metropolitan Conservation Corridors" (13) and Subd. 3c "Minnesota Habitat Conservation Partnership" (24).

All Funds

Environment & Natural Resources Trust Fund	**$22,866,000**
Great Lakes Protection Account	**$86,000**
Transfer of M.L. 2006, Chapter 243, Sec. 20, Subd. 3	**$500,000**
TOTAL	**$23,452,000**

This document is made available electronically by the Minnesota Legislative Reference Library as part of an ongoing digital archiving project. http://www.leg.state.mn.us/lrl/lrl.asp

2008 LCCMR Recommendations for the Environment and Natural Resources Trust Fund

**In response to the 2008 RFP, 118 proposals requesting a total of $98.5 million were received. Approximately $22.8 million is available for 2008 funding. After full consideration of all proposals received, the LCCMR final allocation recommendations are for 37 appropriations (74 projects). These recommendations ranged from full funding for the full project and $ amount requested to partial funding for specific project elements and partial $ amount requested.*

Subd.	Title	Affiliation	LCCMR $ Rec. $22,866,000 from TF	LCCMR $ Rec. $86,000 from GLPA	LCCMR $ Rec. $500,000 2006 Transfer of Trust Fund	Region
SUBD. 3 LAND AND HABITAT						
3a	Metro Conservation Corridors (MeCC) - Phase IV MeCC - Individual work programs	DNR/7 Partners	**$3,150,000**			Central, SE, Metro-11
3b	Vermillion River Corridor Acquisition and Restoration in Dakota County	Dakota County	**$400,000**			Metro-11
3c	Minnesotas Habitat Conservation Partnership - Phase V HCP - Individual work programs	Pheasants Forever/DNR/15 Partners	**$3,150,000**			NW, NE, Central, SW, SE
3d	Preserving the Avon Hills Landscape	Saint Johns Arboretum and University	**$337,000**			Central
3e	Minnesota River Valley Green Corridor Land Protection	Southwest Initiative Foundation	**$1,000,000**			SW, Central
3f	Scientific and Natural Area Acquisition	DNR	**$1,000,000**			SE, SW, Central
3g	State Land Acquisition Consolidation	DNR	**$500,000**			NW, NE, Central
3h	State Park and Trail Land Acquisition	DNR	**$1,500,000**			Statewide
3i	Metropolitan Regional Park System Land Acquisition	Metropolitan Council	**$1,500,000**			Metro-11
3j	Local Initiative Grants - Regional Parks and Natural Areas	DNR	**$1,000,000**			Metro-11
3k	Conservation Partners/Environmental Partnerships Matching Grant Program	DNR	**$150,000**			Statewide
3l	County Trail Systems Design	U of M	**$175,000**			SW, Central, SE
3m	Accelerated Prairie Management, Survey, Acquisition, and Evaluation	DNR	**$1,250,000**			NW, Central, SW, SE,

2008 LCCMR Recommendations for the Environment and Natural Resources Trust Fund

**In response to the 2008 RFP, 118 proposals requesting a total of $98.5 million were received. Approximately $22.8 million is available for 2008 funding. After full consideration of all proposals received, the LCCMR final allocation recommendations are for 37 appropriations (74 projects). These recommendations ranged from full funding for the full project and $ amount requested to partial funding for specific project elements and partial $ amount requested.*

Subd.	Title	Affiliation	LCCMR $ Rec. $22,866,000 from TF	LCCMR $ Rec. $86,000 from GLPA	LCCMR $ Rec. $500,000 2006 Transfer of Trust Fund	Region
3n	Prairie Ecosystem Restoration	Martin SWCD	**$80,000**			SW
3o	Best Practices for Native Prairie Management	Minnesota Recreation & Park Association	**$45,000**			NW, Central, SW, SE,
3p	Impacts of Climate Change and CO_2 on Prairie and Forest Production	U of M	**$330,000**			Statewide
3q	Biofuel Production and Wildlife Conservation in Working Prairies.	U of M	**$250,000**		**$500,000**	NW, Central, SW, SE,
		Subtotal	**$15,817,000**	**$0**	**$500,000**	
SUBD. 4 WATER RESOURCES						
4a	Future of Energy and Minnesota Water Resources	U of M	**$270,000**			Statewide
4b	Accelerating Plans for Integrated Control of the Common Carp	U of M	**$550,000**			NW, Central, SW, SE,
4c	Testing Pesticides and Degradates in Public Drinking Water	MN Dept. of Agriculture	**$368,000**			Statewide
4d	Assessment of Riparian Buffers in the Whitewater River Watershed	Whitewater Joint Powers Board	**$52,000**			SE
4e	Intralake Zoning To Protect Sensitive Lakeshore Areas.	DNR	**$125,000**			Central
4f	Native Shoreland Buffer Incentives Program	DNR	**$225,000**			Statewide
4g	Southeast Minnesota Showcase Stream Restoration Projects	Trout Unlimited	**$240,000**			SE
4h	South-Central MN Groundwater Monitoring and County Geologic Atlases	DNR	**$1,600,000**			Statewide
4i	Lake Superior Research	U of M		**$86,000**		NE
		Subtotal	**$3,430,000**	**$86,000**	**$0**	

2008 LCCMR Recommendations for the Environment and Natural Resources Trust Fund

**In response to the 2008 RFP, 118 proposals requesting a total of $98.5 million were received. Approximately $22.8 million is available for 2008 funding. After full consideration of all proposals received, the LCCMR final allocation recommendations are for 37 appropriations (74 projects). These recommendations ranged from full funding for the full project and $ amount requested to partial funding for specific project elements and partial $ amount requested.*

Subd.	Title	Affiliation	LCCMR $ Rec. $22,866,000 from TF	LCCMR $ Rec. $86,000 from GLPA	LCCMR $ Rec. $500,000 2006 Transfer of Trust Fund	Region
SUBD. 5 NATURAL RESOURCE INFORMATION						
5a	Updating the National Wetlands Inventory for Minnesota	DNR	**$550,000**			Statewide
5b	Soil Survey	BWSR	**$400,000**			Statewide
5c	Updating Precipitation Intensities for Runoff Estimation and Infrastructure Designs	Minnesota Pollution Control Agency	**$100,000**			Statewide
5d1 5d2	Minnesota Breeding Bird Atlas	Audubon Minnesota	**$270,000**			Statewide
5e	Restorable Wetlands Inventory	Ducks Unlimited, Inc.	**$245,000**			NW, Central, SW, SE,
5f	Wildlife Disease Data Surveillance and Analysis	U of M	**$100,000**			Statewide
5g	Conservation Easement Stewardship, Oversight and Maintenance	BWSR	**$180,000**			NW, Central, SW, SE,
5h	Conservation Easement Stewardship and Enforcement Program Plan	DNR	**$520,000**			Statewide
		Subtotal	**$2,365,000**	**$0**	**$0**	
SUBD. 6 ENVIRONMENTAL EDUCATION						
6a	Waters of Minnesota Documentary on Watersheds	Bell Museum of Natural History, U of MN	**$349,000**			Statewide
6b	Global Warming - Reducing Carbon Footprint of Minnesota Schools	Minnesota Pollution Control Agency	**$750,000**			Statewide
		Subtotal	**$1,099,000**	**$0**	**$0**	
SUBD. 7 EMERGING ISSUES ACCOUNT						
7	Emerging Issues Account	-	**$155,000**			
		Subtotal	**$155,000**	**$0**	**$0**	
		Grand Total	**$22,866,000**	**$86,000**	**$500,000**	

2009 Project Abstract
For the Period Ending June 30, 2011

PROJECT TITLE: Vermillion River Corridor Acquisition and Restoration in Dakota County
PROJECT MANAGER: Alan Singer
AFFILIATION: Dakota County
MAILING ADDRESS: 14955 Galaxie Avenue
CITY/STATE/ZIP: Apple Valley MN 55124
PHONE: 952-891-7001
E-MAIL: al.singer@co.dakota.mn.us
WEBSITE: www.co.dakota.mn.us
FUNDING SOURCES: 2008 Environment and Natural Resources Trust Fund ($400,000) Transfer of M.L.1999, Chp. 231, Sec. 16, Subd. 13(m) Balance: ($149,965)
LEGAL CITATION: M.L. 2008, Chp. 367, Sec. 2, Subd. 3(b).

APPROPRIATION AMOUNT: $549,965

Overall Project Outcome and Results

The Vermillion River, a designated trout stream, flows through four cities and five rural townships starting in Scott County and running through Dakota County. The existing watershed plan, like most other comparable plans, identified and addressed water quality issues, but recommended and required that management efforts do not include corridor-related wildlife habitat protection and restoration, or recreational use and conflicts.

The new Vermillion River Corridor Plan (http://www.vermillionriverwatershed.org/index.php?option=com_content&view=article&id=58&Itemid=67) developed with these funds establishes a vision and philosophy for the corridor along the main stem and primary tributaries of the Vermillion River from New Market Township in Scott County to Vermillion Falls in Hastings. It is based on integrating multiple benefits: environmental (water quality and upland habitat), social (recreation), and economic (sustainable high-quality places to live and work). The plan creates a foundation for coordinating and prioritizing funding, implementation and management. The plan also includes the "Vermillion River Corridor Handbook" http://www.improvethevermillionriver.org/, a searchable, online Best Management Practices tool intended for use by a broad audience. The tool includes practices indexed by primary benefits (water quality, habitat, and recreation) and by the predominant landscape type of interest to the user (urban, rural, and developing). Information on and links to potential funding sources and technical information is included. The plan, process, and products were designed to be replicable.

The corridor plan also creates the framework for initiating a comprehensive riparian buffers initiative throughout Dakota County. An 800-point criteria system that includes water quality, wildlife habitat, recreation, financial, and other considerations was developed to evaluate and select future land protection projects. An innovative system for determining financial value for corridor buffer easements based on land cover/use types was developed.

The plan and resulting selection system resulted in the acquisition of a 193-acre permanent conservation easement that protects the headwaters of South Branch of the Vermillion River, a very high quality restored prairie, and a network of trails open to the public.

Project Results Use and Dissemination

As the project transitioned from planning to implementation, information has been shared with the general public through various venues and media forms:

- New website for the Vermillion River Watershed Joint Powers Organization launched in 2010 and contains information on the Corridor Plan project as well as the Vermillion River Corridor Handbook online best management practices tool.
- Dakota County Update articles in the monthly newsletters for the Dakota County Board of Commissioners.
- Dakota County environmental listserv: draft plan open house information.
- News releases: project updates and information on the draft plan open house resulting in coverage in the Star tribune and Pioneer Press, as well as other local papers.
- Project updates were provided to the Dakota County Board, Dakota County Planning Commission, Dakota County Parks and Recreation Advisory Committee, Dakota County Township Officers Association, Vermillion River Watershed (VRW) Joint Powers Organization, Farmland and Natural Areas Program Advisory Committee, VRW Planning Commission and VRW Technical Advisory Group.
- Draft plan overviews were provided at the Dakota County Board of Commissioners meetings and project overviews were provided to the Farmland and Natural Areas Program Advisory Committee, County Planning Commission, Vermillion River Watershed Planning Committee and Technical Advisory Group during the draft plan review in 2010.
- Draft plan presentations at local government meetings in all corridor communities: the cities of Elko-New Market, Farmington, Hastings, Lakeville, and Vermillion; and the townships of Castle Rock, Empire, Eureka, Marshan, New Market, and Vermilion.
- Open house information posted on the Friends of the Mississippi River website and distributed through their listserv.
- 3,000+ Workshop III invitation postcards sent to landowners within 300 feet of the river in Scott and Dakota counties.
- Workshop information posted on the Friends of the Mississippi River website and distributed through their listserv.
- Project overview provided at the Dakota County Board of Commissioners Land Conservation Vision workshop on March 16, 2010.
- Project information was provided to visitors at the Dakota County Fair.
- A project overview was presented at the Land Conservation and Water Quality Summit held at the Minnesota Landscape Arboretum on September 24, 2009, and at the annual state Soil and Water Conservation District Conference held in Duluth on December 7, 2009.
- The plan received a National Association of Counties Award in 2011 and will be presented during the annual meeting of the American Planners Association in Minnesota on September 29, 2011.

Environment and Natural Resources Trust Fund 2009 Work Program Final Report

Date of Report: September 28, 2011
Date of Next Status Report: Final Report
Date of Work Program Approval: June 10, 2008
Project Completion Date: June 30, 2011

I. PROJECT TITLE: **Vermillion River Corridor Acquisition and Restoration in Dakota County**

Project Manager: Alan M. Singer
Affiliation: Dakota County
Mailing Address: 14955 Galaxie Avenue
City / State / Zip: Apple Valley, MN 55124
Telephone Number: 952-891-7001
E-mail Address: al.singer@co.dakota.mn.us
FAX Number: 952-891-7031
Web Page address: www.co.dakota.mn.us

Location: Vermillion River Watershed, Dakota County, Minnesota

Total Trust Fund Project Budget:

2008 Trust Fund Appropriation:	$	400,000
Minus Amount Spent:	$	400,000
Equal Balance:	$	0

Transfer of M.L.1999, Chp. 231, Sec. 16, Subd. 13(m) Balance:	$	149,965
Minus Amount Spent:	$	149,965
Equal Balance:	$	0

Legal Citation: M.L. 2008, Chp. 367, Sec. 2, Subd. 3(b).

Appropriation Language:
$400,000 is from the trust fund to the Commissioner of Natural Resources for an agreement with Dakota County to develop and implement a comprehensive and integrated water quality, wildlife habitat, and outdoor recreational corridor plan in the Vermillion River watershed through easement and fee title acquisition and restoration. At least 90 percent of this appropriation must be spent on the implementation of the comprehensive plan. A list of proposed restorations and fee title and easement acquisitions must be provided as part of the required work program. All funding for conservation easements must include a long-term stewardship plan and funding for monitoring and enforcing the agreement. This appropriation is available until June 30, 2011, at which time the project must be completed and final products delivered, unless an earlier date is specified in the work program. On January 2, 2009, the unobligated balance of the appropriation for Dakota County wildlife habitat acquisition and development in Laws 1999, chapter 231, section 16, subdivision 13, paragraph (m), is transferred and added to this appropriation.

II. FINAL PROJECT SUMMARY:

Overall Project Outcome and Results

The Vermillion River, a designated trout stream, flows through four cities and five rural townships starting in Scott County and running through Dakota County. The existing watershed plan, like most other comparable plans, identified and addressed water quality issues, but recommended and required that management efforts do not include corridor-related wildlife habitat protection and restoration, or recreational use and conflicts.

The new Vermillion River Corridor Plan (http://www.vermillionriverwatershed.org/index.php?option=com_content&view=article&id=58&Itemid=67) developed with these funds establishes a vision and philosophy for the corridor along the main stem and primary tributaries of the Vermillion River from New Market Township in Scott County to Vermillion Falls in Hastings. It is based on integrating multiple benefits: environmental (water quality and upland habitat), social (recreation), and economic (sustainable high-quality places to live and work). The plan creates a foundation for coordinating and prioritizing funding, implementation and management. The plan also includes the "Vermillion River Corridor Handbook" http://www.improvethevermillionriver.org/, a searchable, online Best Management Practices tool intended for use by a broad audience. The tool includes practices indexed by primary benefits (water quality, habitat, and recreation) and by the predominant landscape type of interest to the user (urban, rural, and developing). Information on and links to potential funding sources and technical information is included. The plan, process, and products were designed to be replicable.

The corridor plan also creates the framework for initiating a comprehensive riparian buffers initiative throughout Dakota County. An 800-point criteria system that includes water quality, wildlife habitat, recreation, financial, and other considerations was developed to evaluate and select future land protection projects. An innovative system for determining financial value for corridor buffer easements based on land cover/use types was developed.

The plan and resulting selection system resulted in the acquisition of a 193-acre permanent conservation easement that protects the headwaters of South Branch of the Vermillion River, a very high quality restored prairie, and a network of trails open to the public.

IV. OUTLINE OF PROJECT RESULTS*:*

RESULT 1: Develop Comprehensive Corridor Protection and Use Plan

Dakota County will prepare a GIS-based Vermillion River Corridor Natural Resource Protection and Use Plan that incorporates:

- A wide variety of updated data floodplain, demographics, land use, etc.
- Jurisdictional and regulatory rules and responsibilities
- Existing and often overlapping plans and programs involving water quality, land protection, stream restoration, riparian wildlife habitat, and recreation

This plan will provide more strategic and effective direction for current and future funding and implementation of on-the ground projects within a green infrastructure framework of non-traditional funding and partnerships.

Summary Budget Information for Result 1:	Trust Fund Budget:	$40,000
	Amount Spent:	$40,000
	Balance:	$0

Note: A minimum of $40,000 from the Vermillion River Watershed Joint Powers Board will also be used to develop the plan. See Attachment B: Non-LCCMR Budget Summary

Deliverables	**Completion Date**	**Budget**	**Status**
1. Corridor Plan	November 2, 2010	$40,000	Completed
2. Governance Recommendations	November 2, 2010	$0	Completed
3. Corridor CIP	Deleted	$0	Deleted

1. **Corridor Natural Resource Protection and Recreation Use Plan**
   County staff, with VRW Staff and Technical Advisory Group, will complete the following:

   - Review existing zoning and regulations
   - Review extensive data and plans pertaining to agriculture, development, recreation, transportation, water quality, and wildlife habitat
   - Identifies additional stakeholders, partners, and advisors
   - Through a RFP process, selects contractor to facilitate planning process and produce educational products

   This plan will provide a model for creating a countywide, green infrastructure master plan with applications to many other locations throughout the state.

2. **Collaborative Charter**
   The collaborative, multi-jurisdictional, and organizational partners will determine the most effective way of meeting both their individual and collective "interests" while attempting to maximize the multiple public benefits from potential plan implementation. The resulting "collaboration charter" will include governance policies, guidelines, and procedures critical to guiding future investments in natural resource protection and uses within this and other greenway corridors.

3. **Corridor Capital Improvement Program**
   Identifies various financial and regulatory incentives, budgeting, and funding sources to create a multi-jurisdictional, multi–agency, multi-purpose, and multi-year approach to implement and fund prioritized natural resource protection and use projects along the Vermillion River.

4. **Project Evaluation**
   This project will be evaluated at key milestones to ensure timely documentation and appropriate corrections. A final project evaluation will be completed using actual on-the-ground projects to critique/validate the process and outcomes.

Result 1 Final Report Summary:

A tremendous amount of previous and newly developed data was organized into a simple and legible GIS-based characterization of the Vermillion River and was critical for informing the corridor plan. A map series was developed for water quality, land use, natural resources, and recreation potential.

Best practice and precedent research was intended to provide a regional and national portrait of current practices and standards, identify successful practices that are effective over the long-term, and identify innovative approaches that may benefit the Vermillion River Corridor project. Specific areas of focus include map characterization, the physical form of other protected river corridors, land and resource protection tools, restoration, recreation opportunities, funding, governance, partnerships, long-term maintenance, and monitoring. While advisable, not enough time and funding was allotted to this work and we were not able to find much transferable information.

Establishing a clear scope, process, and teams involved significant time and effort to fully engage all of the potentially interested parties including the Vermillion River Watershed Technical Advisory Group, peer watershed organizations and staff from the Vermillion corridor cities of Hastings, Farmington, and Lakeville. This phase includes development of planning process mechanisms to share/leverage findings from/with two related and concurrent projects:

1. Dakota County Greenways Collaborative, an outgrowth of Dakota County's 2007 Park System Plan, is evaluating city-county partnership approaches for developing a 200-mile countywide,

interconnected greenway network. Portions of the Vermillion River were identified as potential greenways in the 2007 Dakota County Park System Plan.

2. Dakota County Active Living, with funding from Blue Cross Blue Shield of Minnesota, seeks to design our environment to promote walking and biking. Several Dakota County communities participated and include segments of the Vermillion River Corridor.

A set of guiding principles was developed to articulate plan outcomes and how the planning process should occur. The guiding principles were reviewed and refined through a staff workshop and four Focus Groups and presentations to several advisory committees for Dakota County and the Vermillion River Watershed Joint Powers Organization.

A comprehensive communications plan was developed to disseminate timely project information to the public, publicize events for gathering community input, and share project findings throughout the project. Communications items developed during this reporting period include news releases, a project fact sheet, and a project web page. Despite these efforts, and a reasonable high public participation rate, the population demographic below 30 years was not adequately represented to speak to the future of this resource.

Focus groups were held with commercial landowners, agricultural landowners, residential landowners, and recreational representatives, to discuss major issues and expectations for the corridor. These sessions provided valuable landowner perspective on the corridor project, as well as insight on watershed activities and water resource protection regulations.

Workshop I was held for and in the five different focus areas along the corridor: Hastings, Empire Township, Eureka and New Market Townships, Lakeville/Farmington, and Vermillion/Marshan/ Castle Rock townships. The first workshop provided a dynamic format that alternated staff presentations with audience engagement and exercises. Staff presented a project introduction and an overview of the river with synthesized map information. Participants were engaged through the use of an electronic Audience Participation System (APS) to provide responses to survey format questions with instant results. Survey topics included basic demographics, current interaction with the river, perception of river quality, vision for the future of the River, and input on the guiding principles. The workshop concluded with a small-group exercise in which participants selected images that demonstrate different approaches to provide major corridor benefits (water quality, habitat, recreation, economic development) in four corridor landscape settings (agriculture, residential, commercial/industrial, and open space/parks). Participants also identified map locations where they would like to see the benefits and approaches employed.

Workshop II offered participants the opportunity to review and refine draft concepts for the corridor. The workshop gathered input on participant values related to the River, refined corridor planning principles, planning and corridor design approaches, and a series of best management techniques for different river landscapes. Participants visited three stations with a display board illustrating the draft corridor concept and vignettes showing typical conditions in one of the rural, developing and urban landscape contexts and showing how the same location could be enhanced with best practices for water quality, habitat, and recreation. Attendees provided input through questions and answer session during presentations, an interactive audience participation system linked to the slide presentation, comments cards, and comments to staff. As with Workshop I, the interactive audience feedback sessions enabled the project team to comprehensively collect participant feedback across a range of topics, including audience demographics, river corridor perceptions, preferred landscape strategies, and implementation priorities.

Key findings from Workshop II include the following:

- Protecting corridor natural areas, habitat and water quality continue to be high priorities.
- A strong majority of participants indicated that the river corridor landscape techniques and practices illustrated would improve quality of life in rural, developing and urban settings.

- The availability of technical assistance, cost-share resources and demonstration projects are important considerations for river corridor stakeholders.
- Individual property rights continue to be an important consideration for many community stakeholders.
- Future recreation interests vary widely throughout the corridor and include both active and passive recreation activities.

Workshop III was held in Hastings and Farmington and participants reviewed the three, refined corridor concepts that comprise the Corridor Plan vision (water quality, habitat and stewardship, and recreation). Participants also provided input on how the Corridor Plan could be implemented, with comments on improving governance (i.e., coordination of public agency and partner organization efforts) and on parameters that they considered important in evaluating and prioritizing future corridor projects. Participants reviewed and discussed a web-based tool for selecting Best Management Practices and also viewed and commented on the North Creek Regional Greenway Simulation prepared for the Dakota County Greenways Collaborative, This simulation provided an opportunity for the public to visualize multi-purpose greenways for urban, developing and rural areas.

The project team completed refinements to the draft Vermillion River Corridor Plan document, including draft project evaluation criteria and developed the pilot version of an online best management practices (BMP) tool. The Corridor Plan http://www.vermillionriverwatershed.org/index.php?option=com_content&view=article&id=58&Itemid=67 establishes a vision and philosophy for the corridor based on integrated consideration of multiple benefits: environmental (water quality and upland habitat), social (recreation), and economic (sustainable high-quality places to live and work). The plan language seeks to provide technical information in a manner suitable for general audiences. A high-level process overview is included as a plan appendix to provide a replicable model to others seeking to use a similar project approach.

The plan also includes the "Vermillion River Handbook" http://www.improvethevermillionriver.org/, a searchable, online Best Management Practices tool intended for use by a broad audience. The tool includes practices indexed by primary benefits (water quality, habitat, and recreation) and by the predominant landscape type of interest to the user (urban, rural, and developing). Information on and links to potential funding sources and technical information is included. The plan, process and products were designed to be replicable.

Project evaluation criteria are intended for use in evaluating projects submitted by private landowners and public agencies for project funding through the original project grant from the Environmental Trust Fund, as well as an ongoing Corridor Plan implementation program also funded through the Lessard-Sams Outdoor Heritage Council, the VRWJPO, and other sources. The criteria incorporate key elements that represent the multiple benefit philosophy and approach, and will be used to evaluate and select implementation projects.

The draft plan was received by the Dakota County Board of Commissioners in August 2010 and the Board authorized release of the plan for a thirty-day public review period, from August 24 to September 24, 2010.

1. The plan document was posted online at the new website for the Vermillion River Watershed. The public review and comment period was publicized through news releases, listserv updates, and partner websites and listserv.
2. The project team provided draft plan overviews at local government meetings in all corridor communities, including the cities of Elko-New Market, Farmington, Hastings, Lakeville, and Vermillion; and the townships of Castle Rock, Empire, Eureka, Marshan, New Market, and Vermillion. Draft plan overviews were also provided to the Vermillion River Watershed Joint Powers Organization Board and its Planning Commission and Technical Advisory Group.
3. A public open house for the draft plan was held in Farmington.

Staff returned to the Dakota County Board of Commissioners with public review comments and received final Board approval of the plan on November 2, 2010 (Resolution No. 10-553).

Governance research involved the Minnehaha Creek Watershed District, Nine Mile Creek Watershed District, and others, culminating in a draft report prepared by Louis R. Smith and Associates. The report outlines three potential governance enhancement options for the Vermillion and other local river corridors. In applying these and other findings to the Vermillion Corridor, the project identified key governance and coordination roles (or a "governance job description") for Vermillion Corridor, based on the functions needed for plan implementation. Public opinion on governance-related performance issues was tested at Workshop III.

While the Corridor Plan recognizes the need for effective governance, it did not recommend a preferred model for two primary reasons: 1) there was consensus that the Joint Powers Organization is still a "young" organization that is dealing with the previous local Water Plan developed by its disbanded predecessor and that there has been significant improvements over the past several years, and 2) that there is still uncertainty at the state level whether the roles of BWSR, DNR and PCA may evolve in the near term.

Development of a Collaboration Charter, including the establishment of a coordinated and prioritized Capital Improvement Program (CIP) among all of the potential entities, though still desirable and possible, is not currently feasible within the confines of this project. There are several reasons for not being able to achieve this outcome as projected. Due to the inherent complexity of the project, funding limitations and other County priorities, completion of the plan has taken longer than anticipated. Although the plan was not intended to be binding upon any of the entities, each of the jurisdictions and respective agencies will be given a formal presentation to review and comment in July 2010. The plan does include a proposed "job description" for advancing a more effective governance structure, as well as possible options to pursue. The current thinking is to use the proposed schedule and process for updating the VRWJPO water plan beginning in 2011 as the basis for creating a new governance structure, which may or may not include a collaborative charter and CIP.

The complexity and goals of this planning project and its significant budget constraints eventually resulted in a deliberate decision to take more time and rely on County and Watershed staff to make sure all parties had adequate opportunities for participation and to complete a high quality plan, rather than creating an inferior plan. This was also crucial in addressing and effectively defusing the private property rights clamor that had emerged during the project planning time frame.

The internal evaluation that occurred after the completion of the plan largely cites the lack of budget and the ability to hire non-County resources for not being able to complete the plan in a shorter time period. That said, there continued to be strong validation on the process used, the strategic use of consultant resources, the public participation process and the products and outcome of the plan. An additional validation was the receipt of a national award from the National Association of Counties for the plan in 2011.

Another key decision was to not begin the implementation phase until the plan was completed. These associated decisions delayed and significantly limited the implementation phase.

RESULT 2: Implementation of Integrated Corridor Projects

Dakota County will facilitate and use the Trust funds to provide financial incentives for on-the-ground projects that:

- Demonstrate more effective integration of water quality, wildlife habitat, and recreation benefits;
- Demonstrate more effective project implementation mechanisms, including budgeting and funding, among traditional and non-traditional partnerships.

These projects may include potential pilot projects already identified prior to plan development (see Attachment B), or projects identified from the corridor plan developed in Result 1. A subsequent acquisition list will be submitted to LCCMR. All potential projects will be reviewed by staff prior to expenditure of funds.

Long-term success of new project implementation methodologies will be dependent upon the ability of the partnerships to implement projects during and after the corridor plan is developed. LCCMR funds will be leveraged with significant direct and in-direct funding from the implementation partners.

An estimated 156 acres will protected through fee title or easement. Fee title will be held by a local unit of government or DNR. Permanent easements will be held and monitored by Dakota County.

With regard to easement stewardship, monitoring, and enforcement, Dakota County currently requires:

- A jointly developed and approved Natural Resource Management or Stewardship Plan for each easement. This plan includes individualized work plans that identify roles, activities, costs, and an implementation schedule.
- Baseline documentation (Property Report) for all easement projects. At present, the County is monitoring 30 conservation easements on nearly 2,500 acres. The County Attorney's Office has committed to enforcing the easements as necessary. The County has recently completed the development of a new land information system that integrates GIS with all electronic documents associated with the easements to further ensure monitoring compliance.

Trust Funds will also be used to begin restoring an estimated 40 acres. Restoration activities will only take place on lands permanently protected. All funds will be directed to contractors to develop these plans and/or for implementing restoration.

Summary Budget Information for Result 2:
The unobligated balance of the appropriation for Dakota County wildlife habitat acquisition and development in ML 1999, Chp. 231, Sec. 16, Subd. 13 (m) has been applied to this result.

2008 Trust Fund Budget:	$360,000
Amount Spent:	$360,000
Balance:	$0
1999 Transfer Budget:	$149,965
Amount Spent:	$149,965
Balance:	$0

Deliverables	Completion Date	Budget	Status
1. Land Protection of 156 acres through fee title or easements	June 30, 2011	~~$439,465~~ $509,965	193 acres protected
~~**2.** Land Restoration of 40 acres~~	~~June 30, 2011~~	~~$70,500~~	No projects selected

Note: Due to the time it took to complete the plan and solicit projects, there was inadequate time to undertake one or more ecologically-significant restoration projects with definable results by June 30, 2011. Instead, the funds were reallocated to the acquisition project which in turn will result in significant short- and long-term restoration and enhancement utilizing non-Environment and Natural Resources Trust Funds. This was discussed with LCCMR staff in spring 2011 with the understanding that this amendment would be within the intent of the project and laws of Minnesota.

Result 2 Final Report Summary:

Another key decision made during the planning phase was to not begin the implementation phase until after the plan was completed. This decision delayed and significantly limited the implementation phase.

With approval of the Corridor Plan by the County Board on November 2, 2010, the Board reviewed the proposed project application, evaluation and selection process. Materials included the application form, final project selection criteria (Water Quality, Habitat, Recreation, Financial, and Other), an easement valuation formula for corridors in townships, and staff review schedule. The Board approved the process on November 2, 2010, (Resolution No. 10-535).

The implementation phase was announced to the public via press releases, emails and postcards sent to 500 landowners along the corridor. In addition, materials were distributed to the SWCD and the VRW Planning Commission and Technical Advisory Group during their November 8, 2010 meetings.

Despite these extensive communication efforts, only official five applications were received by the December 15, 2010, deadline. Feedback from landowners indicated year-end and holiday conflicts, as well as information saturation pertaining to the River was responsible for the low response rate.

Staff completed the project evaluation process and the Agricultural Society, Inc. property emerged has the highest ranked project. This property consisted of 193 acres of restored uplands and wetlands forming the headwaters of the South Branch of the Vermillion River as part of the privately owned Dakota County Agricultural Society, Inc. property in Castle Rock Township and adjacent to the Farmington city limits. Much of the site included in two Conservation Reserve Program contracts set to expire within two years and previously restored by the Dakota SWCD and numerous local wildlife groups. The area is considered the larges and highest quality prairie in Dakota County. The uplands contained mowed, public walking trails. It was a very good example of combining the three public benefits of protecting water quality and wildlife habitat and accommodating compatible recreation. After appraisal and negotiations, the Agricultural Society Board of Directors approved selling a 193-acre permanent natural area conservation easement on May 24, 2011. On June 7, 2011, (Resolution No. 11-272), the County Board of Commissioners approved the acquisition of the Agricultural Conservation easement. This acquisition surpassed the goal of protecting 156 acres.

The Agricultural Society agreed to jointly develop a Natural Resource Management Plan (NRMP) with the County, SWCD, Vermillion River Watershed Joint Powers Organization and the Dakota County Habitat Alliance and agreed to commit $50,000 of the proceeds to implementing the NRMP. These provisions for implementing a more comprehensive and strategic restoration and enhancement on a larger, higher quality tract of land with the involvement of many entities was deemed a better use of the allocated restoration funds than utilizing them on a number of smaller tracts in the project area.

V. TOTAL TRUST FUND PROJECT BUDGET:

Staff or Contract Services:	$40,000
Equipment:	$0
Development:	$0
Restoration (Contract Services):	$40,000 (2008 Trust Fund)
	$30,500 (1999 Transfer Fund)
Acquisition, including easements:	$320,000 (2008 Trust Fund)
	$119,465 (1999 Transfer Fund)
Other	$0

TOTAL TRUST FUND PROJECT BUDGET:	$400,000
TOTAL 1999 TRANSFER FUND BUDGET:	$149,965
TOTAL PROJECT BUDGET:	$549,965

VI. OTHER FUNDS & PARTNERS:

A. Project Partners: U.S. Natural resources Conservation Service; MN Department of Natural Resources; Board of Soil and Water Resources; Dakota and Scott SWCD; Metropolitan Council; Vermillion River Watershed Joint Powers Organization; Cities of Apple Valley, Farmington, Hastings and Lakeville; Empire, Eureka, New Market, and Vermillion Townships; Minnehaha Creek Watershed District; Friends of the Mississippi River; Trout Unlimited; and the Dakota Habitat Alliance.

B. Other Funds Spent during the Project Period:

1) Result 1

$40,000 cash from Vermillion River Watershed Joint Powers Organization
$150,000 of cash and in-kind from Dakota County
$190,000

2) Result 2

$50,000 cash from Vermillion River Watershed Joint Powers Organization
$241,422 from FY 11 Outdoor Heritage funds
$320,000 in landowner donation
$611, 742

Other Land Protection within the Corridor during project period
$759,000 from the Dakota County Farmland and Natural Areas Program for easements
Totaling 445 acres
$588,000 from the Natural Resources Conservation Service for easements
$400,000 from landowner donated easement value
$76,000 from the Vermillion River Watershed JPO for easements
$30,000 from United States Environmental Protection Agency
$30,000 from the Minnesota Pollution Control Agency
$1,883,000

C. Past Spending: Approximately $3 million has been spent establishing watershed standards, a buffer classification system, conducting a variety of studies, land protection, natural resource restoration, and monitoring.

D. Time: Completion by June 30, 2011.

VII. DISSEMINATION:

As the project transitioned from planning to implementation, information has been shared with the general public through the various media forms:

- New website for the Vermillion River Watershed Joint Powers Organization launched in 2010 and contains information on the Corridor Plan project as well as the Vermillion Corridor Handbook online BMP tool
- Dakota County Update articles in the monthly newsletters for the Dakota County Board of Commissioners
- Dakota County environmental listserv: draft plan open house information
- News releases: project updates and information on the draft plan open house and good coverage in the Star tribune and Pioneer Press as well as local papers.
- Project updates were provided to the Dakota County Board, Dakota County Planning Commission, Dakota County Parks and Recreation Advisory Committee, Dakota County Township Officers Association, Vermillion River Watershed (VRW) Joint Powers

Organization, Farmland and Natural Areas Program Advisory Committee, VRW Planning Commission and VRW Technical Advisory Group.

- Draft plan overviews provided at the Dakota County Board of Commissioners meetings Project overviews provided to the Farmland and Natural Areas Program Advisory Committee, County Planning Commission, Vermillion River Watershed Planning Committee and Technical Advisory Group during the draft plan review in 2010.
- Draft plan presentations at local government meetings in all corridor communities: the cities of Elko-New Market, Farmington, Hastings, Lakeville, and Vermillion; and the townships of Castle Rock, Empire, Eureka, Marshan, New Market, and Vermilion.
- Open house information posted on the Friends of the Mississippi River website and distributed through their listserv
- 3,000+ Workshop III invitation postcards sent to landowners within 300 feet of the river in Scott and Dakota counties
- Workshop information posted on the Friends of the Mississippi River website and distributed through their listserv
- Project overview provided at the Dakota County Board of Commissioners Land Conservation Vision workshop on March 16, 2010.
- Project information was provided to visitors at the Dakota County Fair.
- A project overview was presented at the Land Conservation and Water Quality Summit held at the Minnesota Landscape Arboretum on September 24, 2009, and at the annual state Soil and Water Conservation District Conference held in Duluth on December 7, 2009.
- The plan received a National Association of Counties Award in 2011 and will be presented during the annual meeting of the American Planners Association in Minnesota on September 29, 2011.

VIII. REPORTING REQUIREMENTS:

Attachment A: Budget Detail for 2008 Projects - Summary and a Budget page for each partner (if applicable)

Project Title: Integrating Vermillion River Corridor Resource Protection and Funding

Project Manager Name: Alan Singer

Trust Fund Appropriation: $400,000 + $149,965 = $549,965

1) See list of non-eligible expenses, do not include any of these items in your budget sheet

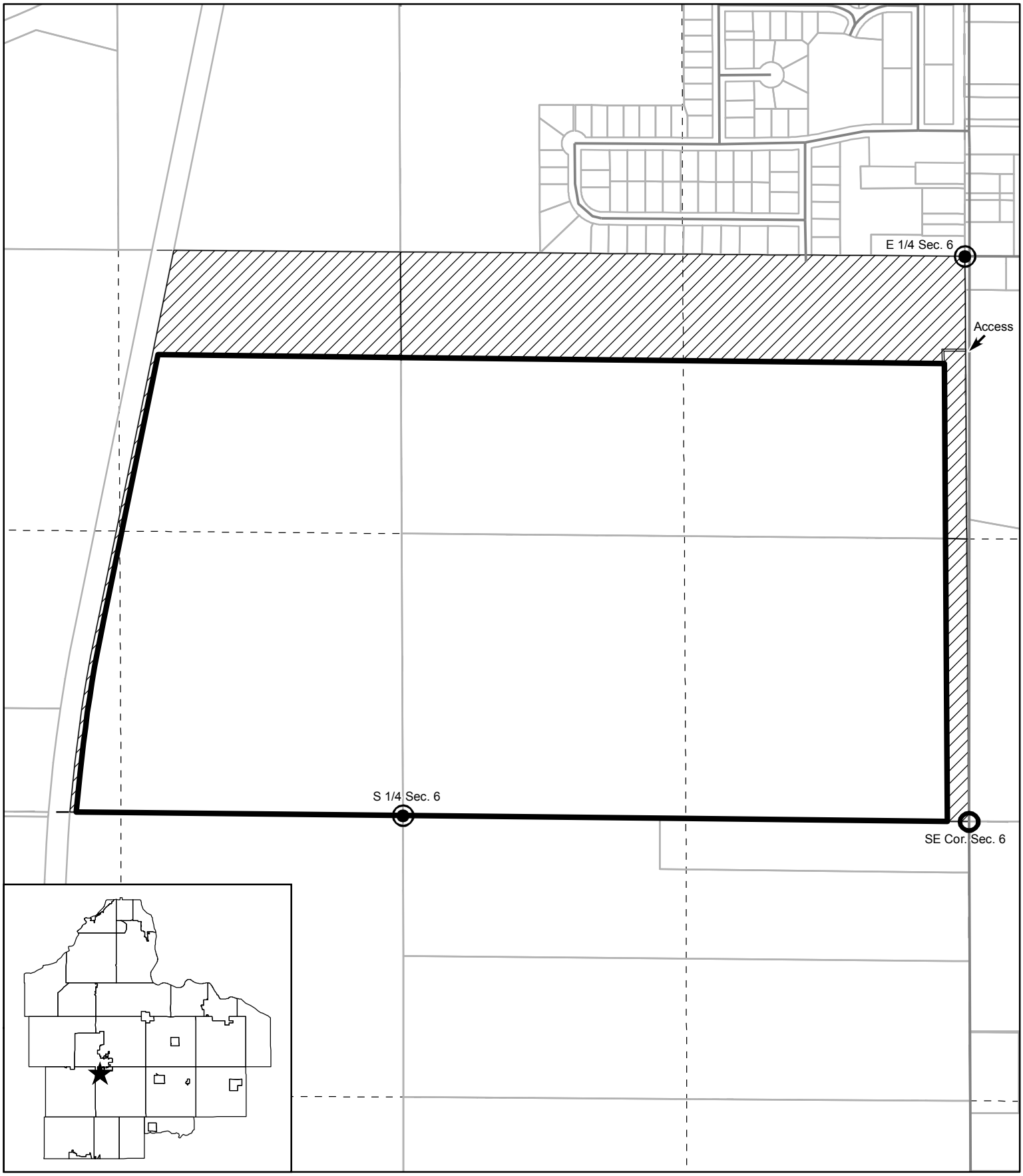
2) Remove any budget item lines not applicable

2008 Trust Fund Budget	**Result 1 Budget:**	**Amount Spent** *(date)*	**Balance 6/30/2011**	**Result 2 Budget:**	**Revised Budget**	**Amount Spent**	**Balance 6/30/2011**	**TOTAL BUDGET**	**TOTAL BALANCE**
	Develop Comprehensive Corridor Protection and Use Plan			*Implementation of Integrated Corridor Projects*					
BUDGET ITEM									
PERSONNEL: wages and benefits									
Contracts									
Professional/technical *(TBD via RFP for facilitation and plan products)*	40,000	40,000	0		0			40,000	0
Land acquisition *(fee title)*									
Initial appropriation				80,000	0				0
Chub Lake fund transfer									
Land rights acquisition *(less than fee)*									
Initial appropriation				240,000	360,000	360,000	0	360,000	0
Chub Lake fund transfer				119,465	149,965	149,965	0	149,965	0
Other land improvemen (restoration)									
Initial appropriation				40,000	0				
Chub Lake fund transfer				30,500	0				
COLUMN TOTAL	**$40,000**	**$40,000**	**$0**	**$509,965**	**$509,965**		**$0**	**$549,965**	**$0**

Exhibit A-1

Dakota County Agricultural Society, Inc. Easement

PLS Section 6, 113-19
Total Easement Acres 193.20



N

Section Corner | Quarter Corner | Easement Area | Exception Area | Parcels | Roads

Map Date: 6/6/11

1 inch = 600 feet

Vermillion River Corridor Plan

Improving Water Quality, Habitat, and Recreation

October 19, 2010

Vermillion River Corridor Plan

Acknowledgements:

This plan was prepared with funding assistance from:
Minnesota Environment and Natural Resources Trust Fund
The Vermillion River Watershed Joint Powers Organization
Active Living Dakota County: Blue Cross/Blue Shield of Minnesota

Dakota County Board of Commissioners:
District 1 - Joseph A. Harris
District 2 - Kathleen A. Gaylord
District 3 - Thomas A. Egan
District 4 - Nancy Schouweiler
District 5 - Liz Workman
District 6 - Paul J. Krause
District 7 - Willis E. Branning

Vermillion River Watershed Joint Powers Organization (VRWJPO):
Dakota County Commissioner Joseph Harris
Dakota County Commissioner Paul Krause
Scott County Commissioner Thomas Wolf

Vermillion River Watershed Planning Commission
Vermillion River Watershed Technical Advisory Group
Dakota County Planning Commission
Dakota County Parks and Recreation Advisory Committee
Dakota County Farmland and Natural Areas Program Advisory Committee

Sincere thanks are extended to all who participated in the public workshop sessions, focus group meetings, and peer watershed organization discussions over the course of this project.

Project Team:
Alan Singer, Dakota County
Mary Jackson, Dakota County
Mark Zabel, Dakota County and VRWJPO
Katherine Carlson, Dakota County and VRWJPO
Paula Liepold, Dakota County and VRWJPO
Brendon Slotterback, Dakota County
Travis Thiel, Dakota County
Mary Hagerman, Dakota County
David Holmen, Dakota County Soil and Water Conservation District
Paul Nelson, Scott County
Andy Hingeveld, Scott County
Grishma Shrestha, University of MN Center for Urban and Regional Affairs Intern

Project Consultants:
Hoisington Koegler Group, Inc.
Friends of the Mississippi River

Contents

Foreword 5
Chapter 1: Plan Introduction, Purpose, and Scope 7
Introduction 7
Plan Purpose, Scope, and Organization 9
Building on Past Efforts 10
Relationship to Other Plans 12
Navigating a Complex Framework 13
Chapter 2: Corridor Conditions Today, Key Issues 17
Characterizing the Vermillion River 17
Water Quality 20
Natural Areas and Habitat 26
Land Use, Economic Conditions, and Urban Development 33
Recreational Opportunities 38
Coordination and Management in the Corridor 43
Public interests and Trends 45
Chapter 3: Corridor Principles, Vision, and Goals 47
Corridor Plan Guiding Principles 47
Corridor Goals and Objectives 48
Water Quality Improvement Concept 50
Natural Area Stewardship and Protection Concept 54
Recreation Concept 56
A Vibrant Economy 60
Priorities for Distinct Geographic Areas of the Corridor 60
Chapter 4: Putting the Plan into Action 63
Implementation Principles 63
Potential Project Approaches 64
Implementation Resources 66
Pilot Projects 67
Partners for Collaboration 68
Prioritizing Corridor Projects 69
Vignettes for Urban, Developing, and Rural Settings 70
Case Examples 78
Chapter 5: Corridor Framework 85
Governance 85
Implementation Resources 89
Chapter 6: Public Engagement 91
Focus Groups 91
Public Workshops 93
Appendix 1: Replicable Model 99
Inventory and Analysis 99
Issues Identification 99
Public Workshop Techniques 99
Public Outreach Methods 100

Foreword

Why, you might ask, is another plan involving the Vermillion River necessary? After all, the Vermillion River has improved over time. Studies have been completed and more plans and regulations are in place to protect water quality. Many landowners have changed land management practices to reduce erosion and many government agencies are involved in one way or another with the River. Millions of dollars have been invested. There are trout, so the River must be doing fine.

Vermillion River, Empire Township

In spite of past efforts, issues remain. The water quality does not meet public health and environmental standards largely due to multiple, diffuse pollution sources. More in-stream conflicts are emerging between people who want to fish and those who want to canoe; at the same time, there are few public places where people can access the River. Private landowners are concerned about trespassers, potential for paved trails, a seemingly uncoordinated maze of rules and regulations, and a perceived overreach by government. What to do about this?

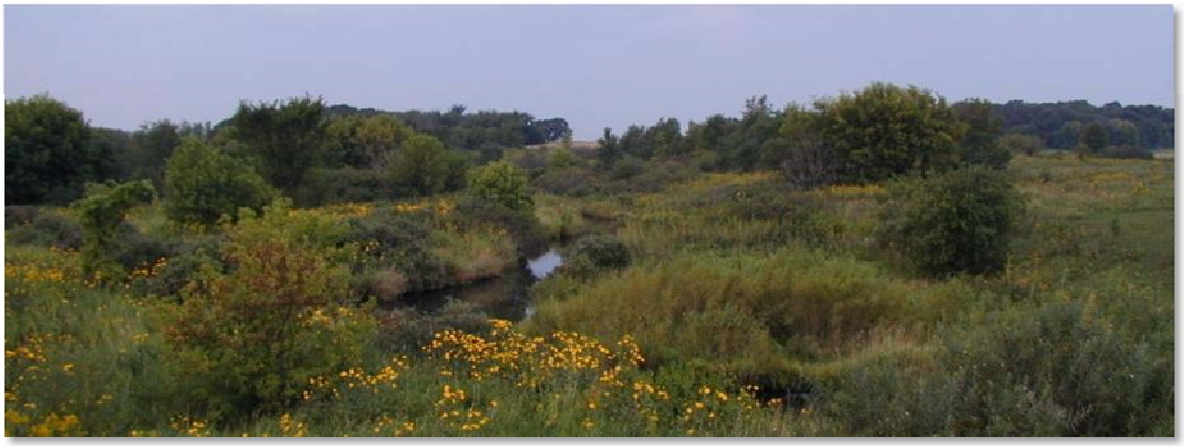
In 2008, Dakota County submitted a proposal to the Legislative-Citizen Commission on Minnesota Resources to use the Vermillion River as the focal point of a plan addressing these types of issues, which are not only occurring here, but throughout the state. The Minnesota Legislature approved the project for funding in 2008. With additional funding from the Vermillion River Watershed Joint Powers Organization and Active Living Dakota County, the plan has been developed over the past two years with many opportunities for public input.

The resulting Vermillion River Corridor Plan looks at the River as a complex natural system, a shared resource, and a place where varied interests and other systems converge. The plan recognizes that the River has very different physical characteristics from the headwaters to the falls. Correspondingly, adjacent land use also varies widely from large swaths of rural, row crop agriculture to nearby historic downtowns and new

suburban development. Rather, than simply focusing on how to improve water quality, the plan integrates wildlife habitat and outdoor recreation in a way to demonstrate how each of these goals can be compatible, strengthen the other and create a framework for more sustainable economic development.

The plan also recognizes that much of this multi-purpose corridor will remain in private ownership among many landowners and that change will occur over time. Each landowner will have an evolving role in what does and does not happen to the river and the surrounding landscape. This plan developed information tools to assist landowners in becoming more involved in individual or collective projects and best practices. New ways for better coordination and communication among all entities involved with the River are described, including possible models for governance among these same entities.

This plan, which is also designed to serve as a guiding document among all of the political jurisdiction and agencies, seeks to create a new foundation for cooperation and strategic financial investments that can provide multiple benefits. Fortunately, the legislature also provided over $500,000 for implementing projects that exemplify the goals of the plan. In addition, millions of Outdoor Heritage Funds have now been allocated to the County for related corridor protection and improvements throughout the Vermillion River and Cannon River systems.



Vermillion Headwaters Area

Chapter 1: Plan Introduction, Purpose, and Scope

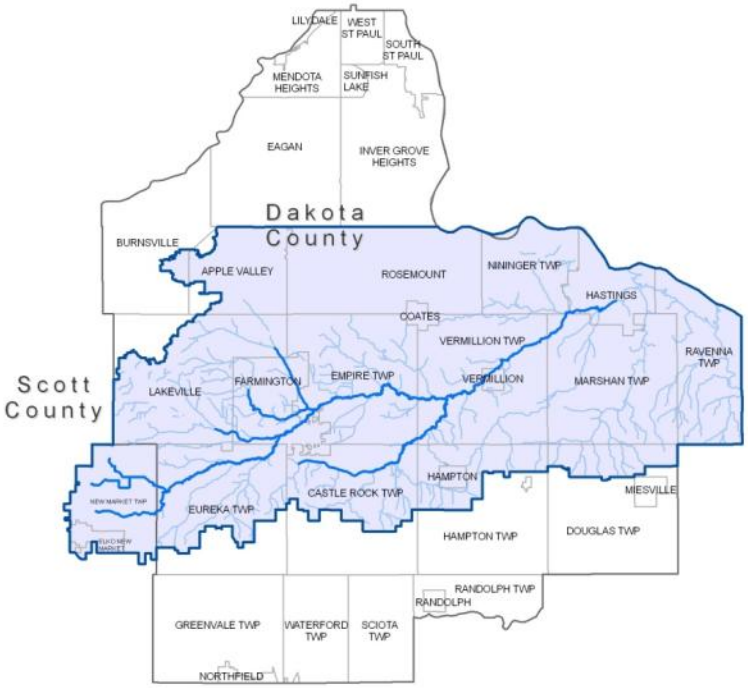
Introduction

The Vermillion River is a "prairie river" that slowly winds through rural and urban areas in the southern Twin Cities area of Minnesota, draining 335 square miles in central Dakota and southeastern Scott counties. The Vermillion River watershed contains all or part of twenty municipalities, making it the largest watershed in the Twin Cities metro.

Vermillion River Watershed Location
Twin Cities Metropolitan Area, Minnesota

Originating in southeastern Scott County and fed by a network of tributaries, the River flows across central Dakota County to Hastings where it drops 90 feet over a dramatic falls. The River splits below the falls with one branch flowing north to the Mississippi River; the other flowing south along the Mississippi for 20 miles before joining it near the City of Red Wing in Goodhue County. Forty-nine miles of the Vermillion River main stem and tributaries are designated trout streams, making it, the only world-class trout stream in the United States within a major metropolitan area, according to Trout Unlimited.

While the Vermillion River is a natural resource worth protecting, its future is uncertain. Many of its stretches consistently have been classified as impaired by the Minnesota Pollution Control Agency. Water quality is intrinsically tied to land use, management, and disturbance patterns over the long-term. Portions of the Vermillion watershed include some of the nation's fastest-growing communities that have undergone dramatic changes in the past two decades, with growth often accompanying conversion of agricultural land to suburban development. Dakota County's overall population grew by 12 percent between 2000 and 2009, adding nearly 45,000



Vermillion River Corridor Planning Scope,
Watershed in Dakota and Scott Counties, Minnesota

Vermillion River Brown Trout

Vermillion Falls in Hastings

people. Scott County's population grew by 46 percent during the same period, with more than 41,000 new residents.

In this context of new urbanization and growth pressures amid ongoing agriculture, much of the River has been silted, channelized, or otherwise degraded through the cumulative effects of many land management decisions. Within this setting, scientific knowledge is expanding our understanding of how the River and its ecosystems respond to land use changes. These and other factors make a coordinated focus on the Vermillion River a timely initiative.

Actions taken to strategically direct change in the Vermillion River Corridor must be informed by prior and related plans, demographic projections, jurisdictional issues, sensitive natural resources, economics, public involvement, trends, and other existing conditions. Planning for change ensures that actions fit known circumstances, places, and people. Planning also ensures that actions coordinate with, rather than conflict with, plans and actions taken by others, and achieve the greatest benefit for the least time and cost.

Plan Purpose, Scope, and Organization

Plan Purpose: A Shared Vision and Effective Implementation

In a complex world of differing visions, this plan worked with many River stakeholders to build a shared vision and to encourage cooperative and coordinated efforts among the many people who care about the River's future. The purpose of developing the ***Vermillion River Corridor Plan*** was to identify and focus effort on functions of the Vermillion River Corridor that maximize these public benefits:

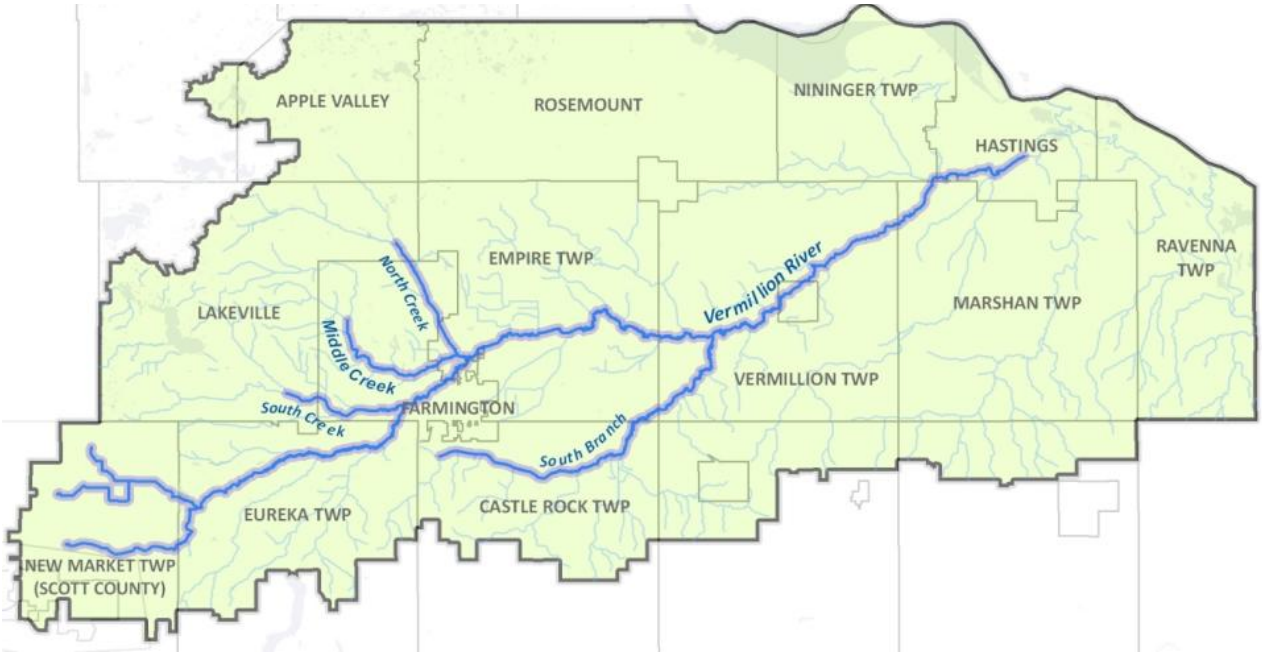
- Improved water quality
- Improved, interconnected in-stream, riparian, and upland natural habitat
- Compatible recreation
- A resilient natural framework in which to live and work, that serves as a foundation for future growth or development

This shared vision addresses *what* the corridor can become in the future. The other aspect of this plan is demonstrating *how* that vision can become reality, by providing an implementation framework based on collaboration, realistic approaches, and carefully weighed priorities. This plan provides a springboard for continued dialogue among its many stakeholders about the River and new ways of managing and investing in shared resource corridors.

Plan Scope

The ***Vermillion River Corridor Plan*** focuses on the Vermillion River main stem from its headwaters to the Vermillion Falls in Hastings and its primary tributaries of South Creek, Middle Creek, North Creek, and South Branch.

Scope of the Vermillion River Corridor Plan



Although this plan focuses on the mainstem and major tributaries of the River, it is clear that major water quality improvements depend on improved "whole-watershed" approaches. This plan is a subset of the Vermillion River Watershed Plan in geographic scope, with a targeted focus on the riverway and adjoining lands. In addressing corridor habitat and recreation, this plan also represents an expanded scope beyond the traditional water quality and flood control focus of the watershed plan.

Plan Organization

The plan is organized to:

1. Create greater understanding of the Vermillion Corridor and its landscape
2. Demonstrate a desired future for the River and how change in the surrounding landscape can help attain this future
3. Suggest a structure or framework by which the vision can be implemented
4. Identify shared community and public values that form the basis of the plan

Building on Past Efforts

Natural resource and natural area protection in Dakota County and the Twin Cities began with parkland preservation, initially by the region's cities and followed by park systems at the state, regional, and county levels. State designation of wildlife management areas in the county began in the 1950's to preserve wildlife habitat and create hunting areas. These efforts have protected some of the best quality natural areas in the region.

Natural resource and natural area protection efforts have gone beyond early parks and hunting areas in recent decades, to protection of watersheds, prime farmland, natural areas, and corridors, and to developing buffers along critical waterways. Broadened protection efforts relate to a shift from thinking about protecting *natural places* to thinking more holistically about protecting *natural systems* and the critical support functions they provide. Often referred to as ecological services, these benefits include:

- Cleaning air and water
- Protecting river channels and banks from erosion
- Mitigating drought and floods
- Protecting biodiversity with refuge and nursery habitat and movement corridors
- Dispersing seeds and storing native seed banks
- Cycling, moving, and storing nutrients
- Detoxifying and decomposing wastes
- Building soils and renewing their fertility
- Pollinating crops and natural vegetation, controlling agricultural pests
- Contributing to climate stability
- Moderating weather extremes
- Recharging and cleaning groundwater for human use and surface water supply

Natural area protection also provides economic and social benefits by:

- Providing for public appreciation, knowledge, education, and recreation
- Increasing and stabilizing community attractiveness, appeal, and livability
- Enhancing individual property values

This evolution in thinking about resource protection is represented among many studies and local plans that provided a foundation for the Vermillion River Corridor Plan.

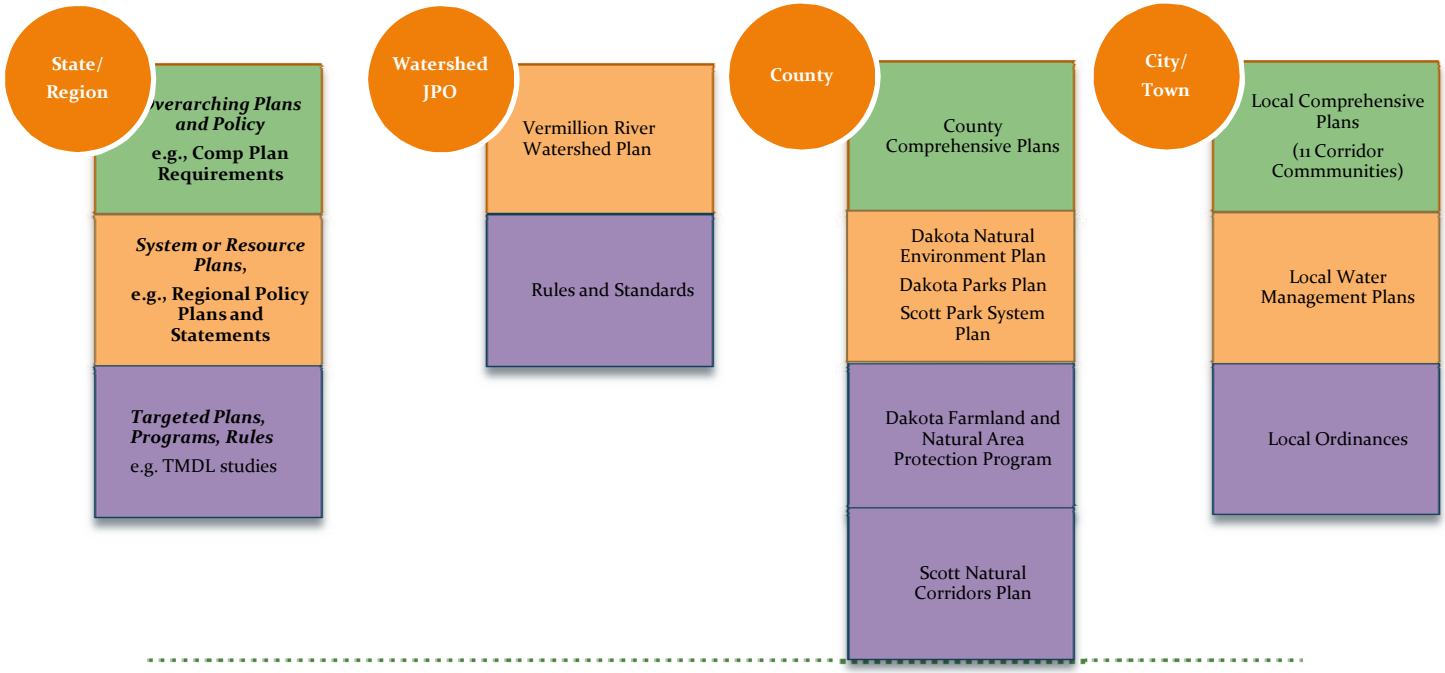
Plan and Study Documents	Year
Vermillion River Watershed Joint Powers Organization Biomonitoring Plan: Ongoing assessment of habitat, fish communities, and macroinvertebrate health	2009
Vermillion River Thermal Trading Study (EPA Targeted Watersheds Grant): Study on stabilizing temperature and volume in the Vermillion River Trout Streams	2009
Scott County Comprehensive Plan: Natural Area Corridors vision	2009
Dakota County Comprehensive Plan, DC2030, and Park System Plan: Greenways - Conservation corridors as part of a green infrastructure framework	2008, 1999
Local City and Township Comprehensive Plans, Dakota County Rural Collaborative Comprehensive Plan: Contemporary resource and recreation plans	2008, 1999
City and Township Local Water Management Plans: Land use authority in Dakota County resides with cities and townships, which are required to adopt local water plans and ordinances to comply with the Vermillion River Watershed Plan	2009
Lon-Range Plan for Fisheries Management, MN DNR: placed high priority on maintaining/improving trout populations in southeast Minnesota trout streams and Vermillion River trout stream reaches. An Aquatic Habitat Action Plan is likely to be developed and published in 2011.	2005
Metropolitan Conservation Corridors: Regional natural corridor planning	2005
Vermillion River Watershed Plan: Goals, objectives, and work plan for improvements in the watershed. Eight predominant issues identified in the plan: 1. River flow volumes have increased 2. Surface water quality is threatened or impaired 3. River channel/corridor is impacted and sensitive to change 4. Sensitive resources are present and/or threatened or impaired 5. Groundwater quality is threatened or impaired 6. Additional development is expected 7. Data for making informed decisions is limited 8. Public awareness and appropriate water stewardship is limited	2005
Mississippi National River and Recreation Area Water Resources Information and Issues Overview Report: Planning document for river water quality	2004
Dakota County Farmland and Natural Area Protection Plan: Resource protection in partnership with private landowners	2002
Vermillion River Volume Study: Increasing flow volumes are concern for channel instability. Good infiltration capacity exists in watershed's developing areas.	2002
Dakota County and Scott County Biological Surveys: Inventory and map of state and federal listed species habitat (threatened, endangered, and special concern)	1992-1994

The Vermillion River Watershed Joint Powers Organization (VRWJPO) is relatively new. The JPO was created in 2002 to replace the original watershed management organization (WMO) that was established in 1984 through a joint powers agreement among 21 cities and townships wholly or partially within the watershed. The WMO dissolved in 2000. Dakota and Scott counties entered into a joint powers agreement to form the VRWJPO in 2002. Their first watershed plan was completed in 2005.

The VRWJPO has markedly increased scientific knowledge about the Vermillion River since the 2005 watershed plan, and they continue efforts to assess specific reaches and prioritize potential improvements. More is now known about what is effective in improving water quality, stabilizing volume and temperature, protecting groundwater base flow, and shaping stormwater management strategies at developed or developing sites. By prioritizing protection and restoration activities, fully characterizing the sites and circumstances, and using best management practices proven through experience and testing, the Vermillion River Corridor can be improved.

Relationship to Other Plans

The Corridor Planning process benefited from recent updates by all of the corridor community to their comprehensive plans (2008-2009); whereby each local community engaged its residents; defined a shared values and goals; and set a coordinated course for growth, development, transportation and resources over the next twenty years. As contemporary statements of each community's projected future, these local plans were timely informants to the Corridor Plan project. Each corridor community's vision for its specific systems – e.g., natural resource corridors, recreational trails, and water management – was factored into the Vermillion River Corridor Plan. The Corridor Plan also benefited from targeted plans, programs, studies, and rules, and integrates their findings and recommendations wherever feasible.



Navigating a Complex Framework

Water Management and Regulation

In this plan's public engagement process, a theme emerged related to the complex programs, agencies, and regulations that address the River. Landowners seeking permits cited multiple check-ins and processes with several agencies, each of which is responsible for a different aspect of water management and oversight. Participants identified issues with understanding the regulations, knowing which agency is responsible for specific issues, and at times, the need for separate mitigation practices to satisfy the all regulatory. Their concerns are not unique to the Vermillion River.

A 2009 study prepared by the Citizens League of Minnesota evaluated how well current governance systems and public policy are protecting Minnesota's surface waters. The report, ***To the Source: Moving Minnesota's Water Governance Upstream*** notes:

> "In Minnesota's current water governance system, government entities bear the lion's share of the responsibility to assure the public has access to clean water. This system is not effectively protecting and improving the state's waters. Addressing today's diffuse water policy challenges will require more than changes to government. It will require a much more central role for the millions of actors who are responsible for water problems and are capable of creating solutions—businesses, homeowners, civic groups, cities, watershed organizations, and all citizens. To effectively address today's challenges, the people and organizations that contribute to water problems must play a central role in the actions and decision making to address these problems. Minnesota needs a model of water governance that takes advantage of the imagination and capacity of the public to confront these challenges.
>
> Minnesota's system of water governance is fragmented, incoherent, and poorly coordinated to the extent that it is failing Minnesota on all five principles by which the Citizens League evaluated the system:
>
> 1. **Transparency:** The lines of responsibility and accountability are difficult to understand, even for professionals and the legislators responsible for funding and overseeing water governance.
> 2. **Effectiveness:** There is a lack of evidence of overall effectiveness or cost efficiency.
> 3. **Equity:** Responsibility, resources, and authority for addressing water issues are not equitably distributed, either by geography or by impact on pollution.
> 4. **Accountability:** is often unclear and frequently not enforced.
> 5. **Appropriate scale:** The system is driven by individual program and agency goals. Particular tasks have been delegated from the federal government to the state and from state agencies to special districts, cities and counties without comprehensive goals or a coherent picture of the whole system."

In keeping with some themes identified in the Citizen League's report, the Corridor Plan seeks greater public-private collaboration in implementing solutions for the Plan.

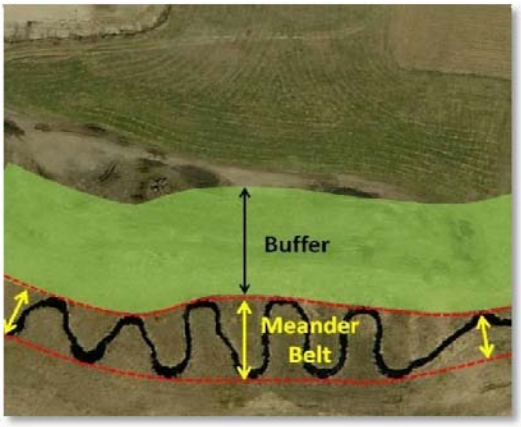
Current Key Regulations for the Vermillion River

Among water quality regulations, buffers became an important discussion topic during the Corridor Plan public engagement process. At the time, local communities were reviewing and adopting of local water management plans, which incorporated the VRWJPO Buffer Standards for the first time. An overview of buffer regulations follows:

Vermillion River Watershed Buffer Standards specify buffer distances from the edge of the River's meander belt for the mainstem, major tributaries, and minor tributaries, shown on the following map. Buffer requirements are triggered by parcel subdivisions under specific circumstances. The following table lists the major buffer categories based on stream classes, which are color-coded to the map. Also included are required buffer widths, with estimated total lengths and estimated total areas for each stream class.

BUFFER STANDARDS Stream Class	Buffer Width (Feet)	Est. Length (Miles)	Est. Area (Acres)
Conservation Corridors			
Lower Reach	150	41	1,240
Upper Reach	150	64	2,205
Aquatic Corridors			
Principal Connectors	100	74	1,797
Trout Streams	100		
Tributary Connectors	50	84	1,019
Water Quality Corridors			
Smaller Tributaries	30*	182	1,327

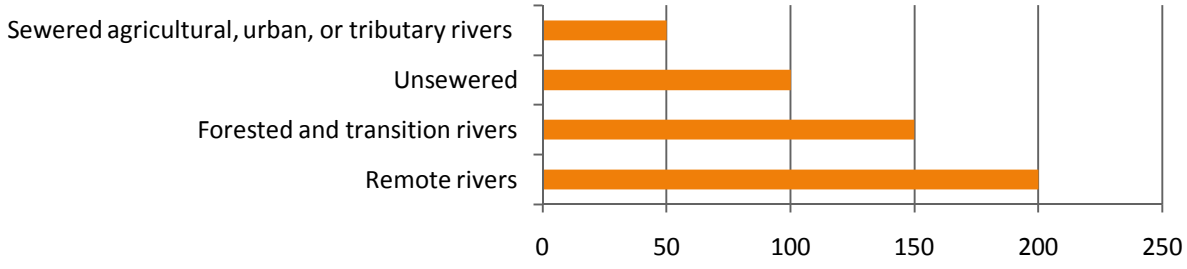
**Measured from center of channel*



Meander Belt and Buffer

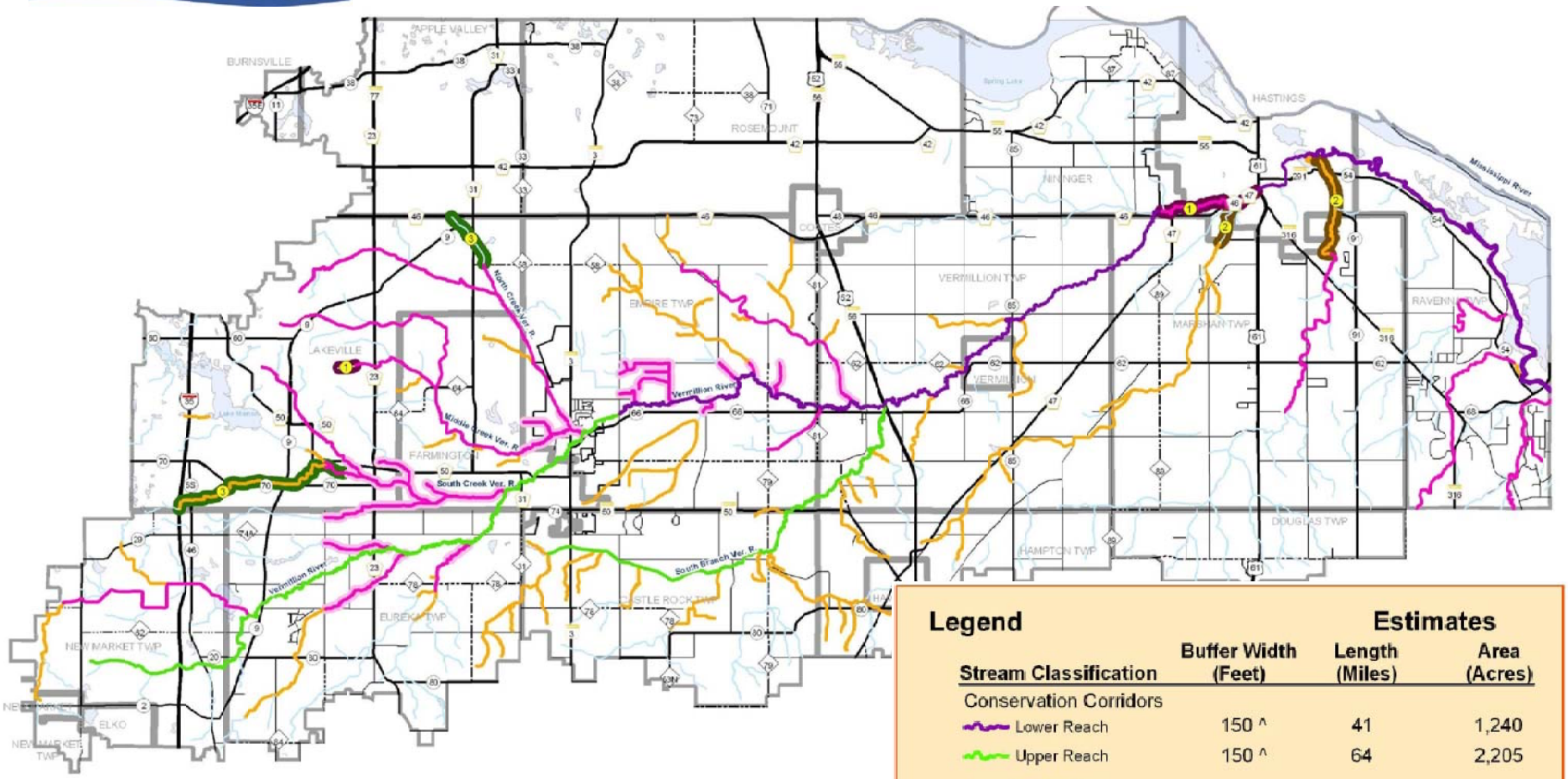
DNR Shoreland Rules specify structural setback standards on rivers, shown below, and also establish a shore impact zone for agriculture at *50 feet* parallel to the Ordinary High Water Line. Agricultural production should not extend into this 50-foot zone.

MN DNR River Structural Setback Standards (feet)



Vermillion River Watershed

Adopted Stream Classification and Buffer Standards



Legend

Stream Classification	Buffer Width (Feet)	Estimates Length (Miles)	Estimates Area (Acres)
Conservation Corridors			
Lower Reach	150 ^	41	1,240
Upper Reach	150 ^	64	2,205
Aquatic Corridors			
Principal Connectors	100 ^	74	1,797
Trout Streams			
Tributary Connectors	50 ^ +	84	1,019
Water Quality Corridors	30 -	182	1,327
		Total: 445	7,588

^ Measured from edge of meander belt.
- Measured from center of channel.
+ Slope factor may apply.

Footnotes:

1. Reclassified due to existing development or active lots of record.
2. Reclassified due to active platting process at time of rule adoption.
3. Reclassified due to existing infrastructure or previously approved stream management plan.

Vermillion River Aquatic Management Area, Empire Township

Newly developing urban edge, Hastings

Landscape Diversity and Complexity

The Vermillion Corridor captures diversity in land uses, economic activity, and land management practices. The Vermillion Corridor includes one of Minnesota's oldest cities, with historic commercial and residential districts and a newly developing edge with new townhome neighborhoods, subdivisions, and commercial development.

Just beyond this developing edge are rural communities with long traditions in agriculture and a future vision for continued agriculture.

Further along the corridor are examples of more working farms, a 4,000-acre wildlife management area, industrial parks and commercial districts, another historic downtown, new suburban development, and rural residential development.

The Vermillion River Corridor is a complex fabric in which diverse activities and a broad spectrum of interests are interwoven.

Chapter 2: Corridor Conditions Today, Key Issues

Characterizing the Vermillion River

Location and Size

The Vermillion River watershed—the largest watershed in the Twin Cities Metro area—is part of the Lower Mississippi River Basin. The 335-square-mile watershed lies within the Western Corn Belt Plains ecoregion, characterized by cultivated land, pasture, and open space. The Vermillion River and its tributaries are *small urban streams,* with mean flows ranging from 15-40 cubic feet per second (cfs) in Farmington to 80-127 cfs in the City of Vermillion, depending on rainfall. For comparison, the Minnehaha Creek drains 176 square miles and has a flow rate of approximately 160-340 cfs.

Channel Qualities

A Meandering River: The River's channel size and depth varies, reflecting near natural to highly engineered conditions. In physical terms, the Vermillion is described as *meandering*. Its natural channel pattern tends to be sinuous rather than straight, due to the natural spiral pattern of water flow within rivers, also referred to as *thalweg*. Without channel straightening or bank armoring, river courses naturally will move over time, carving out curves in its channel and re-depositing riverbed material along its course. The water's own movement creates variation in width and depth.

Channel Straightening: allows faster water movement, and is often accompanied wetland drainage, installation of pattern tile in farm fields, and urban development. Portions of the Vermillion have been straightened over the past 100 years in concert with these land-use changes. A recent study of the South Creek in Lakeville found many straightened ditches with minimal channel or habitat complexity and minimal riparian vegetation.

Bank erosion

Channel straightening has contributed to many of the Vermillion River system's present- day challenges. Because straightened channels speed stormwater flow, the River's overall flow has increased, along with pollutant loads – sediments, nutrients, pesticides, bacteria, and even increased heat. Meanders that were turned into ditches usually were excavated to a consistent depth, destroying the variation in habitat that is necessary to attract diverse fish, macroinvertebrates, and wildlife. It has

also contributed to bank erosion, as the straightened bank is unable to resist the River's natural tendency to meander. Examples of a straightened channel and the restoration of a meandered channel are in the following image.

Tale of Two Streams:
MN DNR restored and stabilized loops and turns in a small portion of the Vermillion River in 2009. This reach, part of the Vermillion River AMA, is a designated cold-water fishery. A straightened tributary intersects the Vermillion River at the point indicated by the arrow. This formerly meandering reach was straightened into a drainage ditch by the U.S. Army Corps of Engineers in the 1940s to drain runoff from the former Gopher Ordnance Works to the northwest.

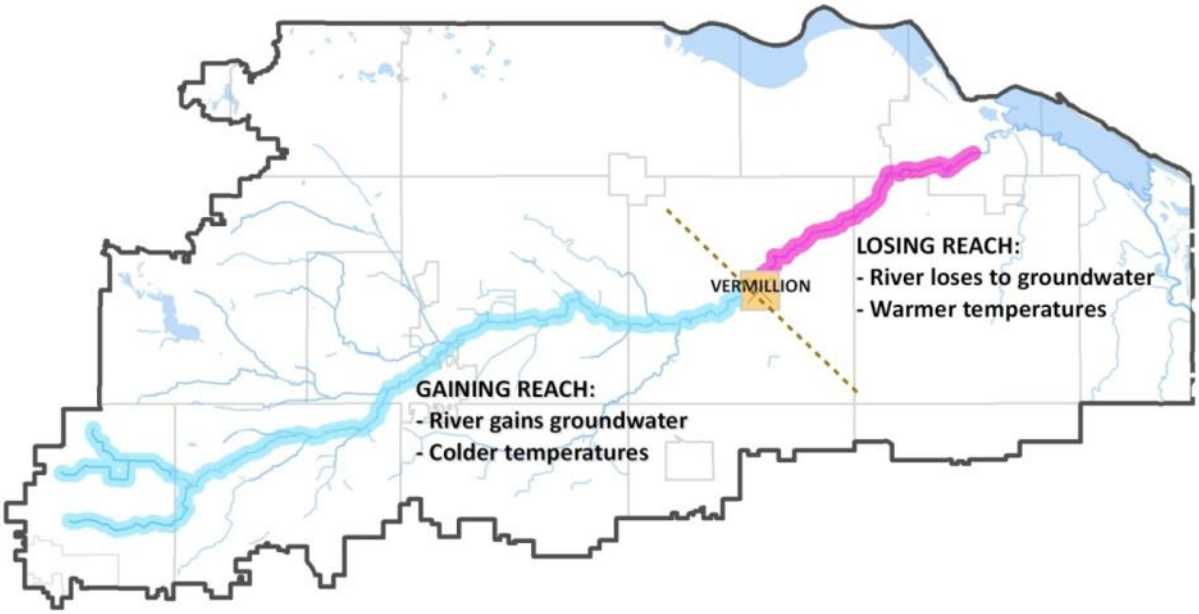
A recent analysis of channel changes was encouraging. Studies of previous data, aerial photographs and direct comparison by staff that conducted the 1999 survey indicate that previously studies sites showed no significant change in channel condition from the 1999 survey. The results of this assessment effort suggest that the study subreaches were not subject to considerable change in channel stability over the past 10 years.

Channel Ownership: The Vermillion River is also classed as a *meandered stream*, meaning that land along the River was platted for individual ownership in the 1800s and property ownership extended to the centerline of the riverbed. The corridor today is predominantly in private ownership, and many landowners derive a living from farming along the River. Public landholdings are few, but include a few city parks as well as a vast open space complex at the midpoint of the Vermillion's course through Dakota County – 4,000 acres comprised of the Vermillion Highlands Wildlife Management Area (WMA), the Vermillion River WMA and Aquatic Management Area, Dakota County's new regional park, the Empire Wastewater Treatment Plant, and Empire Township public lands.

A River of Contrasts

The Vermillion River has been described as a "perfect laboratory" for studying ecology, hydrology, and geology. The River is a study in contrasts on many counts. Beginning as a narrow stream strongly fed by springs and cold groundwater in its western headwaters (the gaining reach), the River widens and loses volume to groundwater and underlying bedrock as it flows east to Hastings (the losing reach). Contrasts continue in the varied land use contexts within the gaining and losing reaches. From highly urbanized to newly developing, from protected open space to rural agriculture, from residential to industrial, the River travels through a rich diversity of settings.

Gaining and Losing Reaches



Water Quality

Historic Land Use Patterns and Water Quality Conditions

The Vermillion River and its tributaries drain a watershed consisting of 335 square miles in central Dakota County and extreme southeast Scott County. Surface water quality in this large area is tied directly to how land is used and managed, and a key intermediary in this dynamic is rainwater.

Agricultural Impacts: Historically, Dakota County's fertile soils made raising livestock and crops easy and profitable. By the early 20th century, more than 80 percent of the land in the County was actively farmed. Farming resulted in the removal of native vegetation, draining of wetlands, and modification of river and stream channels within the Vermillion River watershed. Small agricultural centers such as Farmington, Hastings, Lakeville, and Rosemount developed during the days of early settlement. Agriculture remained the most significant land use in the Watershed until World War II.

Portions of the Vermillion River flow through rural communities with strong agricultural roots and a continued commitment to future agriculture. Rural agriculture also affects the Vermillion River – rainwater and snowmelt carry fertilizer, eroded soil particles, pesticides, nutrients, and bacteria from treated fields and animal feedlots; drain tiles and ditches rapidly convey water and field runoff to the River. Groundwater withdrawal for irrigation can also stress the River, since it relies on groundwater for base flows.

Turbidity: Stormwater Conveyed to Surface Water

Development Impacts: In the 1950s, federal highway and home mortgage credit programs led to the earliest subdivisions along major transportation corridors. Single-family homes became the dominant development pattern through the 1960s, transitioning though the 1980s to include infill development with increased high density residential, commercial, and industrial land use. This increasing urbanization throughout the northwestern part of the watershed has led to decreased water quality, increased groundwater consumption, and further modification of natural hydrology.

The northwestern portion of the watershed includes some of the most rapidly developing communities in the

Twin Cities region, and has undergone dramatic change over a short period. Urban development has brought homes and businesses to the watershed, and also has brought physical changes that affect the fate of rainwater and surface water quality. Construction removes plant cover and native top soils, compacts soils, and expands impervious surfaces that promote runoff and block infiltration. Natural hydrology is further altered by stormwater sewer systems, roads, parking lots and other infrastructure.

As traditional urbanization occurs, more stormwater and substances it carries are quickly transported through conveyance systems to surface waters. Less rain infiltrates in the area where it fell, posing multiple problems: flooding, depletion of groundwater, rapid transmission of pollutants, increased water temperature, and more.

Point Source and Non-Point Source Pollution

Point source (PS) pollution includes pollutants discharged to waterways from the end of a pipe, such as an industrial outfall. PS pollution has been reduced through state and federal regulations: stricter permitting, gradual reduction of legally allowable levels of pollutants in discharges, technological advances, more sensitive and comprehensive monitoring, targeted enforcement, increased public awareness, and penalties.

Non-point source (NPS) pollution hasn't been reduced as effectively as point-source pollution, partly because it is tied to widespread land uses and management practices. Unlike PS pollution, NPS pollution comes from many diffuse sources and is readily carried by rainfall or snowmelt to lakes, rivers, wetlands, coastal waters and ground waters. Across a range of management practices, NPS pollution adds soil, sediment, phosphorous, nitrogen, agricultural chemicals, and pathogenic bacteria into waterways like the Vermillion River. Rain and snowmelt carry pollutants directly off farm fields into rivers and streams and conveys pollutants through ditches and drain tiles. According to the US Environmental Protection Agency, NPS pollution is the leading cause of water pollution in the United States today, with agricultural runoff considered to be a significant source. Eroded soils and sediment contribute to turbidity (cloudiness) of the water, one of the major impairments of the Vermillion River today.

Drainage Tile Outfall along the Vermillion River

Urban and suburban runoff is also a NPS pollutant. Collected over large areas and conveyed into city stormwater systems, this runoff is often discharged to waterbodies through an outfall. Among the

pollutants carried by runoff through urban and suburban landscapes are soil, road de-icing salt, pesticides, pet wastes, seepage from septic systems, heat, petroleum hydrocarbons, driveway sealants, and more. Runoff associated with conventional urban development that lacks adequate stormwater treatment remains a challenge in the Vermillion Corridor.

Pollution and Impairment Status

It is important to understand the Vermillion River's current pollution status in the context of established standards. The federal Clean Water Act requires that waters be assessed to see if they are "fishable and swimmable" or are clean enough to be used for designated uses. For the Vermillion River, uses that define water quality standards include consuming fish caught in the River, activities that involve contact with the water, and supporting wildlife.

Water quality in the Vermillion River is monitored continuously throughout the year at eight fixed stations that record water levels and temperature. Continuous temperature monitoring takes place from May through October when hot weather can increase stream temperature. Flow rates are recorded continuously and field-verified five to seven times per season. Spot sampling for chemicals, nutrients, bacteria, and other physical qualities such as turbidity (cloudiness) is done bi-weekly and during large rainfall events at the eight fixed sites. On a biennial basis, the Minnesota Pollution Control Agency (MPCA) compares data from the Vermillion with state and regional standards for similar types of streams to determine if any Vermillion River reaches or tributaries are impaired or unsuitable for designated uses due to:

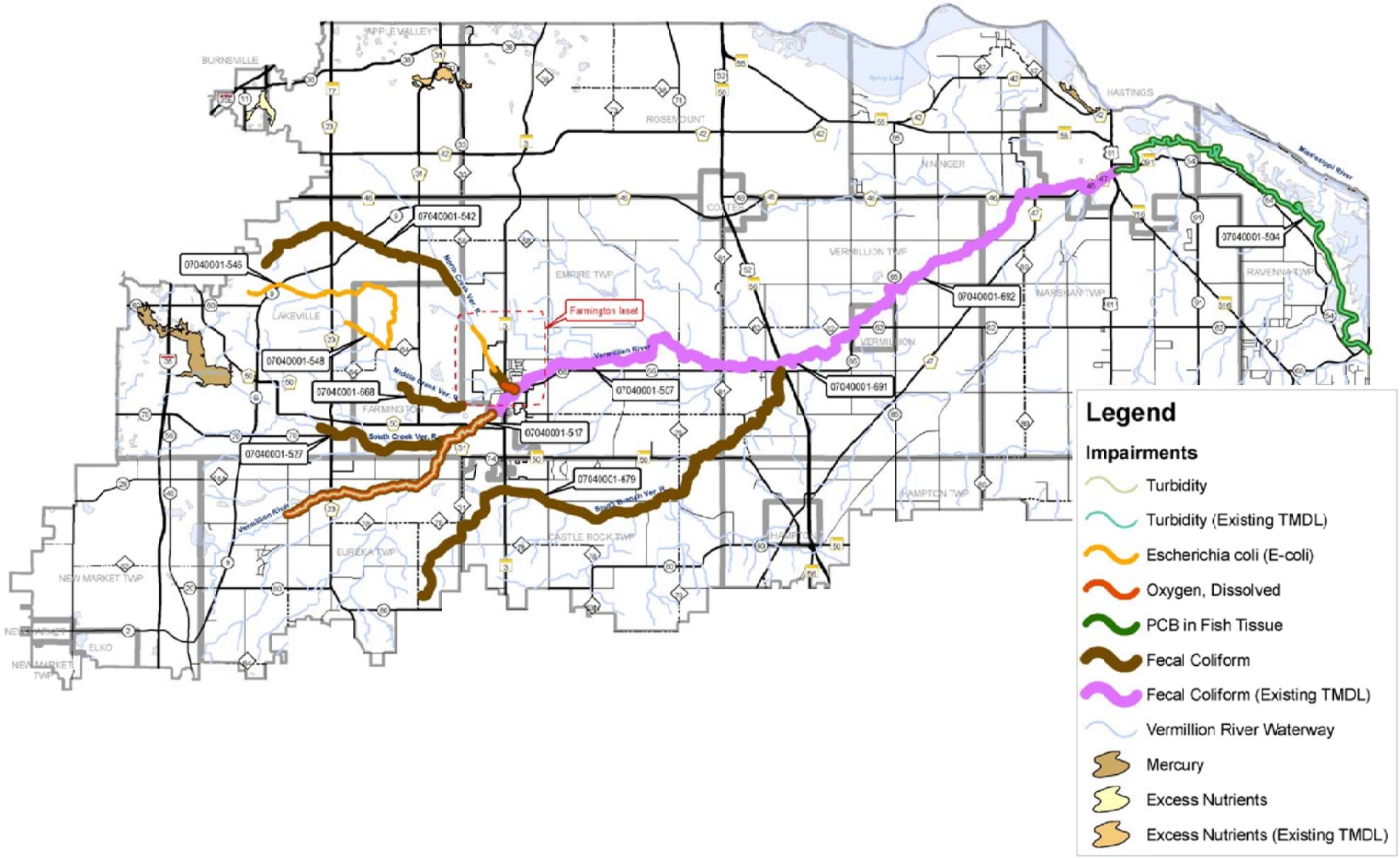
- **High fecal bacteria counts:** from septic and wastewater plant systems, livestock, wildlife, and other sources. Body contact and ingestion are discouraged.
- **Increased levels of turbidity**: excessive sediment, harmful to aquatic organisms.
- **Low dissolved oxygen levels**: insufficient oxygen levels to sustain fish populations. Often related to channel degradation.
- **Polychlorinated biphenyls (PCBs)**: industrial toxins that accumulate in fish tissue. Fish consumption should be in limited amounts, if at all.
- **Increased temperatures**: adversely affects cold-water species such as trout.

MPCA's 2008 and 2010 impairment classifications for the Vermillion include bacteria, low dissolved oxygen levels, PCBs, and turbidity.

2008 and 2010 Impairments	Vermillion River Reach
Fecal Coliform Bacteria	Most of the River, mainstem and major tributaries
Low Dissolved Oxygen	North Creek, from Middle Creek to Mainstem
PCBs	Mainstem, below the Falls
Turbidity	Mainstem, from Highview Ave. to 210th Street and below the Falls

Vermillion River Watershed

2008 and 2010 Stream Impairments



The Vermillion River currently is not impaired for temperature, although monitoring shows that the trout stream segments are nearing levels at which impairment might be proposed. The River also is not listed as impaired for nitrate; however, the MPCA recently adopted a surface water standard for elevated nitrate. The South Branch of the Vermillion frequently contains concentrations of nitrate above the surface water standard and may be listed for nitrate in the future. Because the EPA requires states to propose sites for listing every other year, the River may be listed for additional impairments as soon as 2012.

Impairment Consequences: Impairment triggers a study process known as a Total Maximum Daily Load (TMDL), whereby the MPCA or designated local government identifies and quantifies impairment sources. Upper limits are then set on pollutant amounts that can enter a target waterbody on a daily basis. In 2009, the MPCA initiated TMDL study for bacteria in the reach shown in pink on the preceding impairment map. A TMDL study for turbidity was completed in 2009 as part of the Lower Mississippi River Basin TMDL, which identified sources and strategies for improving turbidity. The VRWJPO has been requested to conduct watershed-wide TMDL study on all impairments (2012).

Groundwater Relationships: Groundwater and surface water interact continually throughout the Vermillion Corridor. Groundwater maintains base flow and stream temperatures in the River, but is also affected by land use and management decisions. Due to unique geologic conditions, the River loses volume and transported contaminants to underlying groundwater near Hastings. The Hastings Area Nitrate Study (HANS) identified high nitrate levels in drinking water wells and pesticides at some sampling locations. The HANS program, now in its third grant cycle, is currently working with area farmers to lower nitrate and pesticide levels in drinking water. The Minnesota Department of Health, in developing a wellhead protection plan for the City of Hastings water supply, identified parts of the lower watershed as having impacts on drinking water quality.

Decision-Making on Individual Properties and Water Quality

Bank slumping and erosion

The preceding sections describe water quality in cumulative terms. How land use practices at the level of a single property contribute to nonpoint source pollution in the Vermillion River may be less apparent. External factors influence individual land management decisions and may relate to public agency roles and standards, changing subsidy or conservation programs, market dynamics and crop prices, changing land use, land

management options, changing scientific knowledge, and the responses of natural systems. A complex set of issues can coalesce on a single property in ways that reduce or compound the pollution problem.

Farming to the Vermillion's edge compared to buffering

For example, Dakota County Soil and Water Conservation District staff conducting field work in the 2008 season noted changes in agricultural set-aside areas that had been in perennial cover for years. In some areas, planted trees were cut down and marginal croplands brought back into cultivation—in some cases, less than 50 feet from the River. High corn prices coincided with changes to the Green Acres conservation program, whereby woodlands, wetlands, and other areas not used for agricultural production became ineligible for reduced property tax valuation and deferrals. Site level management choices don't always anticipate natural system responses. For example, invasive non-native plant species, like reed canary grass, are common along the Vermillion. Reed canary grass was introduced and planted extensively in the Upper Midwest for forage and, ironically, for erosion control. Reed canary grass forms a thick root mat near the surface and lacks the deeper stabilizing root structure of native grasses. Over time, reed canary grass allows bank slumping and erosion to occur, contributing sediment loads to the River.

Summary of Water Quality

Is the Vermillion River's water quality better or worse than in the past? The answer is some of both, improved by some measures and worse by others. Brown trout reproduce naturally in the River today as they did in the past, but had been all but eliminated by the 1950's and 1960's. Clean-up efforts and re-introduction of trout have produced a river that today supports trout without additional stocking. More recently, progress in issues identified in the 2005 watershed management plan can be partially attributed to removal of effluent from the Empire Wastewater Treatment Plant through a large-scale public investment project. Additional improvement is anticipated with similar improvements to the Elko-New Market wastewater plant, although this will not address all of the remaining water quality issues.

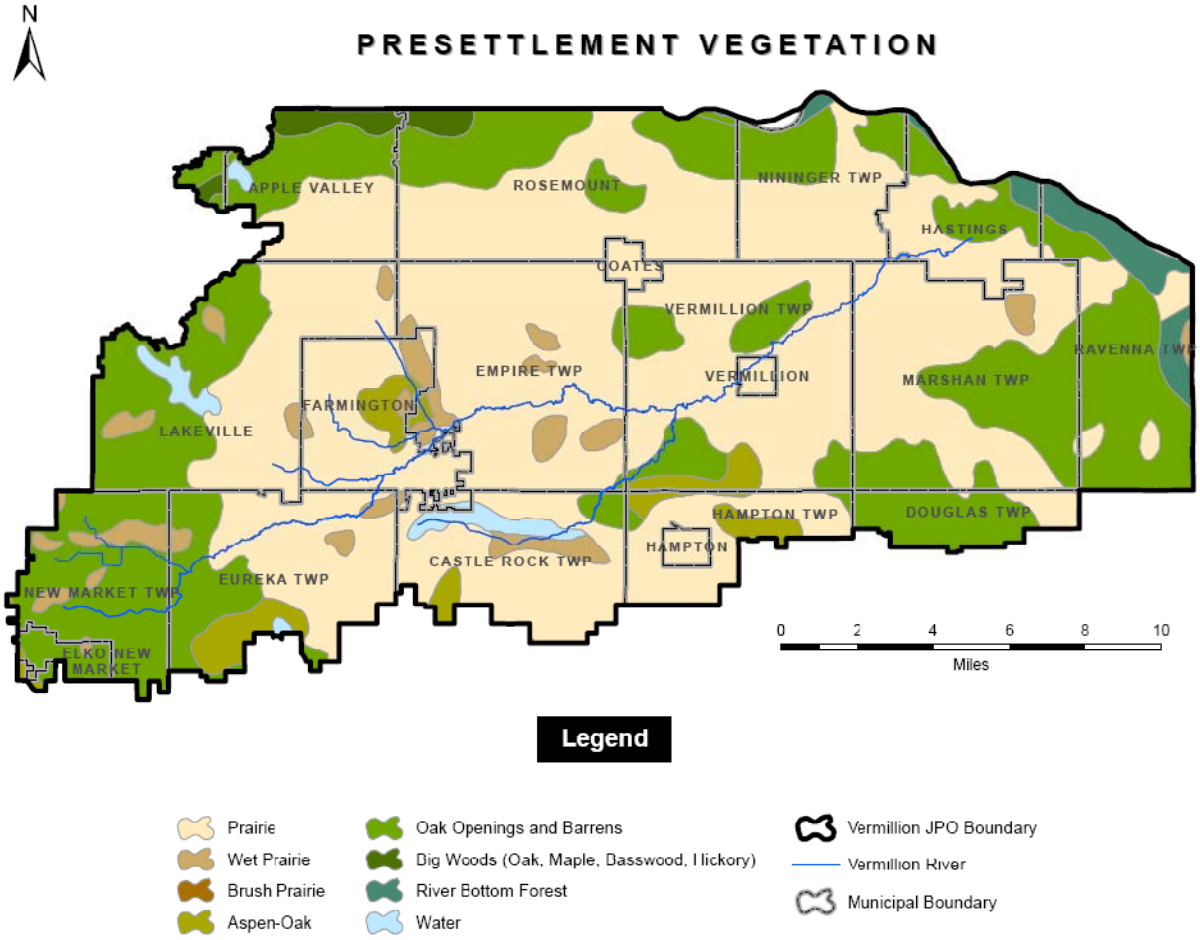
Substantial efforts to improve water quality have been underway for many years by public, private, and nonprofit organizations and individual landowners. Improving water quality in the River is a complicated long-term effort, and requires large-scale efforts by the public sector and developers (design, landscape restoration, stormwater system retrofits to increase infiltration). For individual landowners, greater adoption of best management practices is needed, such as installing buffers and promoting stormwater

infiltration. The quality of the Vermillion River today is largely dependent on the land and resource management decisions of thousands of landowners and managers within the watershed, and especially dependant on the decisions of those who live and work along its banks. As land use changes and growth occur in the future, this basic fact will remain. However, the number of individual decision-makers and land managers will likely increase, posing greater challenges to the river system.

Natural Areas and Habitat

Corridor Habitat Conditions

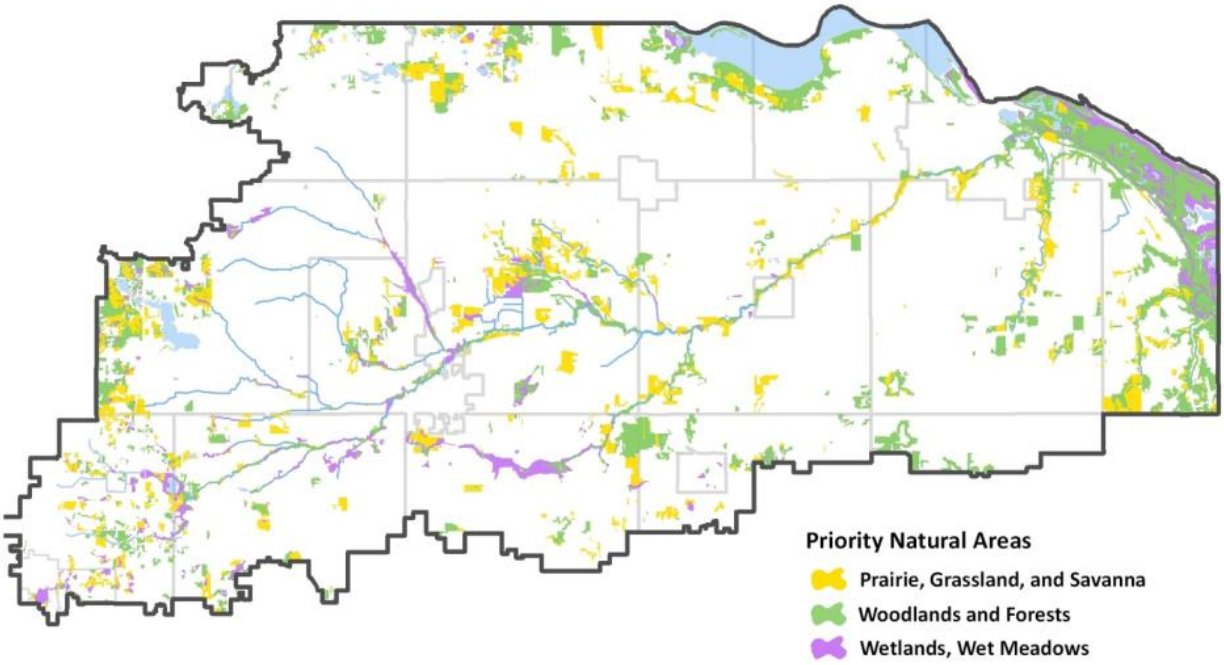
The Vermillion River system is located in the Western Cornbelt Plains ecoregion, which is heavily dominated by row crop agriculture. In contrast, pre-settlement habitat in Scott and Dakota counties was remarkably diverse, based on its location at the crossroads of several distinct ecological subsections. Significant rivers border or cross each county. Native plant communities in the past included prairie; wet prairie; brush prairie; aspen oak forest; "Big Woods" of oak, maple, basswood, and hickory; river bottom forest; and open water, which provided habitat to a broad range of wildlife.



This rich natural legacy has been lost and altered over the past century through agriculture and development. Today only three percent of Dakota County's native communities remain[1] and 86 percent of its native wetlands have been drained.[2] The watershed is still primarily agricultural, but urban development continues to replace prairie grasslands, wetlands, forests, and farmland. Ecological diversity has been further reduced by invasive species, such as reed canary grass and buckthorn.
Although most of the pre-settlement native landscape in the Vermillion River Watershed has been lost, degraded, or fragmented, many less pristine, but high quality natural areas remain. These natural areas include prairie, woodland, and wetland ecosystem types, as shown on the following map of high priority natural areas in the Vermillion River watershed.

Some of the more prominent features include Vermillion River Bottoms (a 3,000-acre floodplain forest along the Mississippi River near Dakota County's eastern border), scattered natural prairie communities, oak forests, and unaltered wetlands. The watershed also includes several State Scientific and Natural Areas with upland hardwood forest, floodplain forest, sand coulee, prairie, and the rare species that reside there.

Priority Natural Areas in the Watershed



[1] Dakota County Biological Survey, 1997: Minnesota Department of Natural Resources
[2] Minnesota Wetlands Conservation Plan, 1997: Minnesota Department of Natural Resources

Adjoining Upland Habitat

In addition to the floodplain and riparian zone habitats that supports fish, macroinvertebrates, insects, birds, and mammals, there are high-quality and restorable upland habitat areas adjacent to the Vermillion Corridor. Some of these high quality ecosystems and the species they support include:

<u>Grassland Communities</u>: Various native grassland communities exist within the Corridor and adjoining lands under different moisture conditions. This variation influences the mix of native plants typically found within the community, including:

- Dry Prairie, including sand-gravel subtype and barrens subtype
- Mesic Prairie (intermediate moisture regime)
- Dry Oak Savanna (mostly grassland with scattered oaks, typically bur oaks), including sand-gravel subtypes
- Mesic oak savanna

Oak Savanna

<u>Wooded Communities</u>: Several types of forest, woodland, and shrubland are adapted to differing moisture regimes within the Corridor and adjoining lands, including:

- Oak Forest, including Mesic and Dry Oak Forest communities
- Maple Basswood Forest
- Aspen Forest
- Floodplain Forest
- Lowland Hardwood Mixed Forest
- Mixed Hardwood Swamp
- Red Cedar Woodland
- Willow Swamp

Floodplain Forest

<u>Wetland Communities</u>: Dependent on hydrology, soils, and topography, a variety of wetlands are found within the Corridor, including:

- Seepage Meadow
- Cattail Marsh
- Mixed Emergent Marsh
- Wet Meadow
- Wet Shrub Meadow

Willow Swamp

In addition to a broad variety of native plant and animal species, several species with State-listing status have been documented in the Corridor area, including:

Blanding's Turtle *(Emydoidea blandingii)*
State-listed as Threatened

Loggerhead Shrike *(Lanius ludovicius)*
State-listed as Endangered

Valerian *(Valeriana edulis ciliata)*
State-listed as Threatened

Hill's Thistle *(Cirsium hillii)*
State-listed as Special Concern

Blanding's Turtle

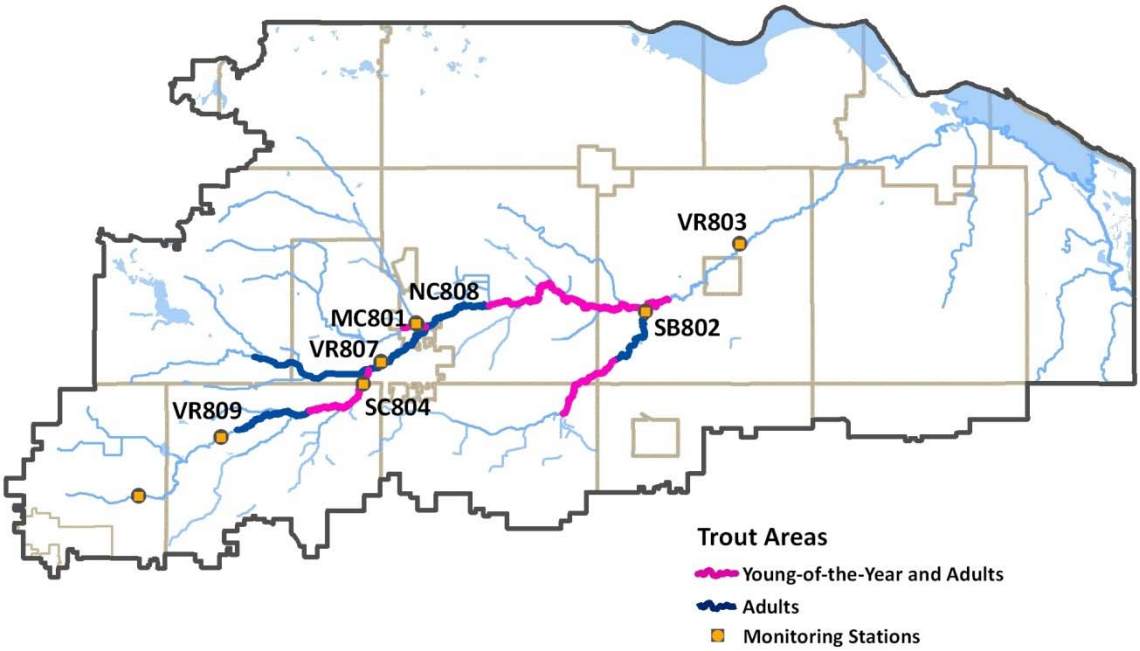
Loggerhead Shrike
Photo: Tom Munson

Hill's Thistle,
Photo: William Glass

Valerian
Photo: Charles Pierce

Aquatic Habitat and Cold Water Ecosystems

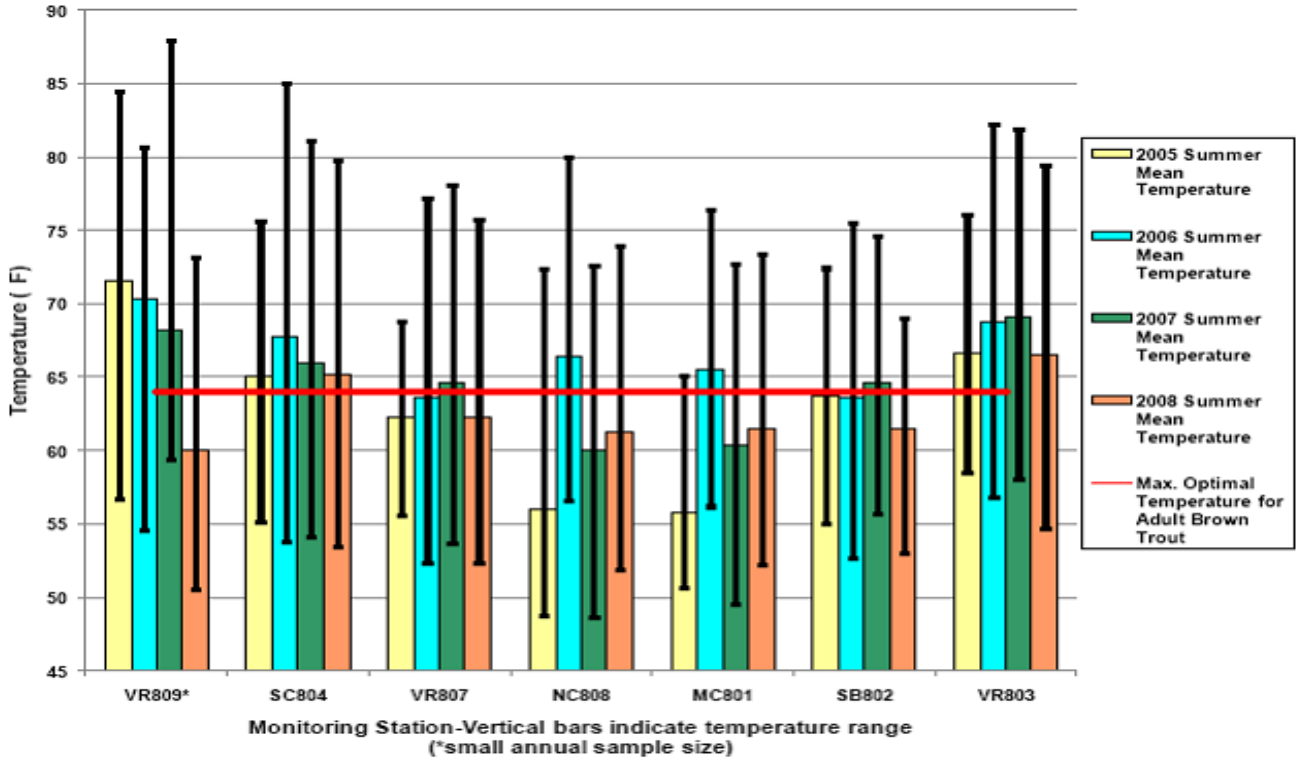
The Vermillion River is unique among rapidly developing urban areas nationwide due to its 49 miles of designated trout stream in its upper reaches. Brown trout naturally reproduce in some reaches, supported in part by inflow of cool groundwater. The Vermillion has been described as one of the best urban trout fisheries in the nation, due to the length of the system and the trophy-sized fish it produces. Brook Trout once reproduced in the River, although this native species was extirpated by high pollution levels in the 1950's. Non-native Brown Trout and Rainbow Trout were introduced in the 1970's. Trout can be considered as an "indicator" for the other essential species that thrive in this cold-water ecosystem, many of which are less readily recognized and aren't specifically valued as part of a recreation tradition or culture.



Favorable Water Temperatures for Juvenile and Adult Trout

Adult trout favor water temperatures below 64 degrees Fahrenheit. Temperatures above 68 degrees stress adult trout, and above 73 degrees can be lethal for adults and for juveniles. Young-of-the-year trout are most sensitive to warming waters. The above map shows areas usually cool enough to support juveniles (pink). Dark blue segments are less supportive habitat for juvenile trout.

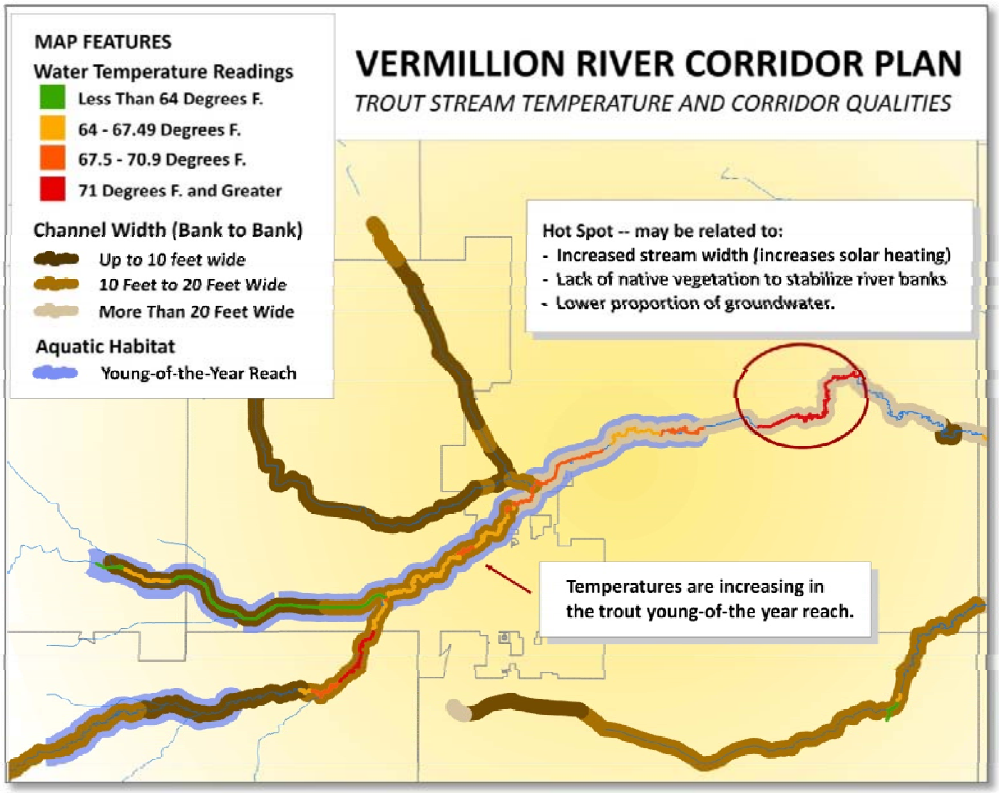
2005-2008 Mean Summer Temperatures along the Vermillion River



The preceding graph shows the results of temperature monitoring at seven stations on the Vermillion River over a four-year period (2005-2008). The red horizontal line marks the temperature where adult trout begin to experience heat stress; i.e., 64 degrees Fahrenheit. Colored bars indicate *average* temperatures over the summer at each monitored location for each year of the study. All locations showed average temperatures above the stress level for at least one year in the study, although generally below the lethal level (73 degrees). The black lines over each bar show the range of recorded water temperatures for each location and demonstrate that temperatures intermittently exceeded both the stress and lethal levels. The warmest water temperature recorded in the study was 87 degrees.

Cold water streams receive substantial water volume from cool groundwater. Factors that maintain cool stream temperatures include bank, channel, and streambed characteristics; stormwater management and infiltration; streambank shading; agricultural drainage or management systems; and temperature control of industrial discharges or wastewater effluent. The following map shows bank widths in relation to warmer water temperatures measured in 2009.

River Hot Spots
The JPO tested river summer temperatures in trout reaches of the river and found warming waters in areas that support juvenile trout (blue), which are more heat-sensitive than adults. Stress level (orange) and lethal level (red) temperatures are shown. Brown shows bank width (dark =narrow, light=wide). As banks widen, water temperatures increase.



The VRW JPO and the St. Anthony Falls Laboratory at the University of Minnesota conducted an extensive thermal modeling study in evaluating a potential thermal credit trading program. Although the VRWJPO chose not to actively pursue the trading program, they learned much about how heat loads into the Vermillion River and have a

clearer picture of the portions of the River that generally stay cool and which portions, on average, appear to be warming.

One of the more surprising study findings of the study was the amount of heat loading from un-vegetated stormwater detention ponds, which can overflow during moderate rainfall on a hot summer day to piping that drains to the River. Commercial and industrial rooftops are another major contributor during these types of rain events as they can quickly shed a large volume of warm water from a highly heated surface. The JPO is conducting additional studies on options to reduce heat loading into the designated trout stream portion of the River.

What can be done to preserve the Vermillion's cold-water ecosystems? Designated trout streams are protected by special fishing regulations set by the MN DNR and are eligible for MN DNR Trout Stamp funds for habitat improvements. The MPCA sets stricter water quality standards for designated trout streams, requiring no material increase in temperature and lower levels for turbidity and for ammonia. The MN DNR also recently acquired three Aquatic Management Areas along the River to protect and restore trout reaches and provide public access. Restoration efforts include re-meandering straightened reaches, improving trout habitat, and planting native species. Some efforts, such as re-meandering, are landscape-level restorations that require adjoining shoreland. Other effective practices can be accomplished within a small area.

Tale of Two Streams:
The City of Lakeville re-meandered a straightened stream reach west of Cedar Avenue in Lakeville, adding habitat features to provide shade for trout.

East of Cedar Avenue is another re-meandered stream segment, completed by Dakota County and the City of Lakeville as part of an upgrade to Cedar Avenue and associated mitigation.

Biological Quality of General Fish Populations

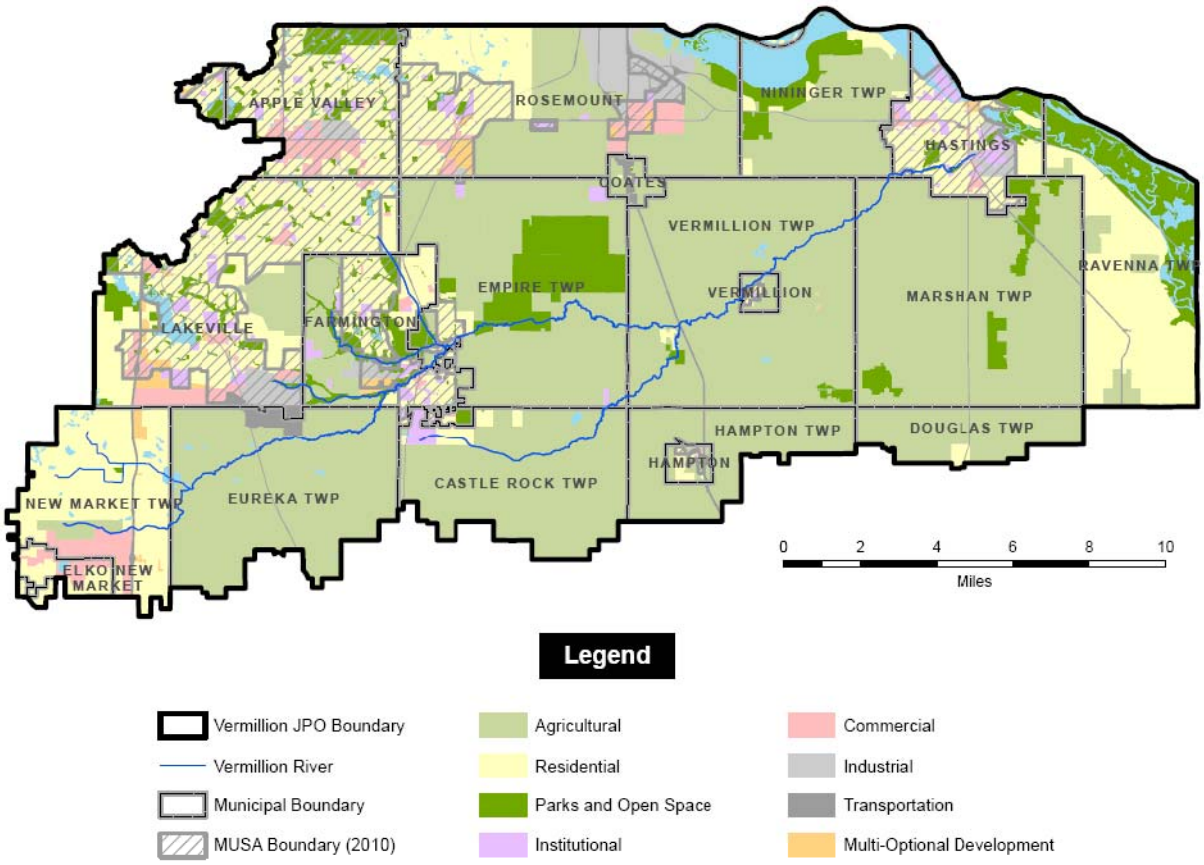
The VRWJPO prepared a Biomonitoring Plan to assess changes in all fish populations, including warm water species, and evaluate channel stability on a regular, rotating basis. The 2009 fish evaluation for a range of sampling sites along the River all scored *fair to poor* on an Index of Biological Integrity. This indicator of low quality fish populations was attributed to stressors on streams throughout the watershed, lack of diversity in species, and variable stream quality in different reaches of the Vermillion River.

Land Use, Economic Conditions, and Urban Development

Current and Planned Land Use

The Vermillion River watershed today includes diverse land use patterns, including suburban residential, commercial districts, historic downtowns, large lot rural residential, agriculture, industry, mixed use development, and institutional lands. Settled in the mid 1800's, Hastings and Farmington include the corridor's oldest urban development. The leading edge of new development is in central Rosemount, Lakeville, Farmington, and Elko-New Market.

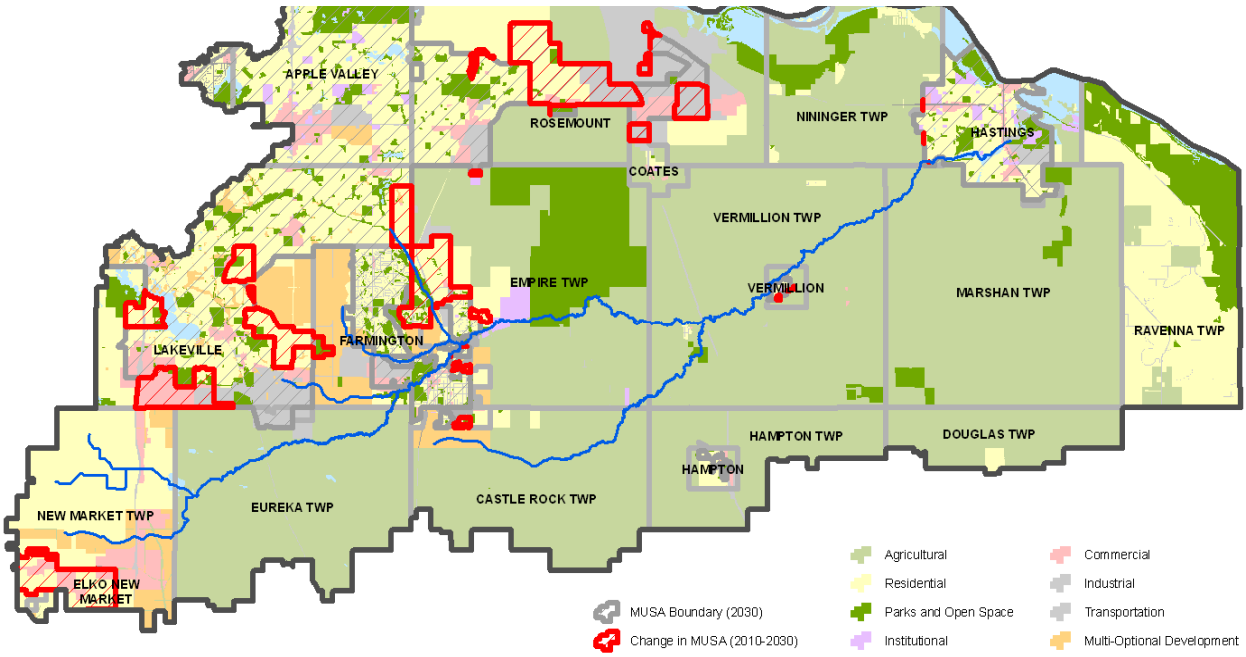
Current Land Use



In the watershed's rural townships and along the Vermillion River corridor, the predominant land use today is agriculture – corn, soybeans, alfalfa, small grains, vegetables, livestock, and other products. Much of the Vermillion watershed has prime agricultural soils, among the most productive in the state.

Where Growth Will Occur: The following map was compiled using each community's projected land use for the year 2030, the planning horizon required by the Metropolitan Council for the 2008-2009 round of Comprehensive Plan updates. The Metropolitan Council requires that all local communities update their comprehensive plans every ten years, to address future regional needs for housing, transportation, and other services.

Projected Land Use, 2030



By 2030, transition from rural to fully serviced urban uses along the Corridor will be concentrated in parts of the cities of Lakeville, Farmington, and Elko New Market, with more modest changes in Hastings. Areas proposed to enter into the Metropolitan Urban Service Area (MUSA) and receive public sewer and water service are outlined in red. Local plans are summarized according to predominant land use patterns below:

Rural Agriculture (light green): Townships zoned 1 dwelling unit per 40 acres and in agriculture plan to remain so. Rural townships (Eureka, Castle Rock, Empire, Vermillion and Marshan townships) seek to preserve agriculture into the foreseeable future. New residential development is proposed for western Empire Township.

Rural Residential (light yellow): Ravenna and New Market townships are rural residential and plan to remain so over the next 20 years. These townships frame the easternmost and westernmost ends of the River.

Existing Urban Development (gray, yellow, pink, orange): commercial, residential, industrial and institutional land within the MUSA, representing a full spectrum of development and potential redevelopment opportunities.

New Development with Expansion in Urban Services (red outline): Areas to receive MUSA services include a mix of land uses. Modest expansion of MUSA is proposed for western Hastings and the City of Vermillion. Lakeville and Farmington will add residential development near North Creek, currently outside of the MUSA, but proposed to receive services by 2030. Lakeville will add residential development with urban services in the eastern part of the city currently used for agriculture, and will expand its industrial corridor along the South Creek. Elko-New Market also is proposed to receive a MUSA expansion, shown in red on the map.

Quantifying Projected Growth: This Corridor plan was completed in 2010, during an economic slowdown that has brought new development in the watershed to a near standstill. Assuming growth resumes its past pattern, more than 82,000 new housing units are projected to be added in Dakota County (county-wide) between 2000 and 2030, and population will increase by 77,359 households. Between 2000 and 2030, the Metropolitan Council forecasts 43,027 new households in Scott County overall. Scott County cities are projected to at least double their housing stock by 2030.

In its 2030 Regional Development Framework forecasts as updated in 2009, the Metropolitan Council projected that 31,120 new households will be added to the Vermillion Corridor communities between 2010 and 2030.

Vermillion Tributary in Lakeville

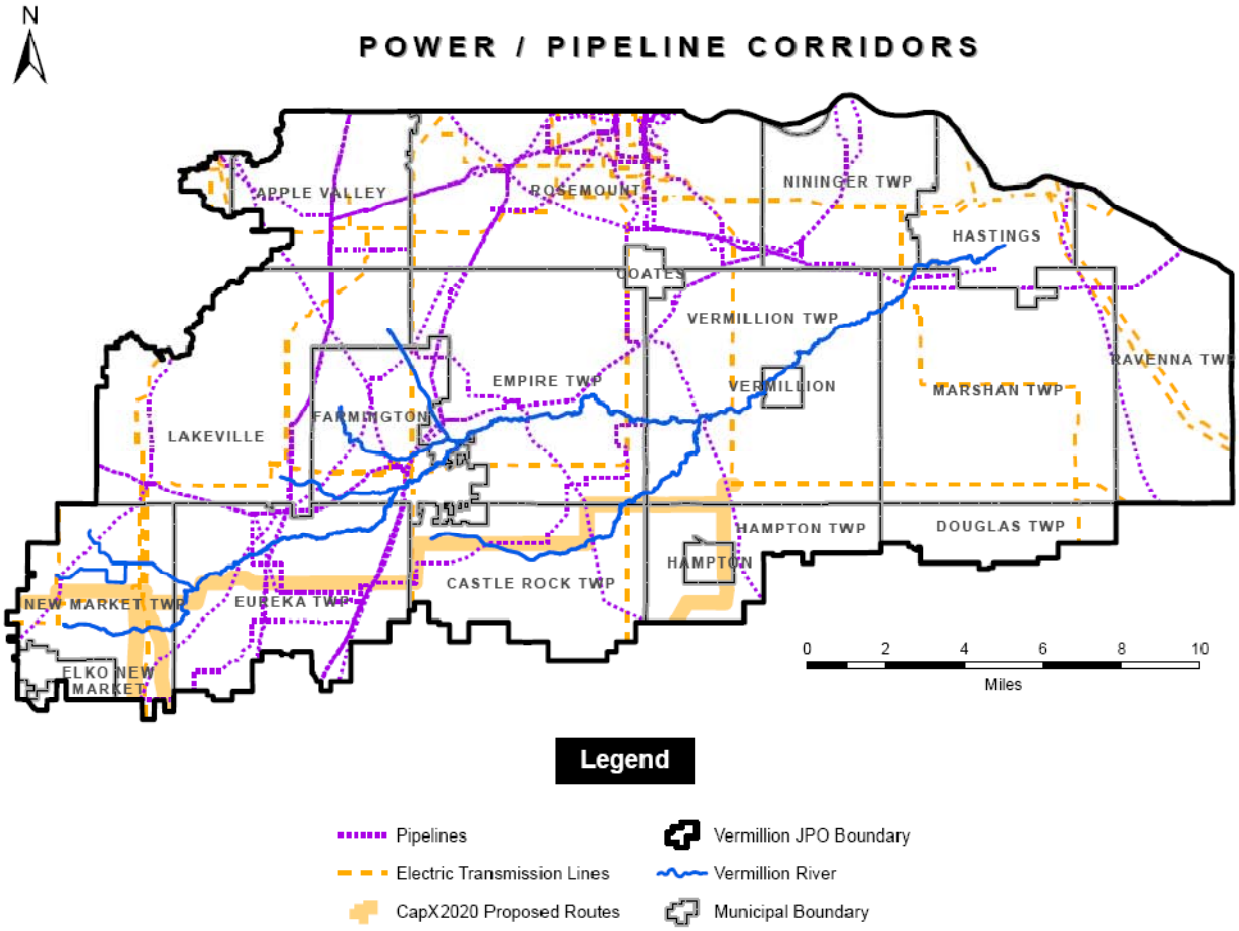
Community, County	Added Households, 2010 to 2030
Castle Rock Township, Dakota	100
Elko New Market, Scott	5,880
Empire Township, Dakota	2,150
Eureka Township, Dakota	150
Farmington, Dakota	5,000
Hastings, Dakota	3,700
Lakeville, Dakota	13,300
Marshan Township, Dakota	70
New Market Township, Scott	650
Vermillion City and Township, Dakota	120
Total Households Added	**31,120**

The Vermillion River Corridor is a microcosm of land-use challenges in rapidly developing metropolitan areas. The River threads through communities committed to vigorous economic development as well as communities where a long agricultural heritage translates to a commitment to maintaining the land's rural character and function.

Factors that future development should consider include:

- Groundwater's role in hydrologic systems, its sensitivity to land change and pollutants
- Soil types that vary, from slowly infiltrating clays to rapidly infiltrating sands
- Drinking water availability, especially where municipal supplies have not been established and private or production wells use groundwater resources
- Availability of suitable soils and sufficient land for septic systems in areas where wastewater facility treatment is not available
- Regional needs for sand and gravel, in plentiful supply in the upper watershed
- Local land-use authority in Dakota County cities and townships, and county land-use authority in Scott County
- Brownfields properties where hazardous substances and contaminants are suspected, but not confirmed
- More stringent regulatory requirements
- Location of major infrastructure (current and planned) such as roads, rail lines, power lines, pipelines, sewer lines, and other features

Expansion of utility infrastructure to meet local, regional, and state needs will be part of the Corridor's future. The following map shows existing pipelines and transmission lines and the proposed alignment of the CAPX2020 interstate electric transmission line.



Dakota County promoted two overarching goals related to development and protecting natural capital in its 2009 Comprehensive Plan:

1) Protect the integrity of the county's natural resource base, reinforce natural systems, and restore their functioning – green infrastructure

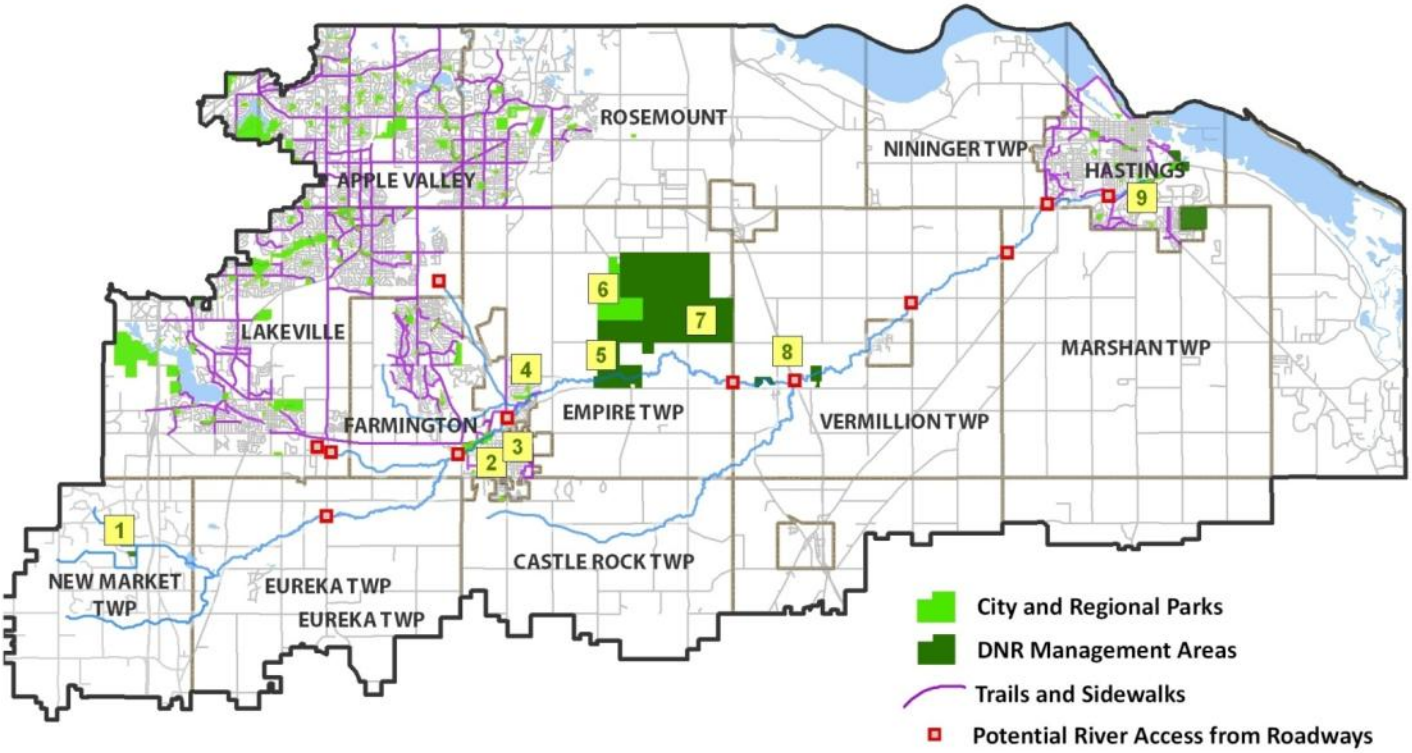
2) Let green infrastructure shape land use instead of fragmenting natural systems. Orderly development around natural systems will preserve their function, provide cleaner air and water and healthier natural resources, reduce long-term costs, and create high quality amenities that enhance the value of development.

Planning efforts such as the Vermillion River Corridor Project focus on river corridors as a natural amenity that provides an organizing structure for new development while protecting the our natural resource base and ensuring economic growth and stability.

Recreational Opportunities

Parks and Trails in the Corridor

Public access and recreation opportunities within the Vermillion Corridor currently are limited to parks and trails within Lakeville, Farmington, Hastings, and Empire Township and DNR management lands in Empire, Vermillion, and New Market townships.



Public Lands

From west to east, the existing public recreation areas within the corridor are:

1. Spartina Wildlife Management Area (WMA): 17 acres in New Market Township on the Vermillion River, managed by MN DNR for wetland and brushland species, and primarily used for wildlife viewing and hunting
2. Rambling River Park: 76 acres, managed by the City of Farmington for community recreation, sports facilities, habitat, and River access
3. Prairie Waterway: managed by the City of Farmington as a linear community green space with River access
4. Empire Soccer Fields: 3 acres, managed by Empire Township for athletic activities and River access
5. Vermillion River Aquatic Management Area and Wildlife Management Area (AMA)/WMA: 837 acres in Empire Township, managed by MN DNR. Much of the land was previously farmed, but recently has been seeded to native grasslands. Provides opportunities for birding, hiking, nature study, and hunting.

Game species include deer, small game, pheasant, doves, and turkeys. The AMA provides aquatic habitat improvements and fishing access.

6. New Regional Park: 462 acres in Empire Township, managed by Dakota County and undergoing master planning in 2010 to determine future recreation uses
7. Vermillion Highlands Modified WMA: 2,838 acres in Empire Township, co-managed by MN DNR for wildlife and hunting and by the U of MN for research and Dakota County for limited trail-based recreation. Hunting options include deer, pheasant, and turkeys.
8. Otting and Kummer AMAs: Two new AMAs (former Otting and Kummer properties) totaling 104 acres in Vermillion Township, managed by the MN DNR for aquatic species habitat and River access
9. Hastings Vermillion River Falls and Old Mill Parks: 12 acres in Hastings, managed by the City of Hastings for general leisure recreation and River viewing.

In-Stream Recreation: Angling, Canoeing, and Kayaking

The Vermillion River is seasonally suitable for canoeing and kayaking, particularly east of Farmington to Hastings, where the River widens and water depths increase. Conversely, portions in the extreme western reaches seasonally lack adequate volume for canoeing and kayaking. At present, little or no formal provision has been made for canoeing and kayaking, such as designated put-in and take-out access with parking.

The western reaches of the River, generally west of Highway 52, include the designated trout stream reaches. Maintaining habitat conditions that favor trout may involve leaving deadfall trees in place in the River to provide shade and spawning habitat – a practice inconsistent with the needs of kayakers and canoeists. Because the banks and floodplain along much of the River are privately owned, trespassing can be an issue once a kayaker or canoeist leaves the water, even if the intention is getting around a fallen tree.

Under Minnesota law it generally is legal to kayak or canoe in the river and walk in the channel if access was gained through an allowable access, such as public lands or public road rights-of-way. Informal water access for angling and canoeing is limited and currently exists on most public recreation and management lands and at bridge crossings. Most of these informal sites have not been improved, such as providing parking and better shoreline access for public recreational use. The preceding map includes results of a preliminary screening of potential River access on public rights of way, based on accessible slopes, bank heights, adequate right-of-way width, and potential for limited parking. Several of these sites are currently used by anglers and others. With some improvement, many sites east of Highway 52 present good potential for kayak and canoe access, and would improve the overall spacing of access points along the Corridor.

Community Trail and Greenway Plans

Trails are among the most popular public recreation amenities, particularly those that follow natural features and connect well to neighborhoods. Trail connections to the Vermillion River are in purple on the preceding map. Hastings, Lakeville, Farmington, and Empire Township have developing trail networks and Elko-New Market is planning a trail system. Each Corridor community engaged its residents during Comprehensive Plan updates to address growth-related needs, and each community has a contemporary vision for trails between now and 2030. These plans were reviewed as they relate to a Corridor vision and summarized below:

City/Town	Reach	Trail and Corridor Language from Plans
Farmington	Vermillion Mainstem	Not specific about side of River. Widen 8' trails in Rambling River to 10'-12' width with vegetative buffers. Locate out of floodplain, as possible.
	North Creek	10'-12' trail on both sides of River. Out of floodplain, vegetative buffers. Meandering throughout greenway.
	Middle Creek	Start on south, work with north side landowners for future 10'-12' trail width, vegetative buffering
	South Creek	10'-12' trail, both sides of River. Trail setback from River of 100', vegetative buffering.
	Prairie Waterway	Trails exist in half of the greenway from Hwy 50 to the Vermillion River. Should connect to new regional park (through Empire Twp).
Elko-New Market	Vermillion River (S. Headwaters)	Conservation Area/Greenway for future study, establish 100' buffer. Future consideration for trail connections to Dakota County.
Empire Township	Vermillion Mainstem	Regional trail on north side of River throughout township. [May also evaluate south side as needed.]
Eureka	Vermillion Mainstem	Natural Resource corridor now and near-term. Residents may have future interest in parks/trails, but no demand now.
	Chub Creek	Natural Resources corridor now and near-term. Residents may have future interest in parks/trails, but no demand now. Will work with County on planning future Chub Lake Greenway.
Vermillion Twp	Vermillion Mainstem	Preference for connected natural resource corridors. Discuss greenways with Dakota County. Important to know when to establish trails.
	South Branch	Preference for connected natural resource corridors. Discuss greenways with Dakota County. Important to know when to establish trails.
Vermillion City	Vermillion Mainstem	City has one park. Coordinate regional trail development with Dakota County.
Scott County	Vermillion Headwaters	Natural Area Corridors proposed with no specific trail plans on River. Coordination with Dakota County on road trail connection.
Hastings	Mainstem	Vermillion River Linear Park with trail, continuing southwest along River into adjacent township. Core destination trail, 10' width, ADA accessible
Lakeville	South Creek	Greenway with trails, land acquired along much of S Creek
	North Creek	Outside of Vermillion River Corridor Plan scope, but continuation of greenway and trail on west fork of N. Creek
Castle Rock Township	S Branch	No type of trail or greenway included in the plan.
Marshan Township	Mainstem	Natural resource corridor/river greenway. Planning in coordination with Dakota County.

Dakota County's ***2030 Park System Plan: Great Places, Connected Places, Protected Places***, developed in 2008 with extensive public participation, calls for the development of a countywide connected network of greenways and rural conservation corridors. *Conservation corridors* emphasize protection of habitat and water quality along rural stream corridors. *Greenways* function as linear parks that connect communities and incorporate benefits for habitat, water quality, recreation, and transportation. Greenways connect popular destinations at local and community levels; provide nested loops that offer short or longer experiences; and offer trails around lakes. Many will rely mostly on public lands, such as parks, schools, and community centers.

The Dakota County Park System Plan included the Vermillion River in both categories, prioritizing near-term greenways in Hastings, Lakeville, Farmington, and parts of Empire Township. Conservation corridors are the near-term priority for the other rural townships, and Dakota County seeks to work with townships on pre-planning greenways as public interest increases and/or development and land use change approach. Timing is critical to planning greenway networks as land use evolves. It is imperative to preserve the corridor and build a local greenway vision before development proceeds.

Scott County engaged residents in its Comprehensive Plan update and the subsequent Detailed Area Plan (DAP) for rural residential services in the southeastern part of the county. This 73-square mile area is the largest pocket in the seven-county metro region that the Metropolitan Council recognizes as an area unlikely to be served by public sewer and water services; i.e., the final build-out form is rural residential with 2.5-acre lots. The DAP includes a portion of the Vermillion River headwaters and does not call for a trail along the Vermillion in the near-term. The overall Scott County vision calls for Natural Area Corridors to protect key resource systems, including both branches of the Vermillion headwaters.

Benefits of Recreation

Stable communities generally offer the services and amenities that families and business value, including recreational resources and access to open space. Recreation and open space are important components of community identity that can enhance resident sense of belonging to that community. In addition to physical health benefits provided by outdoor recreation, public access to natural environments is essential for building public understanding and appreciation of natural resources and systems, which in turn is critical for ongoing public engagement in protecting the natural resources.

Greenways with recreational use, such as hiking, canoeing, and biking, function as linear parks that can also provide economic and social benefits and contribute to healthy lifestyles. Because greenways are being planned to connect the kind of destinations that are already on the daily or weekly schedules of many residents, greenways promote healthier transportation choices that involve some physical activity (biking or walking).

Dakota County Parks, Lakes, Trails and Greenways Vision, 2030

What's New?

GREAT PLACES: Destination Parks

* New Regional Park in Vermillion Highlands
* More things to do in parks
  - Winter activity area
  - Gathering and celebration areas
  - Swimming and water play areas
* More popular "park basics"
  - Enhanced picnicking
  - Biking and accessible trail loops

CONNECTED PLACES: Greenway Trails

* "Bring parks to people" -- Linear parks connect parks, schools, lake trails, playgrounds, libraries, and the Minnesota and Mississippi Rivers.
* Walking, biking, and in-line skating
* Public agencies work together to create 200 miles of greenways using mostly publicly-owned land.

PROTECTED PLACES: Green Infrastructure

* Enhance and protect park resources
* Protect stream corridors in public/private partnerships
* Protect natural areas and open space in public/private partnerships

DAKOTA COUNTY PARK SYSTEM and COLLABORATIVE OPEN SPACE PROTECTION

- Dakota County Parks
- Federal, State, and Other Regional Open Space
- Existing and Planned Regional Greenways
- Regional Status Discussion with Metropolitan Council
- Example City Greenways (route concepts)
- Stream Conservation Corridors and Greenways
- Destinations: City Parks, Schools, Lakes, Libraries
- Privately-Owned Protected Farmland (FNAP)
- Private/Public Protected Natural Areas (FNAP)
- Potential Rail to Trail Opportunities

Notes:
Regional greenways are intended to illustrate routes, not actual scale. City greenway routes are suggested. Greenway design standards and master plans will be developed through greenway partnerships.

0 1 2 4
Miles

Dakota County Office of Planning, 2008

Concepts for Greenways

Rethinking Trails as Greenways

Multiple Benefits of Greenways

Nested Trail Loops, Trails around Lakes

Greenways Connect Places Where People Want to Go

Coordination and Management in the Corridor

Public Agencies and Roles

Within the Corridor, many agencies and organizations are currently involved with improving water quality and habitat and providing compatible recreation. For specific situations involving surface water and groundwater, several of the following agencies may have a jurisdictional role:

Cities: Cities are responsible for plans and ordinances addressing erosion and sediment control, floodplain protection and easements, stormwater rate and water quality control, pond development, maintenance, and easements, shoreland protection, wetland management plans. Cities may implement WCA.

Townships: Dakota County's townships are unique in Minnesota in that they retain land use control. Townships delegate many activities listed for cities to the County. Preparation and implementation of wetland management plans is encouraged. Townships must prepare, adopt and implement local water management plans.

County: Dakota County administers shoreland-floodplain regulations in unincorporated areas; Scott and Dakota counties jointly manage the Vermillion River Watershed; counties may implement the Wetland Conservation Act (WCA). Dakota County is lead agency for regional greenways and the buffer easement initiative in the county.

Soil and Water Conservation District: SWCDs implement urban and agricultural erosion control services, WCA assistance; County Agricultural Inspector services; State cost share assistance; stormwater management services; feedlot program services for surface water improvements; administers agricultural best management practices implementation loan program.

Vermillion River Watershed Joint Powers Organization: Responsible for water management; watershed plans; uniform policies and official controls for surface water; may implement WCA.

Metropolitan Council: collects and treats wastewater; provides regional surface water planning; provides non-point source pollution management, prevention and abatement grants; industrial wastewater management; water quality monitoring and reporting; reviews watershed plans and local water plans; approves funding for regional parks and regional trails.

MN Pollution Control Agency: Administers federal National Pollution Discharge Elimination Systems/State Disposal Systems stormwater permit program, Section 401, septic system regulations, feedlot permitting and enforcement; composes State list of impaired waters; conducts Total Maximum Daily Load studies; administers State water resource monitoring database. Permits: sanitary sewer extensions, wastewater land application, stabilization ponds; potable water treatment plants, industrial process wastewater, stormwater management or runoff, noncontact cooling water, Water Quality Cooperative Area-wide State Disposal System; reviews wetland permits; determines wastewater effluent limitations.

MN Department of Health: Responsible for fish consumption advisories, drinking water protection, groundwater protection planning, and well safety and installation.

MN Department of Agriculture: Administers pesticide and fertilizer regulation; guidelines for soil amendments and nutrient management; surface water and groundwater monitoring for agricultural chemicals, and invasive species.

Board of Water and Soil Resources: implements Metropolitan Area Surface Water Management Act; reviews and approves watershed plans; administers WCA Statewide; oversees watershed organizations and SWCDs; assists local governments in managing and conserving water resources – provides guidelines, training and technical assistance for local water plans; provides State funding for water and soil management programs and

projects; administers National Pollution Discharge Elimination Systems permits.

MN Department of Natural Resources: permits water diversion and appropriation, public waters work, dam safety, fishery-related, floodplains, shoreland and aquatic plant management control. Reviews local water plans; enforces Wetland Conservation Act; manages State's fisheries, including trout stream designations; Mississippi River Critical Area, Flood Damage Reduction Grant, Lake Management, Mississippi National River and Recreation Area, Project WET, River Resource Mgmt., Shoreland Mgmt., Wild and Scenic Rivers, Floodplain Mgmt., National Flood Insurance, Environmental Review, and Public Waters Inventory, Lake Hydrology, Stream Hydrology, Surface Water Technical Analysis.

Natural Resources Conservation Services: Implements Wetlands Reserve Program and the Farm and Ranch Lands Protection Program, Water Quality and Environmental Cost-Share Program, Conservation Plans for Highly Erodible Land.

US Army Corps of Engineers: Provides engineering services, including planning, designing, building, operating and maintaining water resources and civil works projects; administers Section 10 of the Rivers and Harbors Act permit program (regulates placement of structures and/or work in or affecting navigable U.S. waters); administers Section 404 permit program of the Clean Water Act (regulating excavation of wetlands and discharge of dredged or fill material into U.S. waters).

Several non-profit environmental organizations are active within the Corridor, including, among others:

Friends of the Mississippi River (FMR): Protects and enhances the Mississippi River and its watershed in the Twin Cities, though land conservation efforts that protect, restore and manage important natural areas; watershed protection efforts that draw attention to the health of local rivers, lakes and wetlands; and river corridor stewardship activities, including coordination of the Vermillion River Stewards program.

Trout Unlimited (TU): a national organization dedicated to conserving, protecting, and restoring North America's coldwater fisheries and their watersheds though a variety of education programs, habitat restoration projects, partnerships, funding, and advocacy.

Trust for Public Land (TPL): a national, nonprofit, land conservation organization that conserves land for people to enjoy as parks, community gardens, historic sites, rural lands, and other natural places, ensuring livable communities for future generations.

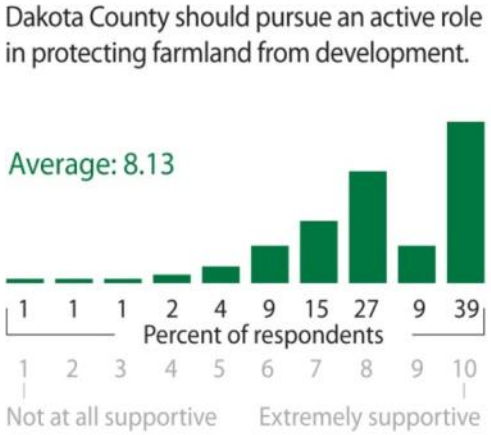
While many agencies and organizations have specific roles in habitat and native species protection and management, recreation, and economic development, the overall coordination of roles among these agencies is neither automatic nor guaranteed to occur. Structures for sharing information exist among a number of the key local and state agencies within the Vermillion River Watershed governance structure and these structures generally work well. What currently is lacking are:

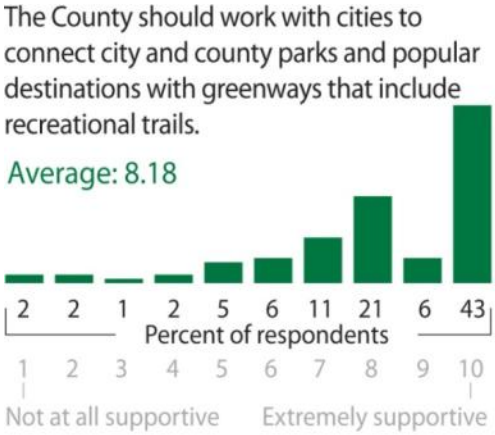
- Full coordination among all water quality related agencies
- An integrated water management approach that incorporates related habitat and recreation benefits
- A dedicated central point of information access for landowners
- Coordinated and strategic public investment
- Enhanced public/private partnerships

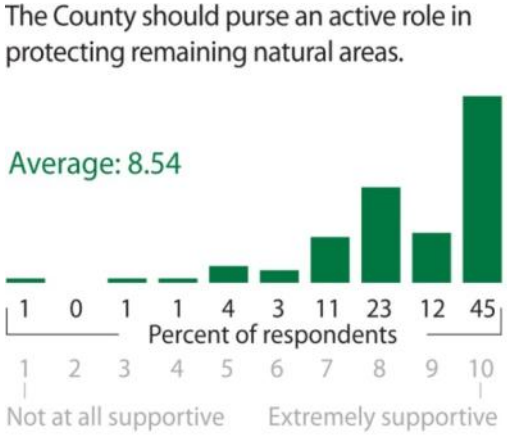
Public interests and Trends

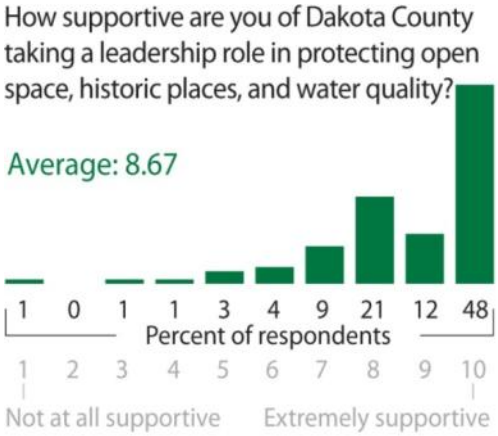
Recent Survey Findings

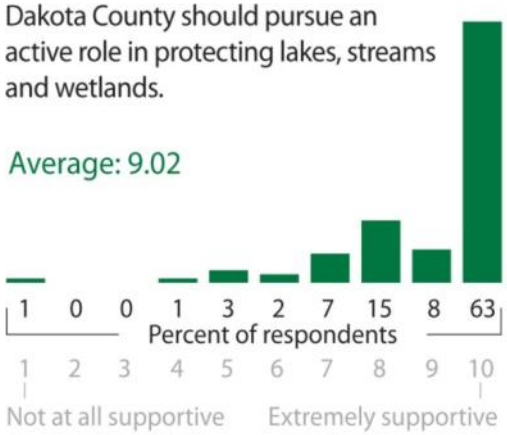
Dakota County residents consistently have expressed support for natural resource protection. The following snapshots from a 2008 scientifically-sampled survey demonstrate resident support for an active County role in the areas related to this plan.

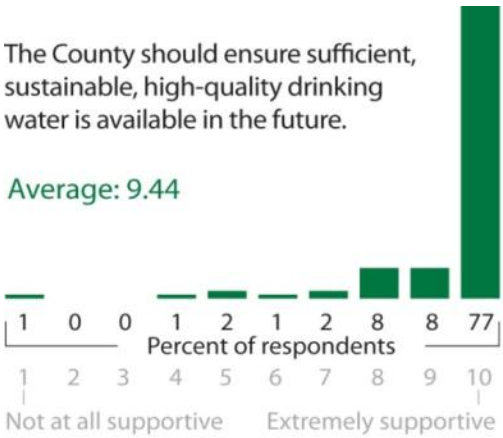












Trends

As a plan drafted in 2010, the Vermillion River Corridor Plan mirrors many of the predominant issues, concerns, and trends of its day. These trends help shape some of the plan outcomes by providing a clearer picture of the complex world in which the plan was written. A study of trends also can help identify potential areas that the plan can tap into to help advance common goals. A few examples follow.

Getting Older, but Staying Active: the age 65-and-older population is expected to grow by 147 percent from 2000-2050. Baby boomers reaching retirement remain more active than previous generations and seek more choices in outdoor and active recreation.

Communities Designed for Active Living: Americans are experiencing an increase in obesity rates and associated health risks often associated with sedentary lifestyles. Community design can help residents incorporate healthy activity into their everyday schedules by providing safe venues for walking to local destinations instead of driving.

Locally Grown Foods: many people are re-thinking the quality and sources of food they eat and serve to their families. Sustainable agriculture promotes foods that are seasonal, genetically diverse, locally grown and distributed, and produced without environmentally harmful chemicals or practices. The Twin Cities is home to organic farms, food cooperatives, farmers markets, and restaurants that take advantage of these trends. The south metro counties and Vermillion Corridor have an opportunity to be premier local food producers for the greater metropolitan region.

Changes in Agriculture: on a nationwide basis, farmers are farming longer than in the past, with many continuing to work into their 70's. Studies have shown that succession planning for transfer of the farm to a next generation of farmers is often delayed. On average, fewer children of farmers go into the family business. As rental of cropland increases, implementation of stewardship practices tends to decline.

Chapter 3: Corridor Principles, Vision, and Goals

The Vermillion River Corridor Plan is based on three components that speak to why the plan was prepared, how planning should occur, and what the plan should deliver:

- **Plan Principles** that summarize collective values in planning for the River
- **Goals** that identify specific desired outcomes for the Corridor Plan
- **Vision** for the River corridor's future, expressed in words and illustrations

Corridor Plan Guiding Principles

The guiding principles summarize important values of the stakeholders who participated in designing an overall approach to protecting the Vermillion Corridor. The principles were reviewed, edited, and refined by focus groups, standing advisory committee members, and participants at seven public workshops.

1. The Vermillion River is a valuable natural resource system and protecting it is everyone's responsibility today and for tomorrow's generations.
2. The Corridor Plan will protect and strengthen ecological stability and water quality.
3. The Corridor planning process will be inclusive of all stakeholders, build a shared vision, provide methods to strategically invest in River protection, and help resolve potential conflicts.
4. The Corridor Plan will draw on previous Vermillion River efforts, incorporate sound science and best practices from other projects, and serve as a model for protecting other river corridors.
5. The Corridor Plan will promote collaboration and communication among landowners, public agencies, businesses, institutions, and others while addressing private property rights and broader public benefits.
6. The Corridor Plan will provide a framework to support a more sustainable network of agricultural, residential, business, public and institutional land uses.
7. Cold-water habitat in the Vermillion River is its most unique and significant natural resource feature and should be a priority in any land use decision-making.
8. The Corridor Plan will improve access to the River in appropriate locations for public enjoyment, education, community involvement, and nature-based recreation (such as hiking, bird-watching, canoeing, kayaking, or fishing).

Corridor Goals and Objectives

The following goals and objectives summarize outcomes sought by the Corridor Plan.

1. **Improve stream water quality and quantity in all corridor settings: agricultural, residential, urban commercial districts, and natural open space**
   - Reduce/eliminate erosion
   - Reduce/eliminate other non-point source contamination
   - Reduce/eliminate point-source contamination
   - Maximize infiltration to contribute to base flows and reduce runoff

2. **Improve stream channel and floodplain structure and function**
   - Improve stream bank stability
   - Re-naturalize stream channels where feasible
   - Address structures that interfere with channel stability and quality
   - Protect floodplains and restore natural flood storage

3. **Improve, stabilize, and connect corridor habitat**
   - Reduce heated storm flow from impervious surfaces, un-vegetated rate control ponds and other contributors
   - Provide stream bank shading
   - Protect natural groundwater inputs (springs, base flows)
   - Protect and restore agricultural wetlands
   - Improve in-stream structure (e.g., pools, riffles, meanders, overhangs)
   - Protect, restore native communities in the corridor
   - Build connectivity through natural corridors

4. **Build and protect a healthy natural framework for the future**
   - Identify and prioritize areas that are critical for water quality/quantity and habitat functions (e.g., floodplain, critical habitat, buffer zones)
   - Identify and protect sensitive cultural resources
   - Permanently protect high priority critical areas through a variety of public and private approaches, and optimize public protection of urban reaches within the corridor

5. **Improve quality of life for corridor residents, businesses, and visitors**
   - Provide healthy recreation opportunities in compatible in-stream and upland areas
   - Improve community walkability and connectivity
   - Provide access to experience natural settings within the corridor
   - Promote sustainable economic development opportunities and sustainable alternatives for existing economic enterprises
   - Protect landscape visual quality

6. **Promote sustainable development patterns within a protected natural framework**
   - Encourage communities to adopt sustainable standards for new development
   - Design community infrastructure to reduce stormwater runoff and maximize on-site infiltration
   - Design communities to cluster urbanization and maximize natural open space
   - Design communities to promote walkability and healthy physical activity

7. **Optimize efficient placement of new infrastructure into the corridor**
   - Consolidate future River/corridor crossings by bridges and utilities
   - Promote on-site energy production

8. **Promote continued research of the watershed and corridor**
   - Continue and update biological inventories
   - Develop additional models for watershed level phenomena, such as sediment loading, nutrient loading
   - Continue to expand understanding of the Vermillion's cold water ecosystems
   - Continue to study relationships between groundwater and surface water in the watershed

9. **Educate and inform the public about the corridor and its goals**

10. **Build partnerships among Corridor interests to implement the plan and maintain projects**
    - Explore coordination options that:
      + Identify and address administrative and service-based gaps
      + Implement the plan over time
      + Streamline provision of information and permitting for the public
      + Improve coordination and efficiency among agencies
      + Monitor progress in plan implementation and benchmark existing plans

11. **Identify and leverage new funding for corridor projects and maintenance**

Vermillion River Corridor Plan Concepts

The vision for the Vermillion River Corridor seeks a balance between broad public good and individual pursuits, between restoring what once existed and improving the current reality, and between cost and benefit. Within this context of balance, the vision seeks a more sustainable and healthier physical environment that is achievable.

Individual concepts have been developed for water quality, habitat, recreation, and economy that taken together help communicate and illustrate the overall vision for the Vermillion River.

Water Quality Improvement Concept

The Vermillion River is believed to be among the best trophy-class trout streams within a major metropolitan area of the United States. This impressive standing is a foundational factor in water quality objectives for the Vermillion River. Without active steps to improve "business-as-usual," it is likely that routine practices will cause a decline in the overall water quality and the ability of the River to sustain a trout fishery.

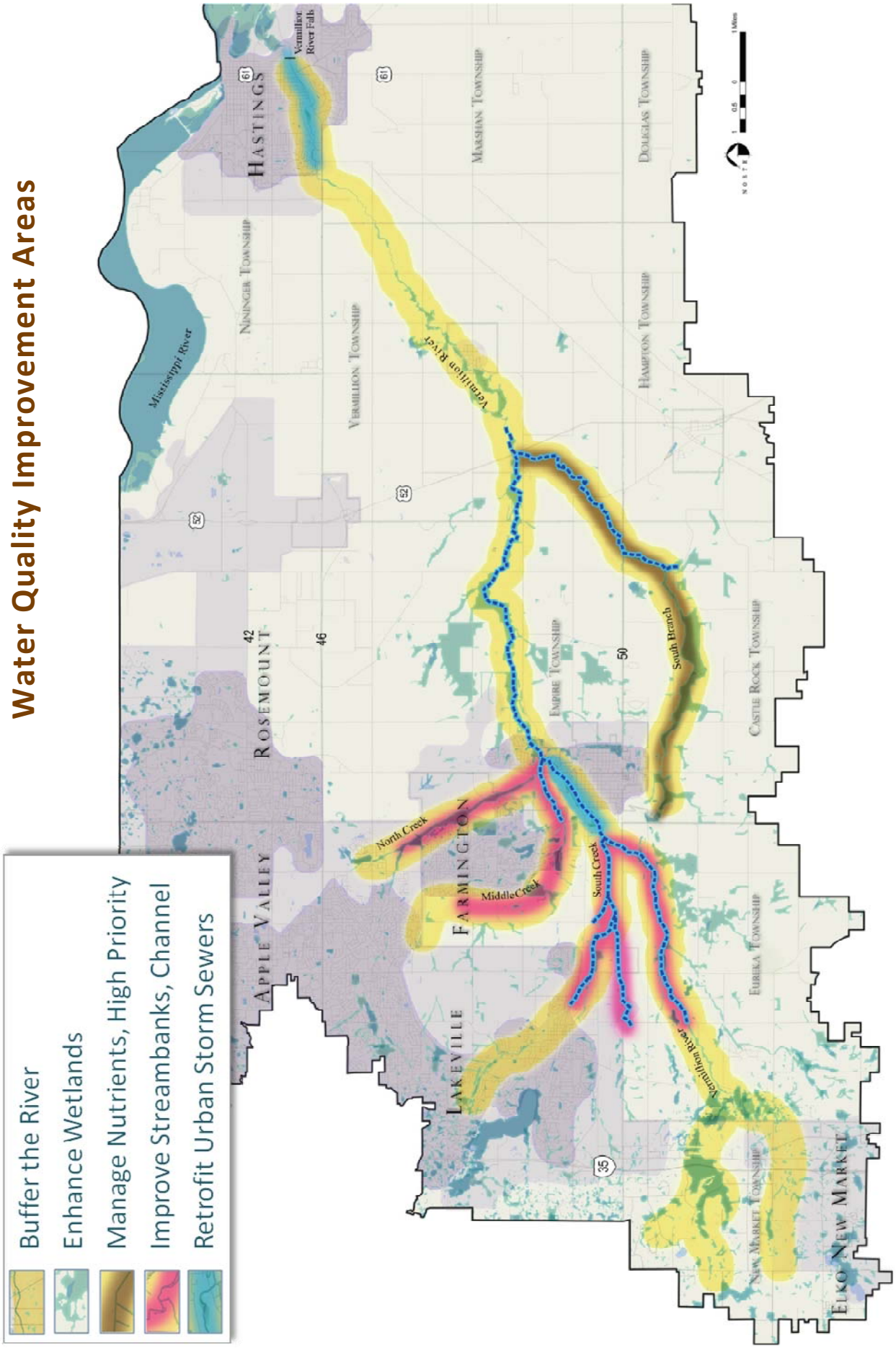
Water Quality Objective: A Stable and Healthy Hydrologic Regime

The water quality objective for the Vermillion River is to create a stable and healthy hydrologic regime – the pattern and quality of rainwater infiltration and stormwater flow reaching the Vermillion River. If the hydrologic regime of the Vermillion watershed can be stabilized and enhanced, even with continued development, better water quality and a resilient cold-water fishery will be major benefits. Healthy trout populations west of Highway 52 is an important indicator of a stable hydrologic regime in the Vermillion River watershed. Critical factors in trout health are water temperature, water clarity, the absence of toxins, the presence of critical native plant and animal communities, and stable river flows.

The *Priority Water Quality* diagram on the next page illustrates resource focus areas for five critical long-term activities that will improve Vermillion River water quality.

Riparian Buffers: A continuous corridor of perennial, native vegetation along the River will significantly reduce runoff sediments and pollutants entering the River. The vision is to establish a continuous riparian buffer of adequate width along full length of the Vermillion River and its tributaries.

Vermillion Corridor Priority Water Quality Improvement Areas



Wetland Management, Restoration or Enhancement: Most of the natural wetlands in the Vermillion River watershed have been drained or degraded. Improved wetlands play a significant role in stabilizing and enhancing the hydrologic regime. Examples include re-creating drained wetlands, removing sediments from existing wetlands, establishing vegetative buffers around wetlands and restoring native vegetation near and within wetlands.

Nutrient Management: Nutrient-laden runoff from excess fertilizer, plant clippings, and animal waste has a devastating effect on River water quality. Aquifer formations in the eastern watershed are fractured and vulnerable to surface water contaminants, including those in the Vermillion River and its tributaries. Nutrient management, especially for nitrates, is a key initiative in parts of the watershed. Strategies like monitoring nutrient levels in soils and adjusting fertilizer rates, introducing and maintaining perennial vegetation, and no-till farming can reduce nutrient loading to the River.

Streambank and Channel Improvement: In most segments of the River, banks have been significantly altered from their natural state. In some areas, long-standing livestock access has flattened the banks and widened the channel, causing water to be shallow and susceptible to warming – too warm to support trout. In other areas, banks have been engineered in ways that don't support native plants and aquatic species. Targeted streambank restoration, including re-grading slopes, re-meandering the stream, stabilizing erosion, and planting native vegetation will improve water quality.

Urban Storm Sewer Retrofits: Many older developed areas still pipe untreated stormwater directly into the Vermillion River. In some cases, current treatment methods address only some of the critical aspects of stormwater treatment, which include volume control, sediments, pollution and water temperature. Effective stormwater treatment methods to infiltrate rainwater where it falls and cleanse and chill runoff before it can reach the Vermillion River will be critical to River water quality.

The following table lists specific management practices illustrated in the water quality concept diagram that can address the water quality needs identified for specific reaches of the Vermillion River.

Water Quality Management Practices and Benefits						
	Water Clarity	**Flow Stability**	**Essential Aquatic Plants and Animals**	**Absence of Toxins**	**Water Temp.**	**Essential Bacteria**
Riparian Buffers	X	X	X	X	X	X
Wetland Improvements	X	X	X	X	X	X
Nitrate Management	X		X	X		X
Bank, Channel Improvements	X	X	X		X	X
Urban Storm Sewer Retrofits	X	X	X	X	X	

Natural Area Stewardship and Protection Concept

The Vermillion River is a unifying feature in the broader landscape. Prior to western settlement, its watershed functioned naturally and maintained equilibrium through natural forces. Plant and animal communities evolved to create an ecological balance that sustained and buffered the Vermillion River. It is well outside of anyone's abilities and outside of anyone's intentions to fully restore the Vermillion Corridor to pristine pre-settlement conditions. However, it is still feasible to create more sustainable and balanced conditions within the Corridor.

Stewardship and Protection Objective: A Healthy Ecological Balance

The natural resource objective for the Vermillion River landscape is to strike a new and healthier ecological balance that is different from pre-settlement conditions, but still creates a healthy context within which the Vermillion River can be sustained. This vision suggests the combination of improved land management and strategic habitat protection and restoration can create protective and resilient natural landscapes that sustain and buffer the Vermillion River.

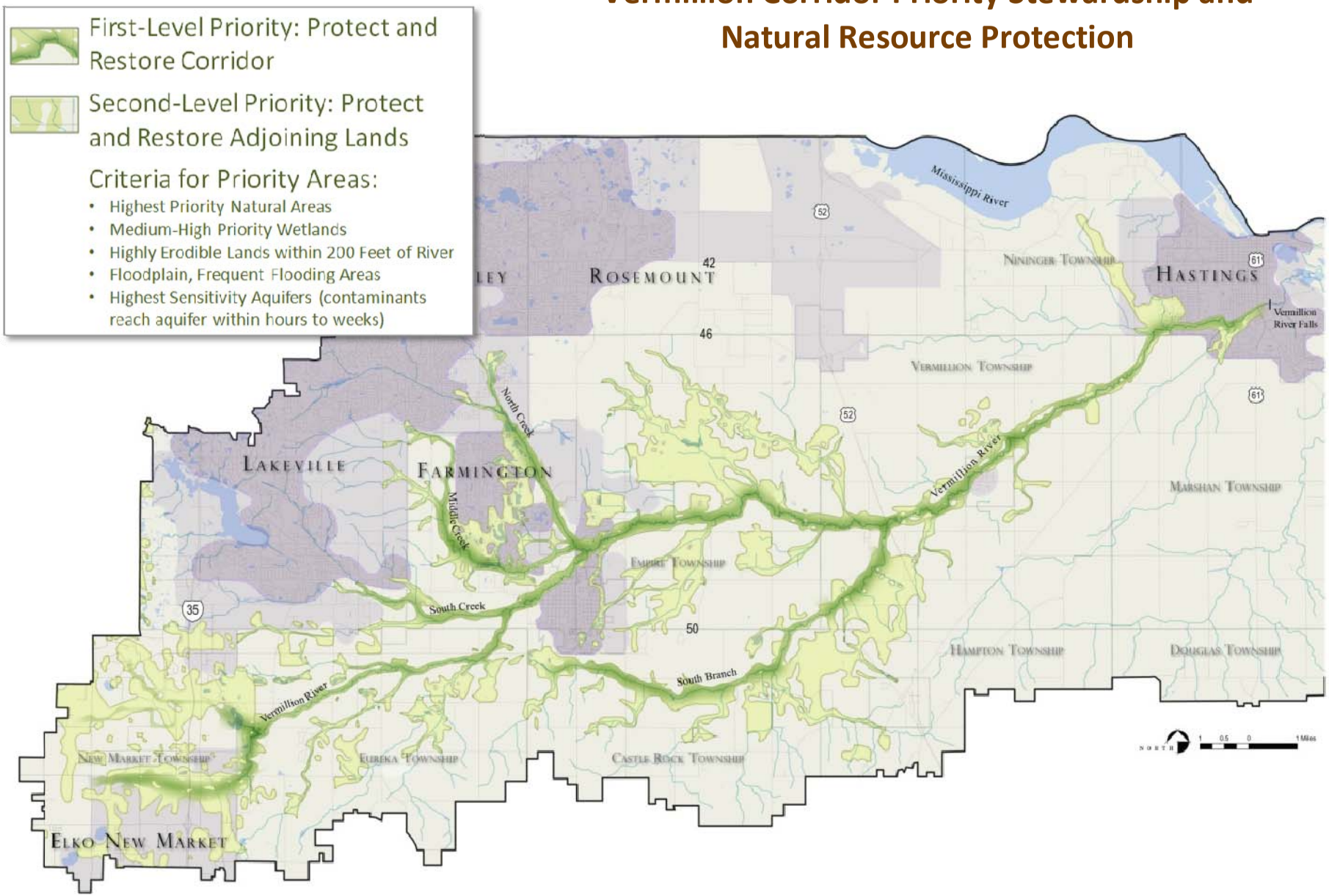
The Priority Stewardship and Natural Resource Protection diagram on the following page highlights the most sensitive landscapes that affect and are affected by the Vermillion River and its tributaries. The diagram identifies two levels of priority.

The Corridor: The first order of priority is restoring habitat of the River corridor itself with continuous native habitat on both sides of the River. This continuous ribbon of varying widths will function as a wildlife corridor and buffer the River from damaging effects like runoff, pollution and invasive species.

Adjoining Sensitive Lands: The next priority is habitat restoration and protection of the most sensitive lands, including uplands that link the River to the broader landscape. These landscapes perform vital functions of preserving habitat, species diversity, and stormwater infiltration and cleansing. Prioritization of these landscapes will be based on several factors including erodibility, aquifer recharge, wetlands, native plant communities, wildlife species of special concern, size, and quality, in addition to landowner interest. Designated wildlife and aquatic management areas and parks are also shown since they provide important refuge for wildlife and native plants, and can support larger-scale restoration projects.

A Healthy Natural Framework: Stewardship of first and second-order landscapes will reestablish a stronger habitat network within which the Vermillion River can exist and thrive in the future. This overall habitat and open space network will have greater resilience and will provide a strong framework for future growth.

Vermillion Corridor Priority Stewardship and Natural Resource Protection



Recreation Concept

While the first two layers of the Vermillion River vision – water quality and natural resources – represent improvement to the ecological baseline, the next two – recreation and economy – represent positive ways for us to interact with a more resilient River.

Like nearly all river corridors, interest is growing in the Vermillion River as a recreation venue for fishing, canoeing, birding, picnicking, walking, and cycling. River corridors with water access and a healthy natural resource base are strong candidates for investing in public recreation opportunities. As attraction to the River as a recreation amenity increases, the potential for conflicts among private property and recreation interests may increase. Establishing a framework for balanced interests and mutual respect is the key to balancing these varied interests.

Recreation Objective: Connected, Compatible, Supportive Recreation

The recreation objective for the Vermillion River is to facilitate a network of supportive recreation opportunities that enhances actively lifestyles, can co-exist with healthy river ecology and respects private property interests. Although recreation is an integral aspect of the River's future, not all types of recreation are appropriate for the Vermillion River nor are they appropriate in all stretches of the River.

The following Outdoor Recreation diagram identifies several categories of recreation and the stretches of the River or adjacent landscape where they are intended.

Existing and Future Parks: Local communities within the Vermillion watershed have identified existing or planned parks through their individual comprehensive plans. Local visions for recreation have been integrated into the Outdoor Recreation diagram to understand and build strategic connections for enhanced opportunities to experience the Vermillion River corridor.

Wildlife-Oriented Recreation: Several DNR Wildlife or Aquatic Management Areas are critical components of the Vermillion River corridor vision. These public lands are designated as permanently undeveloped hunting, fishing and wildlife viewing areas. They will be managed for native habitat and wildlife.

Trout Fishing: The portion of the Vermillion River designated by the DNR as a trout stream will be managed for trout fishing as its primary recreational use. This implies that fish habitat values (such as leaving downed trees in the stream) will supersede other recreational interests (such as removing trees for canoe navigation). It also implies that designated public access to the River will be designed to emphasize fishing and supportive uses such as birding and picnicking, opposed to other recreational uses such as canoe or tubing access.

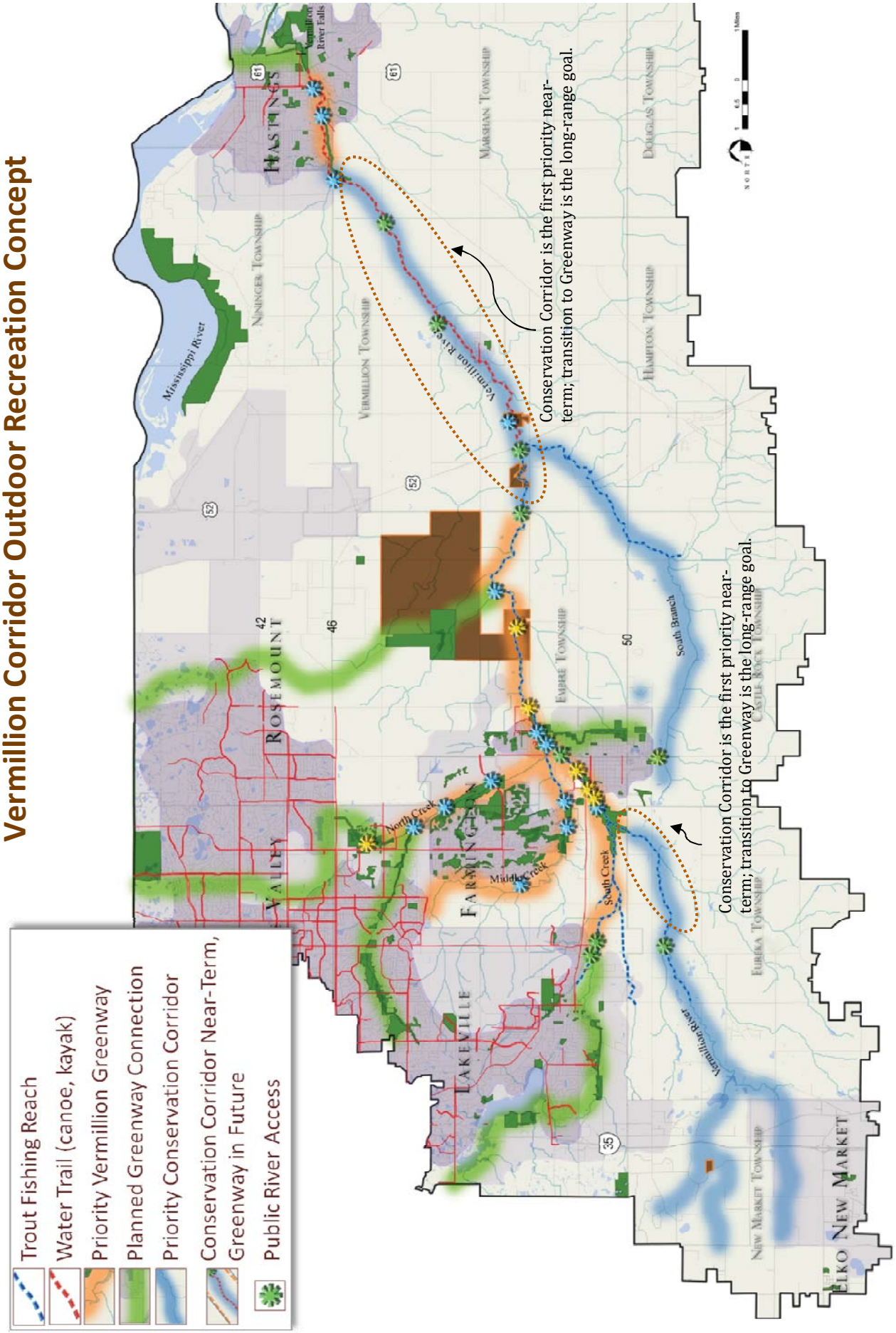
Vermillion River Water Trail: The Vermillion River from near Highway 52 to above the falls in Hastings will be managed as a water trail for canoeing and kayaking. Unlike the designated trout stream, this reach will be minimally-maintained for navigation. To the extent necessary to allow canoe passage, downed trees would be removed from the River channel. Access to the River via public lands will be designed to accommodate canoe and kayak landing, fishing access, as well as associated uses such as birding and picnicking.

Vermillion River Greenways and Key Greenway Connections: The Outdoor Recreation diagram depicts urban reaches of the Vermillion River and connecting corridors beyond the River as "greenways" or multi-functional trail, water quality, and habitat corridors. Greenways promote water and habitat quality, compatible recreation, and non-motorized transportation, and are planned throughout the developed and developing portions of Dakota County. The diagram illustrates planned greenways along the Vermillion River and its tributaries and key connections to the River. As development expands beyond currently-planned boundaries, it is anticipated that conservation corridors (described in the next paragraph) will be re-designated as greenways.

Vermillion River Conservation Corridors: Conservation corridors are public and private lands within rural areas along the Vermillion River and its tributaries that focus primarily on land and water protection and habitat stewardship. For the immediate near-term, conservation corridors are not intended to include recreational trails. Conservation corridors are designated throughout rural portions of Dakota and Scott counties although only those along the Vermillion River and its tributaries are shown in the diagram. For Dakota County, as land adjoining conservation corridors develops, the County will work with townships to transition conservation corridors to greenways with recreational trails. In Scott County, most of the land in New Market Township is planned for rural density residential as an end land use.

Vermillion River Access Sites: Several types of River access have been identified on the diagram. Only opportunities for River access on current public lands are shown. River accesses would be designed differently depending on specific situations, but each would provide parking, access to the River for fishing and/or canoeing/kayaking, and possibly facilities for picnicking or other nature-based recreation.

Vermillion Corridor Outdoor Recreation Concept



Recreation Features

Map Background:

- Rural Areas
- Urban Areas
- Developing Areas (2030 Comp Plans)
- Existing City Sidewalks and Paths

Near-Term Recreation Features:

- Existing and Future Parks (2030 Comp Plans)
- Wildlife Oriented Recreation (hunting, fishing, viewing)
- Trout Fishing
- Water Trail - Canoeing and Kayaking
- Vermillion River Greenways - Near Term: Greenways (public habitat/trail corridors) along the Vermillion River and its tributaries that exist or are designated in local comprehensive plans.
- Planned and Existing Greenway Connections: Key regional greenways (public habitat/trail corridors) extending from the Vermillion River and its tributaries that exist or are designated in local comprehensive plans.
- Vermillion River Conservation Corridors - Near Term: Public and private lands along the Vermillion River and its tributaries earmarked for enhanced stewardship.

SELECTED CONSERVATION CORRIDORS:

Conservation Corridor is the first priority near-term; transition to Greenway is the long-range goal.

River Access

- Public Right of Way or Utility (roadsides, public works)
- Public Land (park, aquatic, or wildlife management area)
- Potential/Future Access on Parks and Public Lands

A Vibrant Economy

While the Vermillion River landscape has few economic activities built around the presence of the River today, with time and investment, those who see an economic, market and lifestyle niche could be drawn to the Vermillion River landscape. The Vermillion River may be an unrealized natural amenity that, with investments in water quality, habitat and recreation, could become the foundation for an emerging, sustainability-focused micro-economy.

Provide a strong natural framework: the first economic objective for the Vermillion River is to first strengthen its quality as a natural and recreational amenity that can support a diverse range of private economic investments and pursuits that sustain value over time.

Grow a river-centric sustainable micro-economy: the fact that the Vermillion River landscape is largely rural, within a metro-area and possesses a compelling riverine ecosystem could offer a market advantage in areas like sustainable agriculture and industry, farm-to-market foods, recreation services and potentially farm-stay tourism. Demand currently exists for all of these economic pursuits. This economic vision ultimately relies on creating a corridor with high water quality, habitat, and open space within a restored corridor ecosystem.

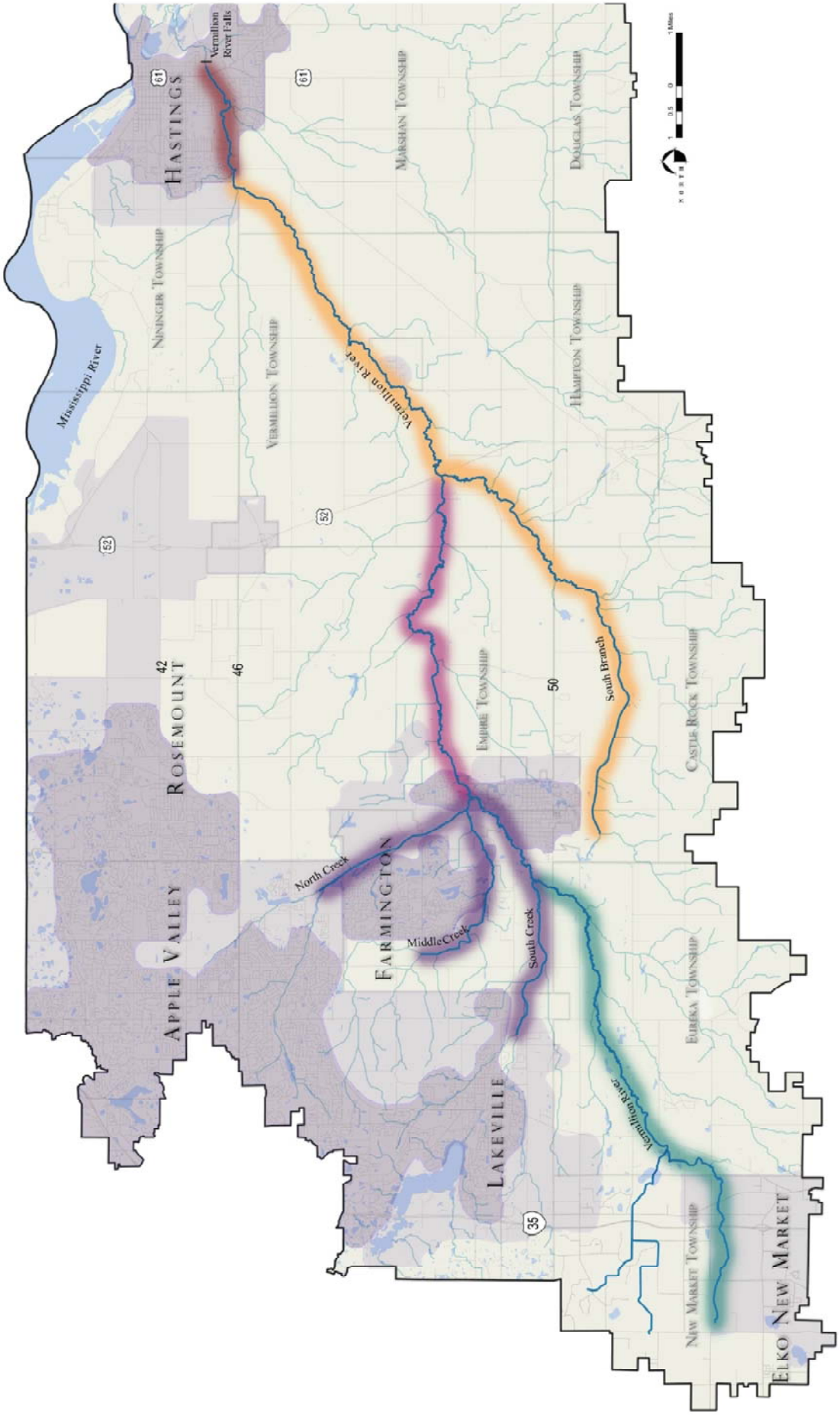
The vision of a **high quality and resilient Vermillion River Corridor** is built upon water quality, natural resource protection, recreation and economy, and this vision is greater than the sum of its parts.

Stable hydrologic regime +
Healthy ecological balance +
Supportive recreation +
River-centric sustainable economic growth =
High quality, resilient Vermillion River Corridor

Priorities for Distinct Geographic Areas of the Corridor

This layered vision includes priorities that apply differently to different reaches of the Vermillion River corridor. The following map illustrates the application of key priorities to the five distinct geographic areas of the River, from west to east: **Headwaters** (Eureka and New Market townships, rural residential and agriculture), **Lakeville and Farmington** (urban), **Empire Township** (rural, with large public open space areas), **Castle Rock, Vermillion, and Marshan townships** (rural agriculture), and **Hastings** (urban).

Vermillion Corridor Priorities by Geographic Planning Area



Summary of Corridor Priorities by Geographic Planning Area

Along the Vermillion Corridor, priorities vary with land use; local interests and needs; and conditions related to river characteristics, water quality, habitat, and public recreational use. The following table summarizes priorities by geographic planning area:

Vermillion Corridor Geographic Planning Area Priorities (through the combined efforts of local, regional, state agencies and private landowners)		**Headwaters**	**Lakeville-Farmington**	**Empire**	**Castle Rock, Vermillion , Marshan**	**Hastings**
General Strategy	In cities and next to Vermillion Highlands near-term, seek public ownership of corridor land via land dedication and purchase from willing sellers.		X	X		X
	In rural areas, enhance protection of corridor via cooperative landowner easements and best practices near-term.	X		X	X	
	Partner with landowners on water quality and habitat improvements	X	X	X	X	X
	Work with government entities to: • Lessen negative impacts and expand river-related benefits of infrastructure • Utilize public land for better River access • Improve natural resource management on corridor public lands	X	X	X	X	X
Water Quality	Expand, enhance River wetland buffers using native plant communities	X	X	X	X	X
	Restore wetlands, stream banks, and channel to more natural states	X	X	X	X	X
	Increase stormwater infiltration	X	X	X	X	X
	Minimize negative impacts of drain tile outlets and ditches	X		X	X	
	Retrofit urban stormwater infrastructure to enhance River quality		X			X
	Plan and create larger scale streambank and channel improvements		X	X		X
	Seek greater reduction in nitrate levels				X	
Habitat	Protect and restore wetlands	X	X	X	X	X
	Enhance thermal protection of designated trout stream	X	X	X	X	
	Strengthen native plant communities in corridor	X	X	X	X	X
	Combine opportunities for corridor habitat improvement with economic benefits	X	X	X	X	X
	Protect, connect, and manage upland natural areas	X	X	X	X	X
	Plan and conduct large-scale habitat and wetland protection, restoration, enhancements on public lands			X		
Public Recreation	Provide River access points on public lands and roadway rights of way	X	X	X	X	X
	Develop regional greenways with trails in urban and developing areas, near-term		X	X		X
	Connect local trails to corridor regional greenways		X	X		X
	Manage adjacent public lands to enhance the corridor		X	X		X

Chapter 4: Putting the Plan into Action

In contrast to implementing a capital improvement plan or road improvement in a planned sequence, the Vermillion River Corridor Plan vision will rely on strategic and opportunistic approaches. Strategic approaches will focus on identified and demonstrated water quality and habitat needs and will be implemented through targeted outreach and project development efforts with the public and private sector. Opportunistic approaches will work with willing private landowners and public partners on a project solicitation and evaluation basis. Coordinated public agency projects and management efforts will continue over the long-term.

Implementation Principles

The following key principles speak to how new and ongoing efforts will implement the Corridor Plan vision over time:

- **Development of an Effective Coordination Framework:** Chapter 5 identifies key coordination roles
- **Collaboration** among public agencies, private landowners, and non-profit organizations to 1) integrate efforts related to water quality, habitat protection, recreation, and building a resilient development framework; and 2) implement and sustain corridor projects
- **Public Education** to increase awareness and understanding about the River, project and assistance opportunities, and existing regulations
- **Leveraging Investment Resources** from existing and new sources, public and private
- **Identification, Prioritization, and Development of Projects** by building opportunities for corridor enhancement into existing efforts, defining project funding criteria, and allocating resources for project development
- **Ongoing Maintenance and Monitoring** of projects over time to protect initial project investments and gain insight on potential improvements in methods
- **Effective Enforcement of Regulations:** Regulations are intended to preserve key public values, and therefore must be well-crafted, understandable by the public and those that enforce them, and enforced in a consistent and equitable manner.
- **Development Review:** Review development proposals and identify opportunities to achieve goals through incentives and other approaches.

Potential Project Approaches

Potential implementation approaches are outlined below for private landowners and the public sector to develop Corridor enhancement projects and adopt best practices:

Individual Projects and Best Practice Implementation

Individual land management decisions, taken in the cumulative across many properties, can significantly improve the River corridor. Private landowner efforts to protect water quality and habitat are vital to the vision of a healthier Vermillion River Corridor. Landowners in the Corridor are encouraged to undertake stewardship projects (such as buffer strip installation or streambank stabilization) and adopt best management practices (such as reduced tillage or soil nutrient management practices). This can best be accomplished through incentives, such as cost-sharing and technical assistance from public agencies and nonprofits.

Small Area Projects with Multiple Landowners

Similar to individual projects, a small-area approach could strategically engage groups of landowners to work together with a coordinating entity to improve a stretch of the River and address high priority issues. This approach would work well on:

Streambank Stabilization Project

1. High priority issues that are common throughout an extended reach with known water quality problems related to inadequate buffering, unstable or eroding banks, or lack of stream shading.

2. Problems that would involve several properties to achieve a stable and sustainable solution, such as a channel restorations to improve low dissolved oxygen levels.

Demonstration Projects

Seeing how a best practice or enhancement project looks and understanding how it works can be very helpful for landowners and agencies considering similar practices or projects. Landowners and agencies that are willing to share information with others can effectively communicate the benefits, costs, and lessons learned from a specific project or practice. Projects can range from individual landowner improvements to urban development or redevelopment projects, major restorations, and infrastructure improvements that incorporate corridor enhancement elements. Partner organizations can also assist with information sharing and evaluation of the effectiveness of a practice or project over the long-term.

Integrated Development and Re-Development Solutions

Developers have a unique position among private landowners, as their work can permanently affect adjacent and on-site natural resources at a large scale. Incorporating development design techniques that address sensitive natural resources and systems, on-site and off-site, can be incorporated to a greater degree in project planning. Addressing these considerations in the development process often yields higher quality development that sustains value over time, by creating places that the public recognizes as quality place to live or work, and reducing mitigation costs related to countering rather than working with natural systems.

Examples include Conservation Design, which maximizes open space in a development project, and Low-Impact Development (LID), which integrates stormwater infiltration in design and relies less on engineered solutions to move stormwater off the project. Developer collaboration with local municipal zoning authorities is essential to the success of environmentally sensitive designs. Cities are encouraged to incorporate environmentally-sensitive design standards into city planning and zoning ordinances. Scott County now provides incentives for Planned Unit Development (PUD) in its unincorporated areas to encourage conservation design and LID, as an example of how this can be accomplished.

Public Sector Corridor Preservation Approaches

Several cities in the Corridor have actively protected portions of the riverway and its major tributaries as an amenity and framework for high-quality development. The Corridor vision calls for continuing public efforts to protect urban reaches for public benefit and access, using a variety of tools, such as park dedication, development guidelines, ordinances, fee acquisition, conservation easements, Transfer of Development Rights, deed restrictions, covenants, developer agreements, and potentially, Official Mapping.

As rural parts of the Corridor urbanize, this Plan seeks timely protection of the riverway, i.e., transition from private conservation corridor to public greenway before subdivision to large lot rural residential parcels occurs or land prices rise. Rural subdivision ordinances with specific provisions for protecting river corridors and other tools such as park dedication can help townships address subdivision of riverfront properties.

Joint Planning Initiatives

Collaborative planning is a cornerstone approach to implementing the Corridor Plan. Consideration of Corridor enhancement opportunities for multiple benefits should be a consistent element of project planning and review. Dakota County and partnering cities prepared the ***Greenway Guidebook*** to develop an approach and joint roles for cities and the County in collaborative planning, design, construction, funding, and operations of regional greenways. The guidebook is based on principles that could apply to other joint planning projects.

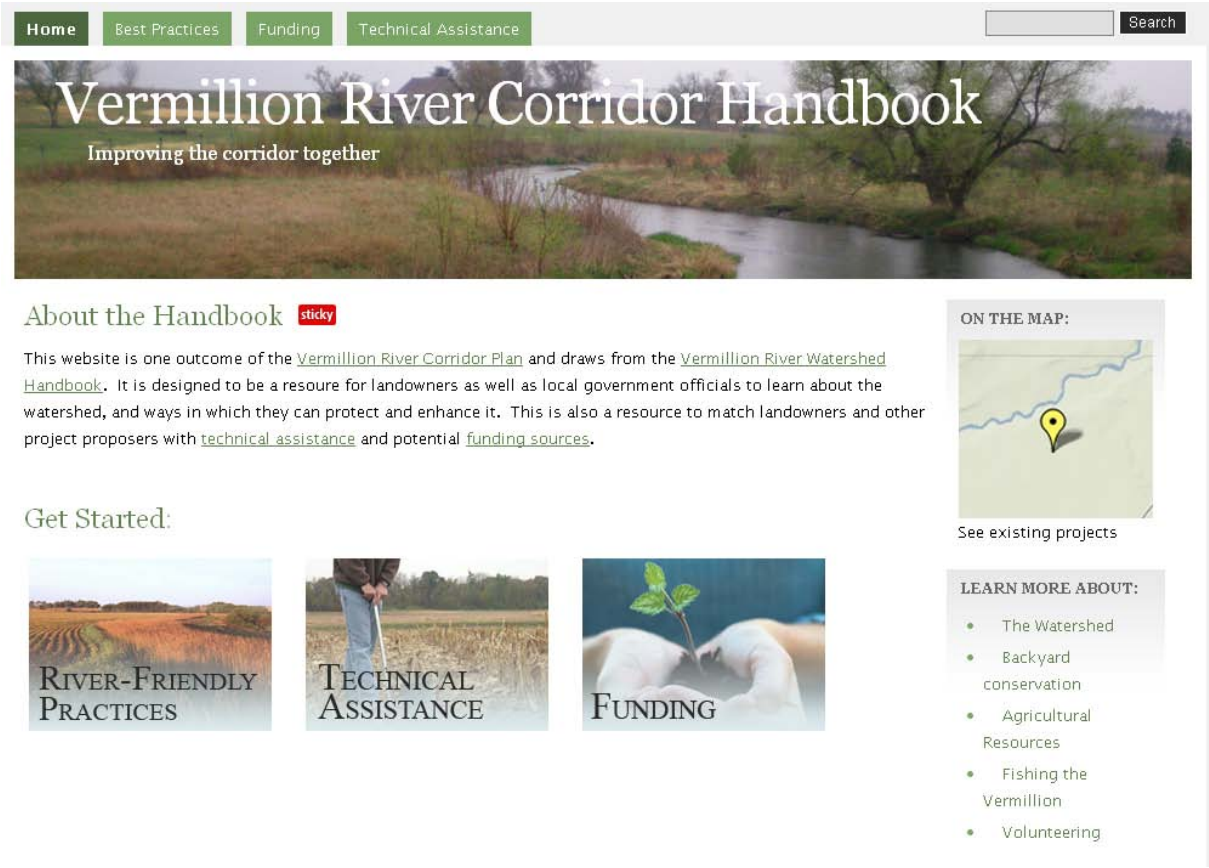
Major Restoration Projects:
Restoration projects can include re-meandering straightened reaches, installing trout-friendly habitat, and restoration of native or natural landscapes. Some efforts are landscape-level projects that require sufficient shoreland and are may be easiest to accomplish on publicly-owned lands. Other effective restoration practices can be accomplished within a small area. All practices require appropriate technical skills.

Implementation Resources

Online Resource for Best Management Practices

This Plan seeks greater adoption of "best practices" that improve water quality and wildlife habitat, and provide appropriate recreation in the Corridor. Practices are intended to be implemented by willing landowners and local governments, in priority locations that will improve the Corridor in multiple ways.

An online resource was developed to provide a searchable database of practices with descriptions, information, and cost-sharing and technical assistance resources. Landowners can also upload imagery and information about their own project and practice implementation to the website, as demonstrations for others to view. This resource is online at: http://www.improvethevermillionriver.org.



The practices were adapted from the Vermillion River Watershed Handbook developed by Dakota County SWCD and the MN DNR. Practices were also identified during the planning process, through review of corridor plans nationwide and review of state and local practices. Practices were refined through the Corridor Plan public workshops. Participants were asked to review practices for applicability to their property, suggest new practices or provide input on how practices could be improved.

Best practices were identified for urban, suburban and rural/agricultural settings and further classified by identified benefits (habitat, water quality and recreation). Practices can be searched by user type, land use, and benefit category. Practices can fall under more than one category (e.g., rural and suburban).

User		Setting		Benefit Category
Land Owner/Occupier	X	Rural/Agricultural	X	Water Quality
Local Government		Developing/Suburban		Habitat
Regulatory Agency		Urban		Recreation

Workshop participants expressed strong interest in additional funding and technical assistance to implement best practices on their property. The website has added contact information and links to organizations that can supply technical assistance. For each best practice, relevant funding sources are identified with information about eligibility and the application process. Funding sources were identified from Dakota County, the watershed district and state and federal programs.

Pilot Projects

Many beneficial projects, large and small, have occurred over the years along the Vermillion River and its tributaries. In many cases, projects have been small and single-purpose with limited value to the overall corridor. More recently, large-scale, collaborative projects have provided multiple benefits. A specific goal of this planning process was to identify and implement on-the-ground projects that:

- Demonstrate more effective integration of water quality, wildlife habitat, and recreation benefits into single projects; and
- Demonstrate more effective project implementation mechanisms, including budgeting and funding, among traditional and non-traditional partnerships.

With over $500,000 of pilot project funding available and several high quality pilot projects identified prior to plan development, it could have been advantageous to spend the funds early in the project to ensure that project deadlines were met. Long-term success of new project implementation methods will depend on partnerships that function well after the corridor plan is developed. As a result, the project team was committed to completing the plan before selecting projects to ensure that these projects would truly illustrate the

outcomes of the plan. During the planning process, project suggestions were solicited from participants. All Corridor landowners will be re-contacted to evaluate their project interest.

The goal of the pilot projects will be to strategically *protect 125 acres of high quality resource land within the Corridor* through fee title or easement and *restore 40 acres of protected resource land to a more sustainable and resilient condition*.

Partners for Collaboration

Many agencies and organizations have been actively involved with efforts to improve the Vermillion River, its watershed, and the corridor, and will continue to work to protect the River in the future. Future collaboration partners could include:

- Vermillion River Watershed Joint Powers Organization
- Scott County Natural Resources Department and Parks Department
- Dakota County Farmland and Natural Areas Program, Parks and Open Space Department, and Water Resources Department
- Dakota County SWCD and Scott County SWCD
- Local Corridor Communities: cities and townships
- MN DNR
- Non-Profit Environmental Organizations: Friends of the Mississippi River, Great River Greening, Audubon Society, Sierra Club
- Civic organizations: Chambers of Commerce, Rotary Clubs
- Scouts and other youth organizations
- Faith-based groups
- Sportsmen: Trout Unlimited, Pheasants Forever, and Dakota Habitat Alliance
- Volunteer Organizations: Vermillion River Stewards
- Academic Institutions: University of Minnesota, Dakota County Technical College, School of Environmental Studies (Apple Valley), and local high schools

Vermillion River Bend

Prioritizing Corridor Projects

The goals of the Vermillion River Corridor Plan are to protect and improve water quality and wildlife habitat, integrate recreational opportunities, and promote economic health within the Vermillion River watershed. To help ensure that projects selected are aligned with these goals, they will be evaluated using the following criteria.

Category	Criteria (Note: Point values to be set for each criterion)
Potential to Protect and Improve Water Quality	Reduces sediments, nutrients, chemicals, and bacteria related to documented impairments and corridor location
	Improves stream channel stability and functions consistent with current geomorphic assessments
	Improves wetland and/or floodplain functions
	Reduces water temperature in designated trout stream and upstream
	Mitigates drain tile impacts
	Achieves buffer objectives
Potential to Protect and Improve Wildlife Habitat	Natural area significance: Regional, County, Corridor, Local
	Length of shoreline and acreage amount (urban and rural)
	Proximity to protected lands
	Landowner's current/previous commitment to stewardship
	Improves in-stream habitat quality
	Improves shoreline and riparian habitat quality
	Improves upland habitat quality
Enhances Natural Resource-based Recreation	Improves upon previous public recreational investments
	Improves public River access
	Improves fishing opportunities
	Improves canoeing/kayaking opportunities
	Provides new trail opportunities
	Improves interpretative/educational opportunities
Financial	Leverages other resources or cost share
	Total project cost
	Landowner commitment to future stewardship
	Part of a more sustainable economic/residential/agricultural development project
	Potential to reduce long-term public costs
	Level of private partnerships in addition to landowner involvement
Other	Level of documented public support
	Level of threat/urgency
	Project readiness and/or difficulty
	Applicability as a model for other projects/areas
	Aesthetic/scenic qualities as viewed by the public

Vignettes for Urban, Developing, and Rural Settings

To illustrate how the Vermillion River landscape could transform over time through the implementation of best practice techniques, a series of before and after vignette sketches were created. The vignettes illustrate hypothetical landscapes in three typical settings found in the Vermillion River landscape – urban, developing and rural. Each depicts the application of various best practices ranging from tried-and-true to innovative.

Perhaps the most important message that the vignettes communicate is the potential to achieve multiple benefits. To varying degrees, each design technique carries multiple benefits for water quality, habitat, recreation and economy. The vignettes illustrate how a critical mass of techniques appropriately applied will not only address core values, but also have the power to aesthetically transform the landscape in positive ways.

Each "after" vignette illustrates a set of best practice techniques. Not all techniques are appropriate in all situations, so it is important to cluster techniques to have the greatest impact on the Corridor Plan targeted benefits: water quality, habitat, compatible recreation, and a resilient natural framework for growth and economic development.

Rural Environment

The design approach to the rural environment is focused on minimizing the impact of agricultural operations to significantly enhance water quality and habitat value. It also demonstrates diversification of the farm operation through alternative crops and agro-tourism.

Urban Environment

Because it is already developed, the design approach to the urban environment must be a targeted one. Design techniques focus on property and infrastructure-based rehabilitation to address issues of stormwater quality, heat-island reduction, and micro-habitat.

Developing Environment

The design approach to the developing environment suggests how greenways can be protected and woven into the development pattern. This could be done through a combination of protection at the time of new development and strategic alterations in existing neighborhoods. The keys are habitat connectivity along stream corridors and upland stormwater infiltration/treatment.

This page intentionally left blank.

RURAL ENVIRONMENT

DESIGN APPROACH

These hypothetical illustrations depict how multiple design techniques can be applied to a landscape to achieve a full range of community values.

TODAY

FUTURE

TECHNIQUES

These images from other places depict how the highlighted techniques may look in the landscape.

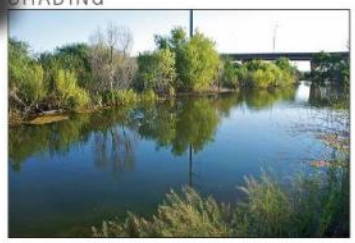
A ENHANCED STREAM BUFFER
width and plant type

B SENSITIVE LANDSCAPE PRACTICES
native landscaping, smaller lawns, minimal chemicals

C ALTERNATE CROPS
permanent cover - no tilling

D EROSION CONTROL
vegetated buffers, grass swales

E STREAMBANK STABILIZATION/ SHADING



F CONSERVATION CORRIDOR
habitat, tourism, recreation, could include trail

G WATER DIVERSION
overland flow vs. tiling

H HABITAT RESTORATION
prairie, wetlands, woods

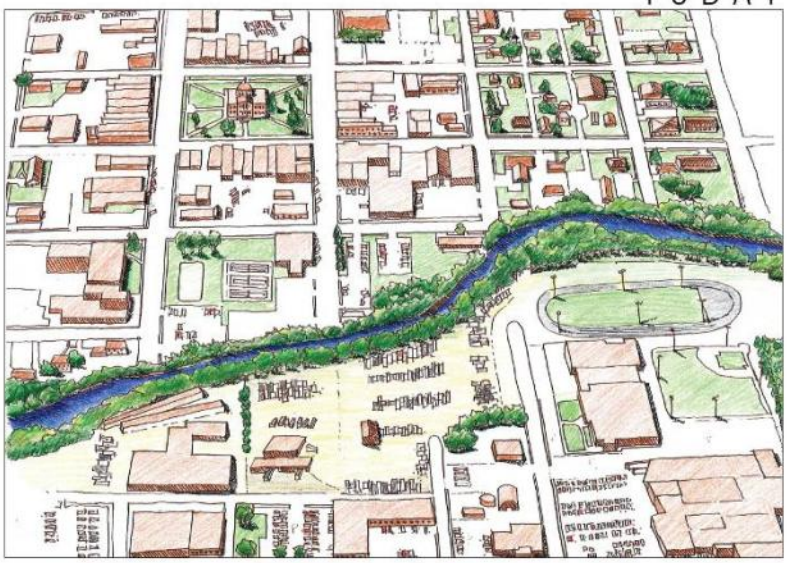
I LIVESTOCK MANAGEMENT
manure management, separate from streams/wetlands

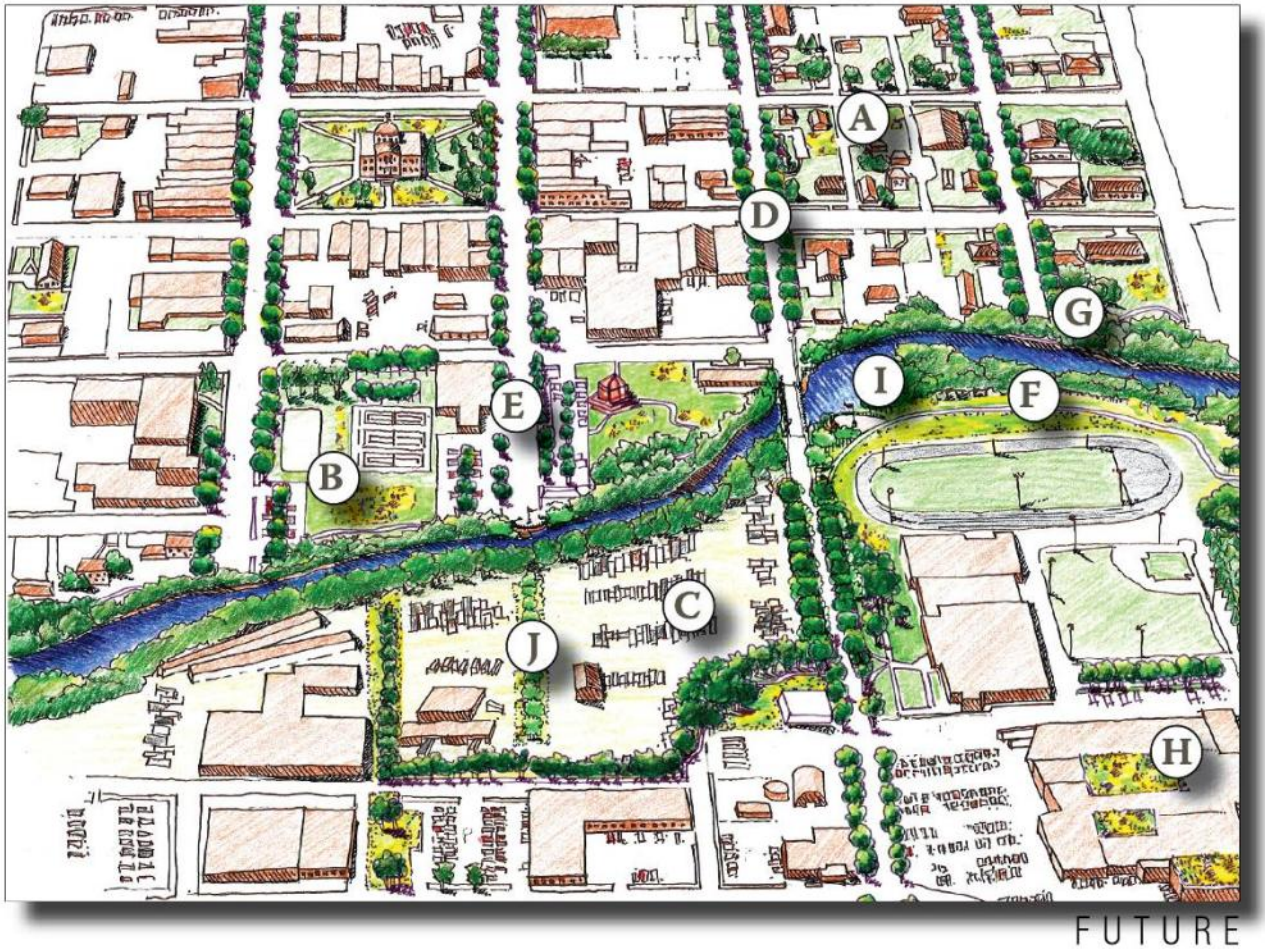
URBAN ENVIRONMENT

DESIGN APPROACH

These hypothetical illustrations depict how multiple design techniques can be applied to a landscape to achieve a full range of community values.

TODAY





FUTURE

TECHNIQUES

These images from other places depict how the highlighted techniques may look in the landscape.

A SENSITIVE LANDSCAPE PRACTICES
native landscaping, smaller lawns, minimal chemicals

B RAINWATER REUSE
cistern-fed or passive irrigation systems

C PERVIOUS PAVEMENTS

D BOULEVARD LANDSCAPING & TREES

E STORMWATER MANAGEMENT
within streetscape

F GREENWAY/TRAIL CORRIDOR
alternative transportation, recreation

G HABITAT RESTORATION
prairie, wetlands, woods

H GREEN ROOFS

I STREAM ACCESS

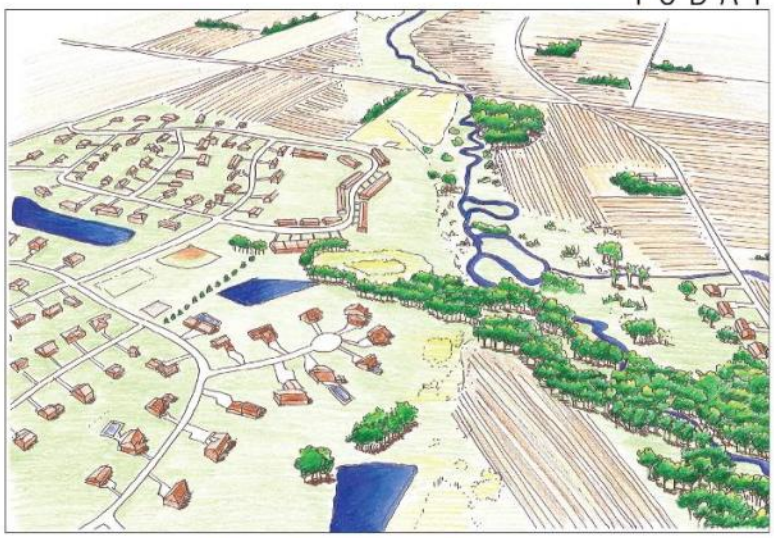
J RAINWATER GARDENS/
BIO-SWALES

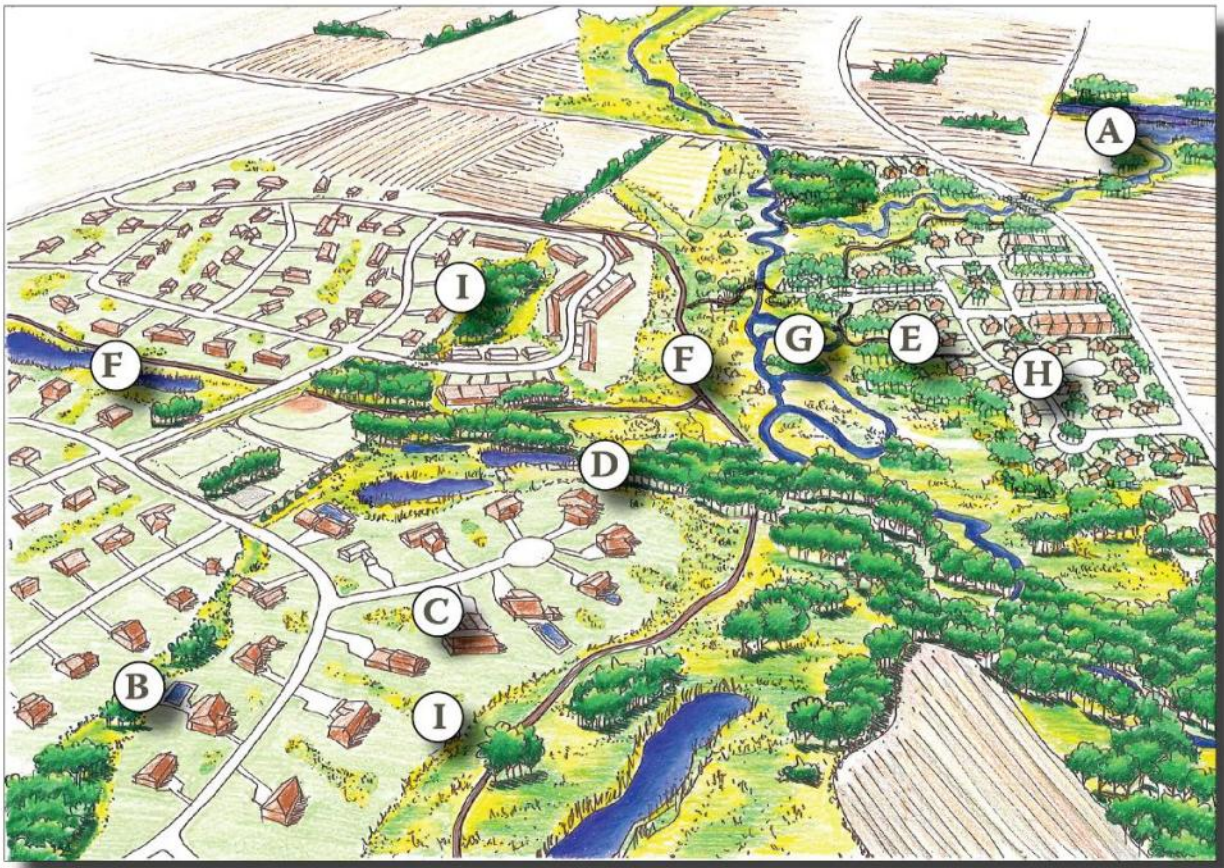
DEVELOPING ENVIRONMENT

DESIGN APPROACH

These hypothetical illustrations depict how multiple design techniques can be applied to a landscape to achieve a full range of community values.

TODAY





FUTURE

TECHNIQUES

These images from other places depict how the highlighted techniques may look in the landscape.

A HABITAT RESTORATION
prairie, wetlands, woods

B STORMWATER STORAGE & INFILTRATION
backyards & communal open spaces

C SENSITIVE LANDSCAPE PRACTICES
native landscaping, smaller lawns, minimal chemicals

D STREAMBANK STABILIZATION/ SHADING

E OPEN SPACE NEIGHBORHOOD DESIGN

F GREENWAY/TRAIL CORRIDOR
alternative transportation, recreation

G STREAM ACCESS

H PERVIOUS PAVEMENT

I RAINWATER GARDENS/ BIO-SWALES

Case Examples

The following pages include case examples that demonstrate water quality, habitat, and recreation enhancement planning and projects conducted in partnership approaches.

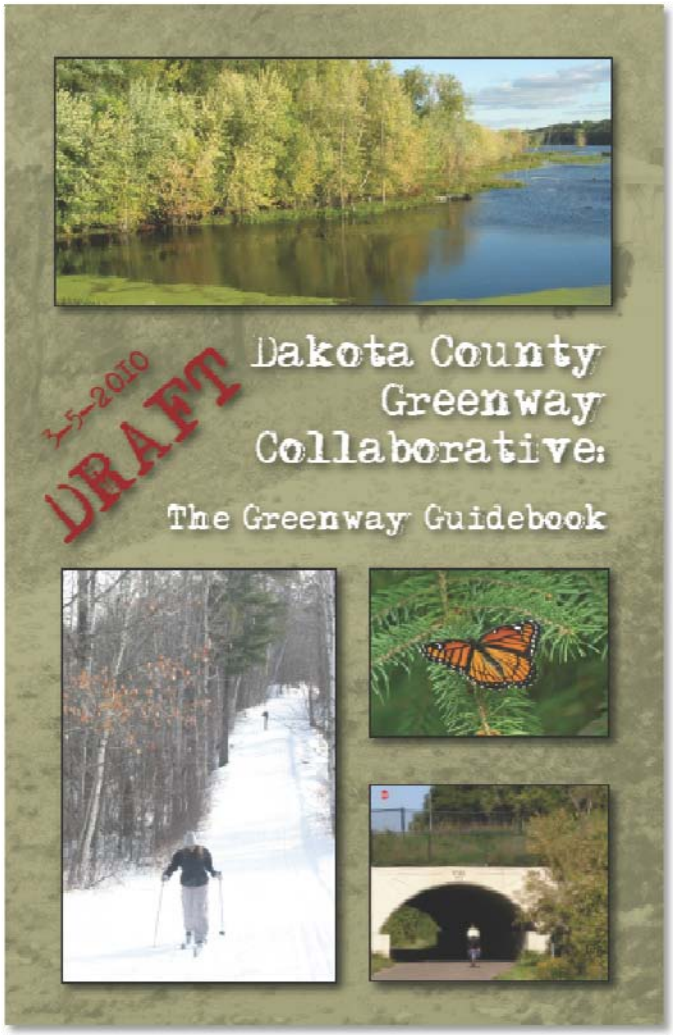
Case Example #1 – Joint Planning:	Greenway Guidebook
Case Example #2 – Restoration:	North Creek Channel Rehabilitation
Case Example #3 – Infrastructure:	Hastings Ravine Improvement
Case Example #4 – Development Studies:	Graduate Student Project

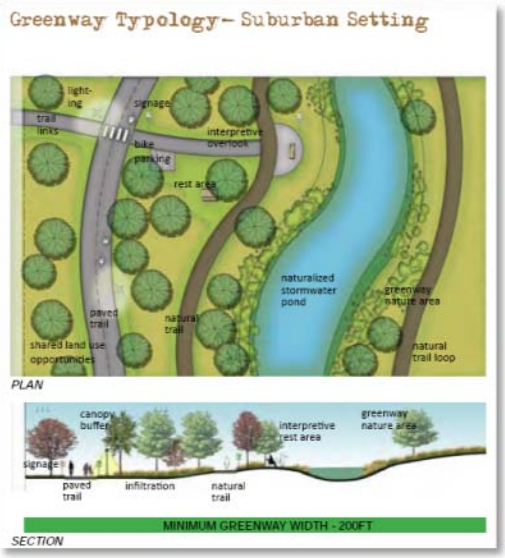
Case Example #1: Joint Planning

The ***Greenway Guidebook*** is the product of a collaborative planning effort that included staff from Dakota County and the cities of Apple Valley, Burnsville, Eagan, Farmington, Hastings, Inver Grove Heights, Lakeville, Rosemount, South St. Paul, and West St. Paul.

The Guidebook outlines a collaborative framework for planning and operating regional greenways, and is organized around key activities for developing successful greenways:

- Funding and Governance
- Land Protection and Stewardship
- Greenway Design
- Construction and Operations





[View the Greenway Guidebook online.]

Case Example #2: Restoration

Vermillion River watershed *reflecting life*

Capital Improvement Project

Farmington: North Creek Channel Rehabilitation

This restored stream meander was planted with native vegetation stabilizing the stream banks, preventing erosion, and providing habitat for wildlife.

A project completed cooperatively between

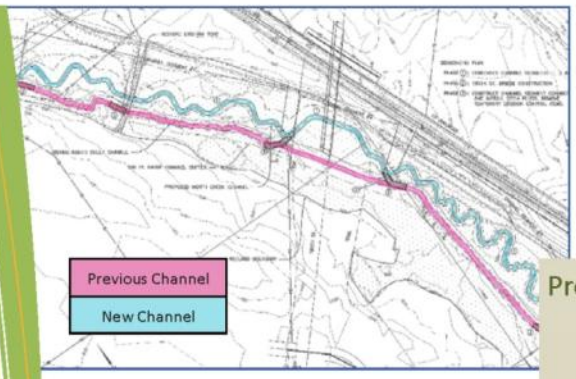
- City of Farmington
- Dakota County Soil & Water Conservation District
- Vermillion River Watershed Joint Powers Organization

Put the bends back into North Creek to reduce erosion

Decades ago, North Creek, a tributary of the Vermillion River flowing through Farmington, was straightened. However, a creek's natural curves or meanders reduce the water's energy, slow the stream flow, and reduce erosion.

The City of Farmington approached the Vermillion River Watershed Joint Powers Organization (VRWJPO) in 2007 to discuss recreating a winding course (remeandering) and restoring 3,200 feet of the straightened North Creek channel. Cost-share funding from the VRWJPO enabled the City of Farmington to complete this project in the fall of 2009 at the same time as the City's 195th Street improvement and extension project.

The project involved channel restoration, stream bank stabilization, and seeding and planting with native vegetation– all of which will improve stormwater conveyance, improve water quality and habitat, and prevent erosion.



City of Farmington, MN within the Vermillion River Watershed.

Vermillion River watershed reflecting life

Vermillion River Watershed Joint Powers Organization
14955 Galaxie Avenue
Apple Valley, MN 55124
www.dakotacounty.us
952-891-7000

The Vermillion River is a vital natural resource that is important to public health and recreation, as well as to preserving unique wildlife habitats. It flows from New Market Township in Scott County, through residential and agricultural areas in central Dakota County, and cascades into a 100-foot ravine before it enters the Mississippi River near the Cities of Hastings and Red Wing, Minnesota. Throughout its journey, the river reflects urban and rural life within its 335-square mile watershed.

Problem:

- Straightened stream reach allows bank and channel erosion and provides poor wildlife habitat

Actions:

- Remeander and restore 3,200 feet of straightened North Creek channel
- Incorporate this project's work with the 195th Street Extension Project
- Use native plants and willow live-staking to stabilize stream banks

Benefits:

- Reduces erosion
- Improves in-stream and riparian (streambank) habitat
- Dissipates stream's energy and excess sediment transport
- Improves aesthetics
- Protects water quality
- Helps maintain stream temperature
- Provides flood control
- Allows for education, outreach, and stewardship

Costs and contributions:

- City of Farmington: $392,493 – project cost
- Vermillion River Watershed Joint Powers Organization: $100,000 – cost share
- Dakota County Soil and Water Conservation District: design and construction technical assistance

Project completed October 2009

9/2009

Case Example #3 – Infrastructure:

Vermillion River watershed *reflecting life*

Capital Improvement Project

Hastings: Hastings Industrial Park Ravine Stabilization and Restoration

The Industrial Park Ravine in the City of Hastings was re-graded and stabilized using a turf reinforcement mat. A pond was constructed at the top of the ravine to control the flow rate in the ravine and provide settling of runoff sediment.

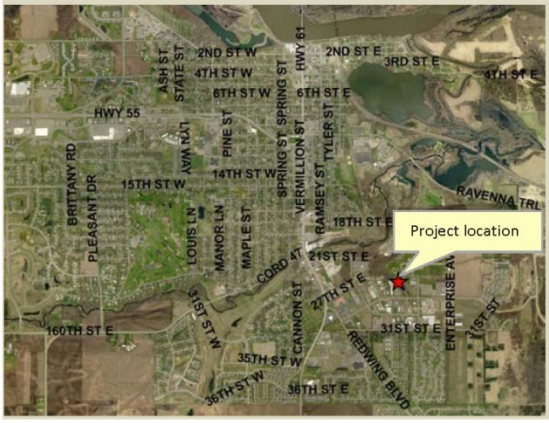
The project was completed cooperatively by the:

- City of Hastings
- Dakota County Soil and Water Conservation District
- Vermillion River Watershed Joint Powers Organization

Reducing Sediment from Entering the Vermillion River

Stormwater flow caused significant erosion, ten to 12 feet deep in places, in the 2,200-foot long ravine adjacent to Spiral Boulevard in Hastings. Sediment- and nutrient-laden waters drained into the Vermillion River. That reach of the Vermillion River is currently impaired for turbidity (cloudiness).

Cost-share funding from the Vermillion River Watershed Joint Powers Organization enabled the City of Hastings to re-grade and stabilize the ravine, prevent further erosion, build a treatment pond, and reduce sediment from entering the Vermillion River. The ravine was stabilized with a turf reinforcement mat to prevent erosion and promote the growth of grass and other vegetation in the ravine.



The project will reduce the amount of sediment entering the Vermillion River and will help address the turbidity impairment.

City of Hastings, MN within the Vermillion River Watershed.

Vermillion River watershed reflecting life

Vermillion River Watershed Joint Powers Organization
14955 Galaxie Avenue
Apple Valley, MN 55124
www.dakotacounty.us
952-891-7000

The Vermillion River is a vital natural resource that is important to public health and recreation, as well as preserving unique wildlife habitats. It flows from New Market Township in Scott County, through residential and agricultural areas in central Dakota County, and cascades into a 100-foot ravine before it enters the Mississippi River near the Cities of Hastings and Red Wing, Minnesota. Throughout its journey, the river reflects urban and rural life within its 335-square mile watershed.

Problem:

- Stormwater flow caused erosion in the ravine adjacent to Spiral Boulevard
- Large amounts of sediment have been delivered by the eroding ravine to the Vermillion River
- Approximately 230 acres of a mostly developed watershed has drained to the ravine with minimal water quality treatment
- The ravine drains to a reach of the Vermillion River where a turbidity impairment exists

Actions:

- Re-grade and stabilize approximately 2,200 feet of highly eroded ravine draining to the Vermillion River
- Install turf reinforcement mat to prevent further erosion and promote vegetation growth
- Install pond at the top of the ravine to control flow rate and allow settling of runoff sediment

Benefits:

- Addresses turbidity impairment in Vermillion River
- New bike trail parallels ravine and allows for public viewing and enjoyment
- Allows for education, outreach, and stewardship

Costs and contributions:

- City of Hastings: $284,065 – engineering and labor
- Vermillion River Watershed Joint Powers Organization: $125,000 – cost share
- Dakota County Soil and Water Conservation District: design and construction technical assistance

Project completed November 2009

8/2009

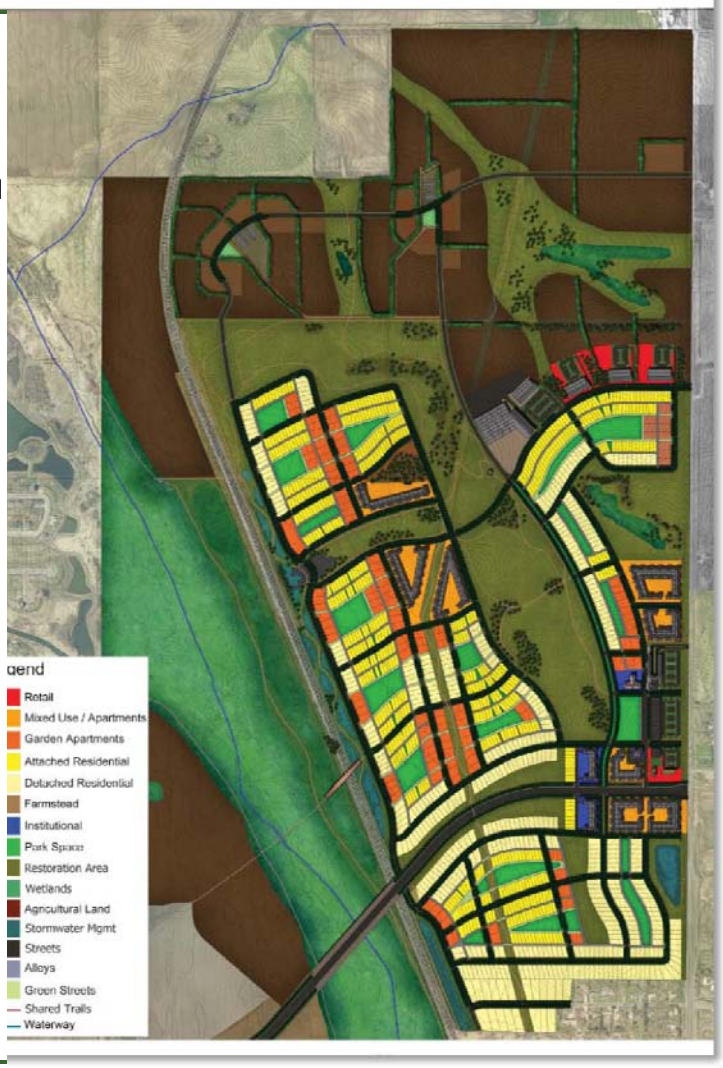
Case Example #4: Development Studies

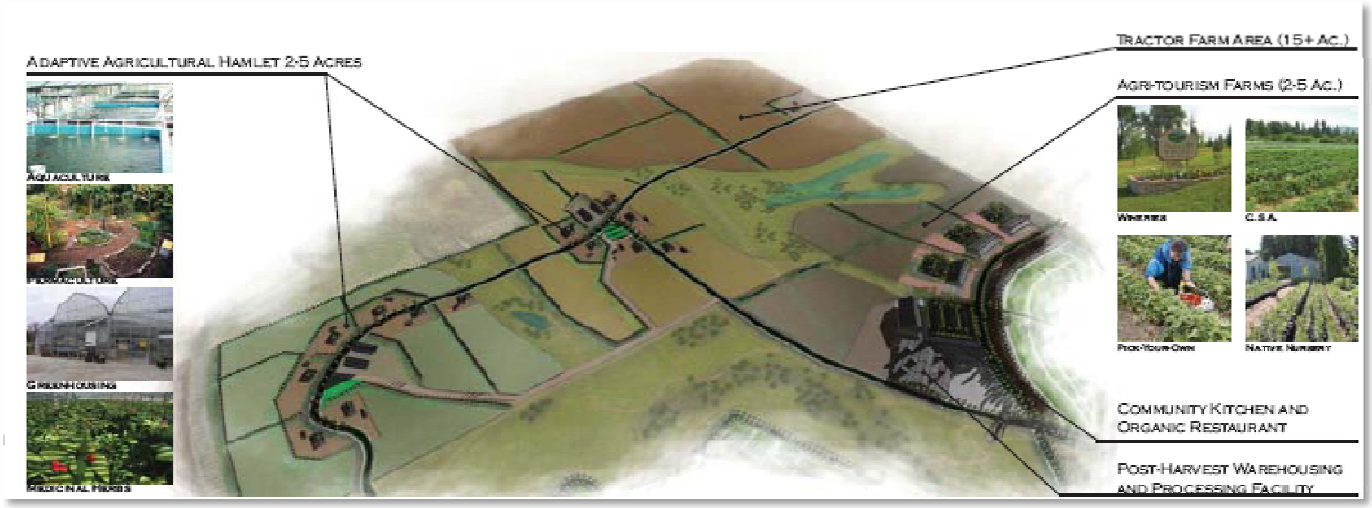
Sam Geer, a graduate student at the University of Minnesota, undertook a capstone project to maximize innovative subdivision design that enhances water quality, habitat, recreation, and sustainable economic development benefits.

Sam met with staff from Dakota County and Farmington, and selected a theoretical project site in Farmington's developing North Creek area– in transition from rural to suburban use. His design, Farmington Meadows, includes:

- On-site stormwater infiltration
- Cluster development
- Shared open space
- Energy efficient design
- Transit -oriented town center
- Complete streets
- Adaptive agriculture – an innovative concept for small-scale, organic production of high-demand locally grown food, shown below. These small farms also provide transition between residential areas and traditional agriculture.

Sam modeled runoff and other factors and demonstrated benefits not found with traditional development patterns.





This page intentionally left blank.

Chapter 5: Corridor Framework

The future of the Vermillion River as well as the success of this Corridor Plan ultimately rests on the ability to coordinate many diverse efforts among public and private entities. Throughout the course of this planning project, landowners participating in focus groups and workshops identified the complexity of the current regulatory environment as an obstacle to using and managing their property. This same complexity makes it difficult to manage a shared resource in a comprehensive manner that addresses all facets.

Governance

Chapter 1 described the complex framework of water governance in Minnesota. Over time, water and land management regulation has become divided among more entities, and no single entity addresses all statutory and administrative issues that can affect a single property. For most public waters in the metropolitan region, the following jurisdictions and agencies are responsible for one or more of the water puzzle pieces:

Townships, Cities and Counties
Watershed Organizations/Districts
Soil and Water Conservation Districts
Metropolitan Council
Minnesota Board of Water and Soil Resources
Minnesota Departments of Agriculture, Health and Natural Resources
Minnesota Pollution Control Agency
US Department of Agriculture
US Army Corps of Engineers
US Environmental Protection Agency

Collectively, these entities constitute components of a governance structure. What is governance? In the broadest sense, governance is administrating, managing and coordinating the development of policies, regulations, and budgets to address specific responsibilities. A short answer is that *governance is what government does*, although government is not the only entity that performs these key administrative and coordination functions.

Within this loose structure, each of the above agencies has its own "job description" for what they can and cannot do related to land and water management. While many of these activities may work well, it is not clear that the "sum of the parts" across all agencies addresses everything that should be addressed, and it is also unclear that the work and roles of these agencies are free of contradiction. Add to that the other key elements of the corridor concept – wildlife habitat, recreation and economic development in its many forms – and the level of complexity, confusion and inefficiency increases even more.

For example, the VRWJPO focuses on water quality, water quantity, and aquatic habitat within the watershed. Its purpose is to look comprehensively at this natural resource across jurisdictional boundaries. Upland habitat improvement, recreation, and economic development are not primary responsibilities. Similarly, Soil and Water Conservation Districts address water quality and habitat issues throughout the watershed, but were not created to provide recreational opportunities. City and township typically begin and end their efforts at their jurisdictional boundaries.

While a great deal of informal effort strives to coordinate these initiatives at a staff level, no formal structure exists to coordinate use of various funding streams to plan and implement key capital projects. It is also possible that each of the municipal budgets in the corridor could be oriented and planned to better address these priorities, but currently no mechanism exists to coordinate efforts among several municipalities. The direct participation and representation of townships and cities within the governance of the Corridor is unclear and not formalized. There does not appear to be a single governmental authority that has governance responsibility to manage funding and policy for all of the programs affecting the future of the Vermillion River Corridor.

Effective public engagement in restoring and protecting the Vermillion River Corridor is critical given the extent to which these activities will depend on the decisions of individual private landowners. Key civic leaders and organizations will likely have a role in shaping community expectations about the stewardship of the River and its watershed. To date, it is unclear how that role will be fulfilled.

Broadly-related issues and shortcomings with the current state of management include:

- Separate public investments targeted solely at water quality improvements, land acquisition, in-stream or upland restoration and management, recreation, or infrastructure such as bridges and utilities are not aligned, sequenced and coordinated in terms of comprehensive goals and outcomes.
- Funding sources are often narrowly defined and directed toward specific benefits. Program eligibility, funding requirements, and time frames do not lend themselves to incorporating multiple benefits beyond the specified program target. Addressing additional benefits can render a project ineligible or impractical for funding.

How can we more effectively address these challenges?

The Vermillion River Corridor Plan attempts to take a step back and ask if we were to think in terms of these different systems intersecting and affecting each other within this shared, multi-jurisdictional corridor, what would it take to protect and enhance all of the interests and opportunities that lie within the corridor? In considering options for enhancing governance for the Vermillion River Corridor, a number of interrelated

functions and activities critical for successful implementation of the corridor vision have been identified. These important functions and activities could constitute a "job description" for the ideal governance entity or entities and would include the following:

Model Leadership and Governance Functions and Activities

I. Rules, Regulations and Policies

A. Develop, Revise and Enforce Standards

B. Improve Coordination Among Regulatory Agencies, e.g., Soil and Water Conservation Districts, Watershed Organizations, Counties, State Natural Resource Agencies, Natural Resources Conservation Service, Transportation, Corps of Engineers, and Local Governments

C. Improve Monitoring/Accountability
   1. Water quality improvements
   2. Program/project implementation
   3. Effective use of financial and other resources
   4. Effectiveness of restoration/management activities

D. Conflict Resolution:
   1. Develop a forum and procedures for resolving conflicts that will arise

II. Financial Management

A. Budget Administration
   1. Develop budgets, accounting procedures

B. Increase, Integrate and Coordinate Cost-sharing and Funding from Traditional and Non-traditional Sources
   1. Private sector (foundation and corporate/business)
   2. Public sector (federal, state, regional, and local)

III. Facilitation

A. Create and Foster Leadership at various levels throughout the watershed
   1. Political (federal to local)
   2. Agencies and Organizations
   3. Institutions, Schools, Foundations, and Faith Communities
   4. Corporate/Business
   5. Landowners
   6. Residents

B. Develop an Comprehensive Communication Plan for internal/external audiences with general information; policies, rules, standards, and procedures; partnership opportunities; individual project needs; advocacy, marketing and fundraising; and recognition

C. Strengthen and Develop Collaborative Structures, Strategies and Processes
   1. Develop innovative and effective partnerships and organizational structure(s)
   2. Develop new volunteer opportunities

D. Elevate and Integrate Land and Water Conservation into Other Plans, Programs and Projects
   1. Transportation
   2. Agriculture
   3. Housing
   4. Economic Development
   5. Recreation
   6. Utilities

E. Collect and Share Information and Data (clearinghouse function)**:** Collect, review, store, monitor, update and share information on previous and current plans, natural resources, land cover, wildlife, model ordinances, etc.

F. Celebration
   1. Recognition and Rewards
   2. Community-Building

IV. Natural Resource Management

A. Improve Conservation Stewardship of Existing Public and Private Lands
   1. Continue improving restoration assessments, techniques, and materials
   2. Increase restoration/management commitment, funding, and capacity for both private and public lands
   3. Increase awareness and adoption of best management practices

V. Land Protection

A. Increase Permanent Protection of Strategic Lands
   1. Ensure the permanent protection of regionally significant natural areas and open spaces already held by the public and semi-public entities
   2. Utilize a wide range of land protection tools (fee acquisition, conservation easements, TDR, deed restrictions, covenants, developer agreements, land registry, etc.) to secure unprotected lands

VI. Recreation

A. Improve Compatible, Outdoor Recreational Opportunities
   1. Inventory potential recreational activities
   2. Prioritize type, location and scope of activities
   3. Improve appropriate recreation uses, facilities and access
   4. Increase/leverage resources to improve recreation opportunities

VII. Research

A. Determine, conduct and interpret research for protection and improvement

1. Accurately and effectively assess, interpret and apply data through a variety of educational materials and programs for land-use planners and decision makers, developers, local governments, agency and organizational staff, landowners, and citizens

Short-term Coordination Structure

Regardless of what governance option might be developed, an enhanced level of collaboration must be fostered to include goals outside of the normal "job description" of one or another agency in order to effectively implement any comprehensive vision for the Vermillion River corridor, At the very minimum, this means providing extensive communication and support across traditional lines of authority and coordinating responses to proposed developments so that confusion is eliminated and opportunities for multiple benefits are encouraged. This includes the coordination of investment opportunities through application of available grant funds, federal and state conservation program dollars, recreational development funds (park dedication and acquisition funds), as well as direct economic development opportunities.

The challenge in this type of approach is managing the additional time required to maintain contacts and communication and work collaboratively on an ongoing basis with all involved agencies. This calls for a coordinating role to be taken on by an entity – the question remains as to which entity would most appropriately take on that role and what capacity and resources are required to accomplish it. Overall, it would be an advantage to use the existing institutional framework and capacities with all involved agencies. Further discussion on this topic among the counties and VRWJPO will continue with implementation of this plan.

Implementation Resources

As a result of many past and present efforts, there are significant financial resources available for implementing the corridor vision.

Minnesota Environment and Natural Resources Trust Fund

As a critical element of the original LCCMR funding proposal, the Legislature provided Dakota County with $360,000 from the Minnesota Environment and Natural Resources Trust Fund and $149,965 of state bond funding to protect 125 acres of quality natural resource land through fee acquisition or conservation easements and to restore 40 acres to a more sustainable and resilient condition. Potential projects will be sought and selected later in 2010 to demonstrate how it is possible to integrate water quality, habitat and recreation into the same project. The County is currently recommended to receive an additional $800,000 for easements and restoration along the Vermillion and Cannon River systems beginning in 2011.

Farmland and Natural Areas Program

With the passage of a $20 million bond referendum in 2002, Dakota County has been protecting and restoring land throughout the County. Over $3 million of these funds have been expended protecting over 1,300 acres within the Vermillion River corridor with several additional projects underway. Over $1 million is still available for use within the corridor. In addition, the County has utilized over $700,000 of federal farmland protection funds within the corridor, with more opportunities available in the future.

Outdoor Heritage Funding

With the passage of the state constitutional amendment in 2008, significant state funds have become available for wildlife habitat, water quality and recreational projects. The County has been successful in securing over $3 million over the past two years for lakeshore and buffer easements for the Vermillion and Cannon River systems. Specifically, these funds are available until 2012 for acquiring permanent conservation easements from willing sellers and then developing and implementing natural resource management plans.

Vermillion River Watershed Joint Powers Organization

In efforts to encourage establishment of buffers on the Vermillion River and its tributaries, the VRWJPO has identified funding for support of the establishment of buffers and purchase of conservation easements as part of its annual budgeting process. There will be up to $200,000 available in 2011, and a similar amount is projected for 2012. These funds are part of the Capital Improvement Projects and may be used to match funds available from other (state or federal) sources.

Soil and Water Conservation District

The Dakota County Soil and Water Conservation District supports cost share opportunities available for various conservation practices from state, federal or local funding sources applicable to the Vermillion River Corridor area. These may be for traditional cost share types of practices supported through USDA by the Federal Farm Bill, state cost share programs through the Board of Water Soil Resources, or may include newer practices such as harvestable buffers for production of biomass based energy.

Chapter 6: Public Engagement

The Vermillion River Corridor planning process was designed to elicit a broad range of perspectives from local residents and stakeholders in all areas of the River through a combination of focus groups and participatory workshops. A summary of the key messages heard from participants follows.

Focus Groups

Information-gathering sessions were held with randomly-selected residential, business, and agricultural landowners located along the corridor and with stewardship and recreation organizations in the spring of 2009. Participants provided insights into how they value the River, changes they have seen in the River over time, regulatory issues, and what they hope the plan would accomplish. The recreation session built perspective on balancing recreation and resource protection in a fragile environment.

Business Landowners: March 12, 2009

Six representatives of banking, food, construction, and development businesses participated. Key messages heard include:

- "Too many hands on the River" - many agencies and regulations. Difficult to know which agency regulates which issue
- Regulations and decision-making should be based on good science
- Consistent policies, enforcement, and procedures are needed throughout the system. Personal contact with knowledgeable agency staff is important
- Required mitigation projects should combine requirements of several programs into a smaller footprint project rather than doing several individual projects to address each agency's requirements
- Planning shouldn't hinder ability to develop. Assistance on phasing restoration and reclamation plans would be helpful.
- Protection of the cold-water ecosystem is important, but specific regulations for designated trout streams caught some landowners unaware
- Increase awareness of the trout stream designation and convey information to landowners on all regulations, sensitivity to pollution, and increasing temperatures
- Increase awareness of cost-sharing available for water quality projects
- Improve public access for fishing to minimize trespassing on private lands. Interest in trails along parts of the River is guarded

Agricultural Landowners: March 18, 2009

Nine participants own agricultural land or represent agricultural interests. Key messages heard include:

- Different land and water programs, how they affect landowners is confusing

- Concern over potential "takings" related to buffers and restrictions on how they could use their land. Uncertainty as to how buffer lands can be used
- Information is needed on maintenance responsibilities for buffers and on the River's impairment status
- Uncertainty about permissible activities in corridor: e.g., driving across tributaries to reach farm fields, withdrawal of irrigation water, and installation of fencing
- The Corridor is valued as a home for wildlife
- Maintaining rural character of the land is very important
- Recreational activities, specifically kayaking, were acceptable as long as private property rights are recognized.

Residential Landowners: March 30, 2009

Six participants who live in the Corridor provided the following key messages:

- Long-term property owners know the River and its issues. Agency staff should talk more with landowners.
- The quality of the River has been damaged. Few or no minnows are seen in parts. Other parts of the River dry up. Protect the springs feeding the River.
- Public works projects have caused damage. Bridges removed deep pools and shade. Drains contribute oil and trash. Road salt is an issue. There seem to be more and more rules and inconsistent enforcement of the existing rules. Dumping occurs. Some houses are too close to the River.
- Eureka Township includes pheasant habitat and eagles nests.
- Too many agencies have a hand in the River.
- People need to be educated on taking care of the River.
- Bike paths won't work in western part of the corridor – soils are too wet.

Recreation and Resource Agencies and Organization: April 9, 2009

12 participants represented recreation, natural resources, and sportsmen's interests. Key messages include:

- Water quality and habitat are priorities. Recreation should include only compatible passive activities. Protection of the corridor now is key, continuous trail from Hastings to Lakeville should be a future consideration. Focus on near-term trails in urban and developing areas.
- Agricultural impacts to the River are considerable. More agricultural easements and funding are needed. Establish water quality buffers as a first priority.
- ATV's and snowmobiles pose conflicts with habitat protection
- Hunting could be controversial and could pose conflicts with a number of other uses

Public Workshops

Workshop 1: A River Worth Protecting

The first workshop was held in June and July 2009, to introduce the Corridor Plan and identify priorities for water quality, habitat, appropriate recreation, and future growth opportunities. Each session focused on a specific part of the corridor, defined by similar land use patterns.

Session 1: Empire Focus Area, June 11, 2009
Dakota County Extension Center – Farmington, MN
Attendance: 20

Session 2: Hastings Focus Area, Monday, June 15′ 2009
Hastings City Hall - Hastings, MN
Attendance: 27

Session 3: Lakeville-Farmington Focus Area, Thursday, June 18, 2009
Dakota County Extension Center – Farmington, MN
Attendance: 25

Session 4: New Market-Eureka Focus Area, Monday, June 22, 2009
Farmington Public Library – Farmington, MN
Attendance: 31

Session 5: Castle Rock-Vermillion-Marshan Focus Area, Wednesday, July 1, 2009
Dakota County Extension Center – Farmington, MN
Attendance: 18

Format

Participants at all five sessions were first introduced to the project with a presentation on the Vermillion River Corridor Plan process, current land use, water quality, habitat, and recreation.

Following informational presentations, attendees worked through three small group exercises designed to share their collective vision for the River's future.

Small groups first reviewed a series of images depicting approaches for enhancing water quality, habitat, recreation, and future development as they might look in each of the corridor's predominant land uses (agriculture, residential, open space, and commercial). Participants used a consensus-based approach to select their most and least preferred future approaches for planning consideration. Small groups then worked to identify where, within the workshop focus area, these approaches would be most appropriate for the River corridor. Participants reviewed a set of draft corridor principles and provided edits and comments that reflected their shared priorities.

Attendees participated in an interactive audience feedback that provided additional information on river perceptions, priorities and performance standards. An Audience Participation System (APS) instant survey technique was used to gain input across a range of specific questions.

Key messages from workshop #1 include:

- Most participants recognize the Vermillion River as a resource worth protecting today and for future generations.
- Water quality and habitat enhancement were prioritized over approaches providing for recreation and economic development, more notably so for rural portions of the Corridor.
- Participants in all sessions placed perennial agricultural buffers in their top five approaches. Participants emphasized the need for a variety of approaches to protect and enhance the corridor.
- Priorities varied across the corridor, reflecting local land use patterns and the degree of income generation from the land.
- Individual property rights are an important consideration for stakeholders.

Small Group Exercise, Empire Township Session

Workshop 2: Working Together

The second workshop series offered participants the opportunity to review and refine draft concepts for the full corridor. The agenda gathered input on design approaches and techniques for different river settings, and further refined the corridor principles. APS was used to gather participant opinions on a range of corridor issues.

Workshop 1: Wednesday, December 2nd 2009
Dakota County Extension Center – Farmington, MN
Attendance: 51

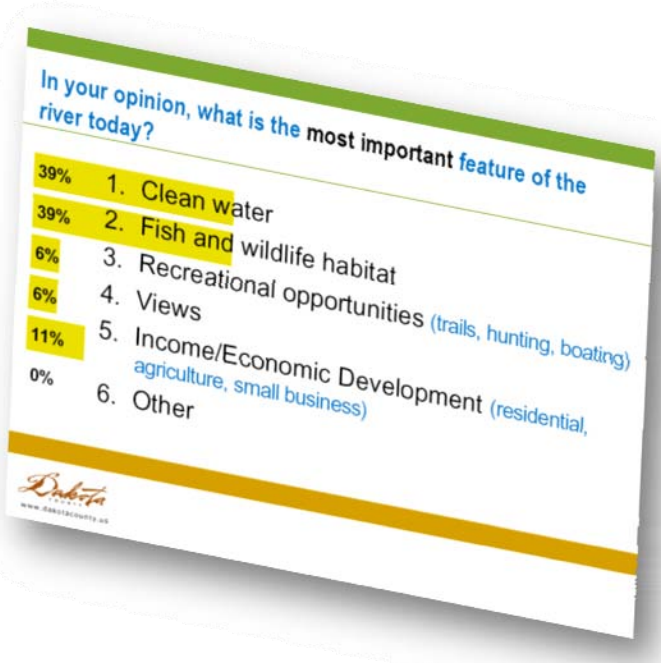
Workshop 2: Monday, December 7th 2009
Dakota County Extension Center – Farmington, MN
Attendance: 50

Format

Participants reviewed project information, project goals, guiding principles, and performance standards. Participants then visited stations featuring one of three corridor settings (rural, developing and urban) to view enhancement approaches consisting of land management techniques and water management strategies.

Attendees participated in interactive sessions that gathered information on audience demographics, river perceptions, preferred landscape strategies, and implementation priorities. Key messages and themes from the second round workshops include:

- Protecting Vermillion River Corridor natural areas, habitat and water quality are priorities for stakeholders.
- Techniques and practices illustrated in the break-out exercises would improve quality in rural, developing and urban settings.
- Technical assistance, cost-share resources and demonstration projects are important to river corridor stakeholders.
- Individual property rights remain an important consideration for many community stakeholders.
- Future recreation interests vary widely throughout the corridor and include active and passive recreation activities.



Example APS Slide with participant opinions

Workshop 3: Putting the Plan into Action

A total of 50 people attended workshop sessions held on April 26 and April 28, 2010. Participants reviewed the refined corridor concepts (water quality, habitat stewardship, and recreation) that comprise the Corridor Plan vision. Input was sought on how the Corridor Plan could be coordinated and implemented. An online best practice information tool and a greenway simulation were demonstrated. Findings include:

- The habitat concept was considered most effective, followed by the water quality and recreation. The concepts should work well together.
- The right issues generally are being addressed, but many don't know which agency is responsible for specific regulations. Enforcement was rated poorly (31 percent) more than positively (20 percent). It is very important to have common, comprehensive goals for the River.
- The most important criteria for selecting enhancement projects were:

  Reducing pollution/erosion and improving stream channel stability, improving wetland and floodplain function, increasing groundwater recharge, and reducing stream temperatures

  Improving upland habitat and protecting high quality or unique habitat, improving in-stream habitat, proximity to other protected lands, and landowner commitment to stewardship.

  Connecting existing and planned recreation infrastructure, interpretive features, trail access, wildlife viewing, fishing access, and canoeing/kayaking.
- People reacted favorably to the online best practice tool and provided useful comments for enhancing its functionality.
- Participants gave generally positive feedback on North Creek Greenway simulation and provided a few suggestions for improving it.
- Comments on urban and developing area greenways related to:
  - Ensuring that natural resources are protected and native plants are used
  - Effective design solutions for safety
  - Phasing and implementation over time, long-range plan
  - Public perception of greenways and trails
  - Needs for efficient maintenance and operations over the long-term
  - Funding needs, budget constraints, and potential funding resources
  - Collaboration among public agencies and the private sector

Other Comments:
Participants liked “instant surveys” with the APS keypads as a part of the workshops.

What Else Should the Plan Address?
Enhance communication among agencies and with landowners. Suggestions: better web sites, more information on River issues, Q / A sessions with landowners.

North Creek Greenway Simulation: Before and After in Lakeville

Final Open House:

The draft Vermillion River Corridor Plan was released for public review from August 25 to September 25, 2010. A total of 24 people attended the final open house held during the public review and comment period on September 23, 2010. The session was unstructured, with project team members available to answer questions and engage participants in discussion about the draft plan. A summary of comment cards received from the open house follows:

Comments about the Water Quality Concept:

- *Looks very reasonable*
- *Water quality concept is very good. Monitoring and identifying problems is key to success.*
- *Concepts cannot be separate from each other – all interconnected as far as trout are concerned.*

Comments about the Habitat Concept:

- *Excellent*
- *Seems like a reasonable priority. Concentrate on establishing buffers in areas that are threatened with development and/or high environmental quality. Better to have some continuous corridor versus scattered protection.*

Comments about the Recreation Concept:

- *Keep the trout stream natural.*
- *Excellent*

What do you like or dislike about the plan?

- *The plan doesn't take my land unless I am willing.*
- *Restoration of the wetlands and the plan for nutrient management are specifically good plans. Developing of greenways and restoring habitat are keys to success.*
- *I appreciate the intelligent separation of the trout vs. canoe by cold vs. warm temperature. "Something for everyone, long-term thinking."*

How can the plan be improved?

- *Secure funding*

Other comments:

- *As it stands, the plan is excellent if most of the concepts can be implemented.*
- *Great balanced approach.*

Appendix 1: Replicable Model

Inventory and Analysis

The project relied on Geographic Information Systems (GIS) mapping and modeling to characterize the Vermillion River Corridor for:

- Water Quality
- Habitat and Natural Resources
- Land Uses and Community Plans
- Recreation Opportunities
- Infrastructure and other intersecting systems

The initial round of maps documented current conditions across the Corridor, and a second round of map modeled the needs related to Corridor Plan goals.

The project benefited from a wealth of GIS information, including very contemporary data being produced with research projects concurrent with the Corridor Plan effort. Some of these data are highly specialized (such as thermal readings) and enhanced the quality of project efforts, but may not be widely available for similar project elsewhere.

Issues Identification

In addition to map analyses, broadly-based efforts to identify major issues included

- Review of similar multi-jurisdictional resource corridor plans
- Discussions among staff from Dakota and Scott counties and the Vermillion River Watershed
- Meeting with peer watershed organizations
- Focus Groups: corridor landowners (business, agricultural, and residential) and recreation and stewardship agencies and organizations
- Public Workshops

Public Workshop Techniques

Public workshops were planned in a variety of locations to bring the effort to residents, rather than inviting the public to one location. Each workshop provided a structured format for collecting information from participants through:

- Pre-designed survey questions
- Open-ended questions, answers, and discussion
- Group exercises with maps, imagery, and editing the Corridor Plan principles
- Demonstration and discussion sessions for specific land uses in the corridor (rural, urban, developing)

The overall format sought to balance and alternate gathering input from participants with information-sharing from the project team on the project, corridor conditions,

interim products, and options for the plan's major directions. The team sought to provide a dynamic session that met a range of communication styles and needs.

All of the workshops used an Audience Participation System (APS) linked to a Power Point presentation. Audience members received handheld keypads with transmitters that allowed instant polling. Survey questions were presented on the screen, participants selected their answers, and the overall results were displayed on screen within seconds. This technique provided anonymity, allowed the project team to gather input uniformly on a full range of issues from all participants, and allowed participants and the team to "read the temperature" of the room on the selected issues. Use of the APS was generally well-received by participants.

Public Outreach Methods

The Vermillion River Corridor planning process engaged Friends of the Mississippi River (FMR), a local membership-based non-profit conservation organization, to conduct community outreach activities designed to maximize public participation Vermillion River Corridor planning workshops. Workshop outreach activities in included, but were not limited to, the following:

- Event bulletins posted on the Vermillion River Corridor Plan website through the Dakota County website: www.co.dakota.mn.us/CountyGovernment/PublicEntities/VermillionJPO/CorridorPlan

- Full color post cards were delivered to 2994 households in communities throughout the Vermillion River watershed for each of the three rounds of workshops. Post cards were sent to a wide range of addressees including:
  - Property owners along the Vermillion River Corridor.
  - Local residents who have recently participated in Vermillion River stewardship, education and public information events.
  - Members of local recreation, hunting, fishing, habitat, conservation, faith-based organizations and other community groups.

- Follow Up e-mail invitations and reminders were delivered to all invitees for whom viable email addresses were available. Emails were delivered to 518 individuals.

- Phone calls were made to 600 potential attendees for the first round of workshops, inviting them to attend the meeting of their choice. Phone call recipients included:
  - A portion of residents who received the initial post card invitation
  - Members of local recreation, hunting, fishing, habitat, and conservation organizations who did not receive the initial invitation post card.
  - Local elected officials, appointed officials and city staff

- Automated phone calls were included in outreach for the second round of workshops to facilitate additional public participation. The automated phone calls delivered a pair of 30-second pre-recorded messages delivered to 2000 phone numbers with a reminder of the meetings. The automated message was sent only to those who had previously received outreach materials.

- Friends of the Mississippi River posted the event through their monthly Mississippi Messages event bulletin (distributed to 5000 individuals each month) and through the www.fmr.org website.

- Event announcements were also distributed by a number of local organizations, including conservation groups, faith-based organizations, river recreation organizations, local business coalitions and others.

- Dakota County communications staff distributed press releases and other information to a wide range of local media outlets, including print media sources.

- Twitter and Facebook postings were distributed to partner networks including FMR and HKGI, encouraging additional public participation.

- Dakota County staff provided information updates at standing advisory committee meetings and local public meetings encouraging residents to attend and participate.

- FMR provided project updates and invitations to attendees of river corridor stewardship, education and recreation events prior to each round of workshops.

2008 Project Abstract
For the Period Ending June 30, 2011

PROJECT TITLE: Preserving the Avon Hills Landscape
PROJECT MANAGER: Thomas Kroll
AFFILIATION: Saint John's Arboretum and University
MAILING ADDRESS: Box 3000
CITY/STATE/ZIP: Collegeville, MN 56321
PHONE: (320) 363-3163
E-MAIL: tkroll@csbsju.edu
WEBSITE: http://www.csbsju.edu/arboretum/avonhills
FUNDING SOURCE: Environment and Natural Resources Trust Fund
LEGAL CITATION: ML 2008, Chap. 367, Sec. 2, Subd.3 (d).

APPROPRIATION AMOUNT: $ 337,000

Overall Project Outcome and Results

The Avon Hills Initiative is a group of local citizens interested in preserving the rural nature of the 50,000 acre Avon Hills 15 miles west of St. Cloud. The group helped steer this project made possible with Environment and Natural Resources Trust Fund support. Saint John's provided the staff and fiscal support. This project had three goals:

1) Increase the level of interest and understanding of all citizens and landowners interested in the Avon Hills, mostly through conferences. Outcome: Three day-long conferences were held with nearly 900 total attendees indicating very strong local support.

2) Negotiate and complete acquisition of permanent conservation easements. Outcome: Six conservation easements totaling 400 high quality forest, wetland, and grassland acres in Stearns County were successfully enacted. Two of the easements, totaling 99 acres, were purchased, and four of the easements, totaling 301 acres, were donated by the landowners. These acres contain a total of more than two miles of shoreline on streams, ponds, and lakes, and provide habitat to a variety of species, including several of greatest conservation need. Additionally, through this process we tested a new method for prioritizing and acquiring easements for the best value. Called MMAPLE, the Minnesota Multi-faceted Approach for Prioritizing Land Easements, the system weighs the measurable environmental benefits against the cost that the current landowner wants to provide a permanent easement on that land. Using sealed bids, each landowner chooses their own price which results in lower costs and fewer complaints from landowners and taxpayers about the "fairness" or "price" of the easement process.

3) Provide support for township and county officials to review and change zoning and ordinances that impeded protection of the open space. Outcome: Two "conservation design" conferences for officials and the public as well as reviews of the existing ordinances by professionals resulted in positive feedback from the participants. This gradual education helped create sufficient support for Stearns County to pass a land-use ordinance that requires new housing developments in the Avon Hills to permanently preserve at least 80% of the land. This is believed to be the highest standard in the USA.

Project Results Use and Dissemination

The success of the land use concepts used in the Avon Hills of Stearns County to preserve open space and working forests and farms has been disseminated in a variety of ways. Staff, officials, and citizens have been asked to discuss the concepts with neighboring county officials and at professional meetings.

Todd County, a neighboring county, sent several officials to the land use conferences and has gradually begun to implement similar practices in their county.

The MMAPLE method developed under this grant is being used to apply for a Outdoor Heritage Fund grant for more easements.

Environment and Natural Resources Trust Fund 2008 Work Program
Final Report

Date of Report: July 29, 2011

Final Report:

Date of Work program Approval: June 10, 2008

Project Completion Date: June 30, 2011

I. PROJECT TITLE: Preserving the Avon Hills Landscape

Project Manager: Thomas Kroll
Affiliation: Land Manager and Arboretum Director
Mailing Address: Saint John's Arboretum, Collegeville, MN 56321-3000
Telephone Number: 320.363.3163
E-mail Address: tkroll@csbsju.edu
Fax Number: 320.363.3202
Web Page Address:
www.csbsju.edu/Arboretum/Education/Community/AvonHillsInitiative.htm

Location: The Avon Hills landscape, located in Stearns County, encompasses approximately 80 square miles in Avon, Saint Joseph, Collegeville, and Saint Wendel townships. See attached project map.

Total Trust Fund Project Budget: Trust Fund Appropriation: $ 337,000
Total Spent to Date: $ 304,412
Ending Balance: $ 32,588

(See Attached budget detail, Appendix A)

Legal Citation: ML 2008, Chap. 367, Sec. 2, Subd.3 (d).

Appropriation Language: Preserving the Avon Hills Landscape

$337,000 is from the trust fund to the commissioner of natural resources for a grant to Saint John's Arboretum and University for community outreach, in cooperation with the Minnesota Land Trust; conservation easements, in cooperation with the Minnesota Land Trust; and local ordinance reviews and recommendations for the Avon Hills landscape in Stearns County. A list of proposed fee title and easement acquisitions must be provided as part of the required work program. All funding for conservation easements must include a long-term stewardship plan and appropriate funding for monitoring. This appropriation is available until June 30, 2011, at which time the project

must be completed and final products delivered, unless an earlier date is specified in the work program.

II. and III. FINAL PROJECT SUMMARY:

Overall Project Outcome and Results

The Avon Hills Initiative is a group of local citizens interested in preserving the rural nature of the 50,000 acre Avon Hills 15 miles west of St. Cloud. The group helped steer this project made possible with Environment and Natural Resources Trust Fund support. Saint John's provided the staff and fiscal support. This project had three goals:

1) Increase the level of interest and understanding of all citizens and landowners interested in the Avon Hills, mostly through conferences. Outcome: Three day-long conferences were held with nearly 900 total attendees indicating very strong local support.

2) Negotiate and complete acquisition of permanent conservation easements. Outcome: Six conservation easements totaling 400 high quality forest, wetland, and grassland acres in Stearns County were successfully enacted. Two of the easements, totaling 99 acres, were purchased, and four of the easements, totaling 301 acres, were donated by the landowners. These acres contain a total of more than two miles of shoreline on streams, ponds, and lakes, and provide habitat to a variety of species, including several of greatest conservation need. Additionally, through this process we tested a new method for prioritizing and acquiring easements for the best value. Called MMAPLE, the Minnesota Multi-faceted Approach for Prioritizing Land Easements, the system weighs the measurable environmental benefits against the cost that the current landowner wants to provide a permanent easement on that land. Using sealed bids, each landowner chooses their own price which results in lower costs and fewer complaints from landowners and taxpayers about the "fairness" or "price" of the easement process.

3) Provide support for township and county officials to review and change zoning and ordinances that impeded protection of the open space. Outcome: Two "conservation design" conferences for officials and the public as well as reviews of the existing ordinances by professionals resulted in positive feedback from the participants. This gradual education helped create sufficient support for Stearns County to pass a land-use ordinance that requires new housing developments in the Avon Hills to permanently preserve at least 80% of the land. This is believed to be the highest standard in the USA.

Project Results Use and Dissemination

The success of the land use concepts used in the Avon Hills of Stearns County to preserve open space and working forests and farms has been disseminated in a variety of ways. Staff, officials, and citizens have been asked to discuss the concepts with neighboring county officials and at professional meetings.

Todd County, a neighboring county, sent several officials to the land use conferences and has gradually begun to implement similar practices in their county.

The MMAPLE method developed under this grant is being used to apply for an Outdoor Heritage Fund grant for more easements.

IV. OUTLINE OF PROJECT RESULTS:

Result 1: Community Outreach and Communication

Description:
Facilitate communication among landowners, environmental groups, local units of government, and others within the Avon Hills landscape to promote comprehensive planning and zoning and environmental awareness that results in land conservation and open space protection. Publish an Avon Hills Initiative (AHI) newsletter; implement at least two conferences regarding land protection, ecological principles, and land stewardship. Promote and secure the adoption of local government comprehensive land use plans and ordinances that are effective in protecting open space, habitat, water quality, scenic zones, working forests, and other conservation benefits.

Summary Budget Information for Result 1:		
	Trust Fund Budget:	$ 61,000
	Total Spent to date:	$ 61,000
	Balance:	$ 0

Deliverable	**Completion Date**	**Budget Status**	
See following to be completed by applicants staff or a contractor or partner working with the applicant :	All ongoing through June 2011	$61,000	N/A

Results-Oriented Billing Deliverables:	Amount paid per result	Minimum Over 3 year contract	Maximum Over 3 year contract
1-1. Avon Hills Initiative Newsletter writing, publication, and mailing to at least 300 households and organizations.	$1,500 per newsletter	6 newsletters	12 newsletters
1-2. Arboretum staff assistance to AHI and participation related to land use, land preservation, land stewardship, open space, easements, zoning, taxation, etc. for AHI meetings, township, county, state meetings, and other organizations requesting information.	$250 per meeting/event/activity	75 Activities	225 Activities
1-3. Conferences on land use, land preservation, and land stewardship, etc. (Must be at least one-day each)	$7,500 per conference	2 Conferences	4 Conferences

1-4. Avon Hills Initiative group meetings for all members and interested parties to advance land use initiatives.	$1,500 per meeting	0 Meetings	4 Meetings
1-5. Passage of a revised Stearns County Comprehensive Land Use Plan with provisions to promote innovations in land stewardship and open space preservation in the Avon Hills.	$5,000 per adoption by County Board	0 Adoptions	1 Adoption
1-6. Passage of new Stearns County Ordinances to enact the County Comp Plan with provisions to promote innovations in land stewardship and open space preservation in the Avon Hills.	$5,000 per adoption by County Board	0 Adoptions	1 Adoption
1-7. Passage of a revised Township(s) Comprehensive Land Use Plan with provisions to promote innovations in land stewardship and open space preservation in the Avon Hills.	$5,000 per adoption by a Township Board (Limited to one per Township)	0 Adoptions	4 Adoptions
1-8. Passage of new Township(s) Ordinances to enact the County Comp Plan with provisions to promote innovations in land stewardship and open space preservation in the Avon Hills.	$5,000 per adoption by a Township Board (Limited to one per Township)	0 Adoptions	4 Adoptions
1-9. Passage of a revised City(s) Comprehensive Land Use Plan with provisions to promote innovations in land stewardship and open space preservation in the Avon Hills.	$5,000 per adoption by a City Council (Limited to one per City)	0 Adoptions	2 Adoptions
1-10. Passage of new City(s) Ordinances to enact the City Comp Plan with provisions to promote innovations in land stewardship and open space preservation in the Avon Hills.	$5,000 per adoption by a City Council (Limited to one per City)	0 Adoptions	2 Adoptions

Result 1 Final Report Summary:

The exciting news of this result is that citizen/landowner participation in this project started high and got even higher. This is best told by the participation in the annual Avon Hills Initiative conferences. While open to anyone and advertising was done in public forums, the direct mailing was directed to the landowners of the townships in the Avon Hills and it was those landowners who made up the majority of attendees. Getting 300 local people to attend any meeting would have to be deemed a success, but getting 900 to attend over 3 years and actually “selling out” the space on occasion indicates very strong public interest and support.

These conferences provided education which increased the interest and created support for preserving the open spaces of the Avon Hills. That support resulted in a multi-year process that saw a full revision of the Stearns County Ordinances which reflected the desire for more land protection. The new ordinance created a conservation overlay district option which was voluntarily enacted by Avon and Collegeville Townships covering the majority of the Avon Hills. See

http://www.co.stearns.mn.us/Environment/LandUseandAgriculture/PlanningandZoning
As part of that overlay district, developers must permanently preserve 80% of the land they are developing as open space /working forests /working farms. In return they may receive extra density on the 20% they are developing. This is one of the most positive ordinances in the USA for preserving open space.

Result 2: Complete New Conservation Easements

Description:
Saint John's Arboretum will partner with the MN Land Trust (MLT) to permanently protect land within the Avon Hills landscape by 1) identifying and contacting interested landowners; 2) negotiating and completing 6-10 permanent conservation easements on up to 450-1,000 acres of land; and 3) dedicating funds for the perpetual monitoring, management and enforcement of the easements.

St. John's Arboretum and the Land Trust will work with landowners willing to protect their land through perpetual conservation easements drafted to: prohibit land uses that could negatively impact identified important riparian, habitat, or scenic values, require natural resource habitat management plans where appropriate, and direct the use of native vegetation where appropriate in conjunction with any required restoration. We will work with donated easements whenever possible but may also purchase easements where necessary.

The budget incorporates the critical components of an easement program: identifying and negotiating with landowners, drafting and completing easements, documenting property conditions, and monitoring and enforcing easements in perpetuity by dedicating funds for long-term easement stewardship.

Funds will be used for staff time, direct payments to landowners, and transactional expenses such as appraisals, title review, and mapping. Funds also may be requested for the Stewardship and Enforcement Fund to provide for the long-term management and enforcement of easements on a project-by-project basis. The Land Trust will estimate anticipated annual expenses for each project and the investment needed to generate annual income sufficient to cover expenses in perpetuity--all in accordance with Land Trust policies and procedures. The Land Trust will report to LCCMR annually on the status of the Stewardship and Enforcement Fund and the easements acquired with funds from this grant.

Summary Budget Information for Result 2:	Trust Fund Budget:	$ 256,000
	Total Spent to date:	$ 225,053
	Balance:	$ 30,947

Deliverable	**Completion Date**	**Budget**	**Status**
2-1. Identify and contact landowners (Saint John's)	Ongoing through June 30, 2011	$ 29,500	N/A

	Amount paid per result
Saint John's will deliver to the MN Land Trust the names and information about Avon Hills landowners interested in meeting with the MN Land Trust regarding a conservation easement.	$30 per acre handed off to the MN Land Trust

2-2. Follow up contacts with landowners (as negotiated between MLT and LCCMR)	Ongoing through June 30, 2011	$10,000
2-3. Negotiate, draft, and complete 6-10 easements, including completion of baseline documentation (as negotiated between MLT and LCCMR)	June 30, 2011	$150,500
2-4. Dedicate funds for easement Stewardship (MN Land Trust) (as negotiated between MLT and LCCMR)	June 30, 2011	$66,000

Result 2 Final Report Summary:

Goal:	**450 acres**
Number of Easements Completed:	6
Total Acres of Easements Completed:	400

(See attached: Avon Hills Completed Project Summaries)
(See attached: Avon Hills Completed Project Map)
(See attached: Avon Hills Final Data Sheet of Purchased Easements)

Permanent easements are clearly the best way to assure that open space on private land is protected for future generations. As the concept of easements was not well known at the start of the project in the Avon Hills, time was spent early on teaching landowners about the value and technicalities of easements. Local staff met with local landowners on an individual basis and the merits of donated easements were promoted for 2 ½ years. This did result in 4 donated easements totaling 301 acres. We entered in advanced conversations with 16 landowners which shows there was interest, but most owners wanted something in return for granting a permanent easement.

The language of our grant also allowed for the purchase of easements. With only 4 months left in the program, we determined that it would be best to seek landowners that would be willing to sell an easement.

LCCMR staff approved a novel approach to acquire easements using a systematic evaluation that compares environmental benefits to easement cost. We named this ranking system the Minnesota Multi-faceted Approach for Prioritizing Land Easements (MMAPLE). This system works especially well in landscapes with a fair number of quality properties and where using easements to add more total acres to the conservation estate is more important than getting an easement on any specific, pre-selected tract.

The MMAPLE Technique: The MMAPLE system was developed using ecological experts to define and rate the environmental qualities and benefits most sought from land within the Avon Hills (e.g. shoreline, land with identified Sites of Biodiversity Significance (SOBS), adjacency to other protected properties, etc.). All of the environmental rating factors are based on existing data that is easy to verify using maps and aerial photos.

For those properties which meet the minimum threshold of environmental benefits, MMAPLE uses a market-based approach, asking landowners to submit a sealed bid for the lowest price they will accept for a conservation easement. The opportunity to bid and the bidding deadline will be publically announced so anyone with qualified land may participate.

Prior to bidding, landowners will be able to visit with our organization to learn about easements and receive an environmental benefits score for their land to determine if their land is qualified. They will also receive a bidding form and will be able to see how different bids might affect their priority for receiving an easement. Our organization will not provide any advice on what a landowner should bid. We will explain that no payments will be made above the appraised value of an easement.

MMAPLE will prioritize easements by comparing the environmental benefits that are inherent to a specific parcel with the easement cost of the landowner's bid for that parcel. This method assures that high quality sites receive easements at the lowest cost and achieves the best value for the public funding.

Benefits of using a process like MMAPLE:

- MMAPLE creates a "Conservation Value Rating" for each parcel which is the ratio of environmental benefits on the parcel compared to the easement costs.
    - Using this ratio as the Conservation Value Rating allows a straight-forward comparison of multiple parcels.
- MMAPLE requires sealed bidding from the landowners offering parcels.
    - Reduces easement cost by letting landowners establish their lowest price (Note: limits are established so no bid can exceed the appraised value or some percent of the appraised value.).
    - Eliminates complaints that bureaucrats are setting the prices.
    - Eliminates gossip and hard feelings about how or why Landowner A got paid more than Landowner B.
    - Eliminates need for complex formulas to establish "fair" easement value (only the maximum needs to be established.).
    - Uses a fixed amount of funding most efficiently.

- MMAPLE uses natural resource experts to create the scoring system for rating the local natural resources.
    - Uses only existing data and aerial photo measurements for the resources.
    - Can be completed and easily explained in 30 minutes in the landowner's kitchen.

- Scoring can be targeted to the funder's priorities.

Example:
Each of the following landowners has 100 acres within the target landscape. Land is worth $4,000/acre in this landscape. Each parcel has different natural resource features and would provide different environmental benefits if enrolled in a conservation easement. Each of the properties meets the minimum threshold of natural resource benefits. Let's assume that $160,000 has been allocated to this landscape for this round of bidding.

- Bob's land is ecologically very nice and has 10,000 environmental benefit points as scored. Equally importantly, Bob is willing to accept $500/acre for an easement. His "Conservation Value Rating" is 10,000/500 or 20.
- Julie's land has 8,000 environmental benefit points as scored. Julie wants $2,000/acre for an easement. Her "Conservation Value Rating" is 8000/2000 or 4.
- Jack's land has 5,000 environmental benefit points as scored and Jack wants $1,000/acre for an easement. His "Conservation Value Rating" is 5000/1000 or 5.
- Rachel's land has the minimum 1,000 environmental benefit points as scored. Rachel is really interested in conservation and wants only $100/acre for an easement. Her "Conservation Value Rating" is 1000/100 or 10.

Under the MMAPLE system, we begin funding with the highest Conservation Value Rating. (Conservation Value Rating = the ratio of Environmental Benefit Points / $ per acre)

- First, we would fund Bob's land using $50,000. (Conservation Value Rating = 20)
- Next, we would fund Rachel's land using $10,000. (Conservation Value Rating = 10)
- Next, we would fund Jack's land using $100,000,(Conservation Value Rating = 5)
- The funding would now be gone and we would not fund an easement for Julie's land. However she may choose to bid in future rounds if funding is again available and she may choose to lower her bid in a future round to increase her chance of being accepted.

More information, including an easement handout, landowner application, and the MMAPLE bidding worksheet are available on the Avon Hills Initiative web site: https://www.csbsju.edu/Arboretum/Education/Community/AvonHillsInitiative/Events/Easements.htm

Result 3: Local Ordinance Reviews and Field Visits

Description:
To best protect landscapes, local ordinances need to actually carry out the lofty intentions expressed in most comprehensive land-use plans. Funding will be available to up to two cities, four townships, and Stearns Co. to submit draft comprehensive plans and ordinances for review by Randall Arendt (or other recognized expert) on land-use planning for conservation.

Summary Budget Information for Result 3:		
	Trust Fund Budget:	$ 20,000
	Total Spent to date:	$ 18,359
	Balance:	$ 1,641

Deliverable	**Completion Date**	**Budget**	**Status**
1. Ordinance reviews	6/30/11	20,000	N/A

Results-Oriented Billing Deliverables:		Minimum	Maximum
	Amount paid per result	Over 3 year contract	
Professional review and written suggestions of draft county, township, or city comp plans or ordinances by a recognized expert such as Randall Arendt.	$4,000 per review	0	5 reviews

Result 3 Final Report Summary:

Provide support for township and county officials to review and change zoning and ordinances that impeded protection of the open space. Two “conservation design” conferences for officials and the public as well as reviews of the existing ordinances by professionals resulted in positive feedback from the participants. This gradual education helped create sufficient support for Stearns County to pass a land-use ordinance that requires new housing developments in the Avon Hills to permanently preserve at least 80% of the land. This is believed to be the highest standard in the USA.

Stearns County using nationally recognized expert Tom Daniels who was in MN to speak at the Avon Hills conference. He met a day earlier with township and county officials and provided a line-by-line suggestion for their consumption. That review was heavily used by the citizens committee assigned to draft the new land use ordinances in Stearns County. (See result 1) The end result of the ordinance review is that Stearns County has a conservation overlay district that is a national leader in that it seeks to protect 80% of the existing open land.

Avon Township and Collegeville Township both do township level zoning and land use planning as a stricter subset of the county zoning. They also elected to undergo a

review of their existing ordinances in an attempt to assure that the land use provisions best protected open space while providing the option for land development.

The City of St. Joseph also requested a mini-conference of local officials and interested parties to look at the land-use provisions of the new comprehensive plan being created. This draft plan proposed to annex large portions of an adjacent township including portions of the Avon Hills. The city was intentionally using old-fashioned methods of land use planning that result in minimal green space, up-front allocations of high density housing to developers, and little thought about the livability of such housing or even the need for such large swaths of open land to be annexed. While the conference speakers were very good and it was well-attended, few city officials chose to attend and the end result was not especially positive. We had hoped it would have a more definitive effect on the final outcome of the comp plan. But the local leadership was very committed to a traditional approach to comprehensive planning. A city council member commented that a large ship turns slowly, but that this review and the preceding day of conferences had started to turn the ship towards a greener future.

Certainly this LCCMR project resulted in the majority of the targeted lands being directed towards a greener future.

V. TOTAL TRUST FUND PROJECT BUDGET:
Staff or Contract Services:
$113,701 for Arboretum staff members/student employee salary.
(Estimated distribution of staff salaries is: Thomas Kroll .10 FTE @ 3 years = $29,251; S. Gainey .10 FTE @ 3 years = $13,480; Avon Hills Land Heritage Coordinator .4 FTE @ 3 years = $45,000. Environmental Education Fellow .4 FTE @3 yrs = $25,970.)
$1,200 for speaker honorariums for conferences, 6 @ $200 each.
$20,000 for comprehensive plan and ordinance consulting.
Equipment: $ 0
Development: $ 0
Restoration: $ 0
Acquisition, including easements: $ Negotiation, stewardship and legal fees, etc. = $198,710 (400 acres; 6 easements); payment to MN Land Trust for easement stewardship.
Other: $ Printing and supplies for outreach and conferences $2,000; mileage $530.

TOTAL TRUST FUND PROJECT BUDGET: $ 337,431
Explanation of Capital Expenditures Greater Than $3,500: N/A

VI. OTHER FUNDS & PARTNERS:
A. Project Partners: The MN Land Trust is the largest partner and is financially involved as a contractor and received $198,710. The Nature Conservancy is an active partner in promoting conservation in the Avon Hills and has recently completed the Conservation Action Plan for the Avon Hills. No funding for The Nature Conservancy is planned at this time, but they could be come involved as a contractor given appropriate circumstances.

B. Other Funds Proposed to be Spent during the Project Period: Saint John's and The Nature Conservancy have been actively promoting open space and innovate land use for 5 years. No specific funding is leveraged as part of this grant, but many groups share an interest in positive outcomes and contribute their time and funding based on the activity.
C. Past Spending: Saint John's and The Nature Conservancy each committed $5,000 in cash to launch the Avon Hills Initiative. Saint John's has committed an additional $5,000 in cash and also spent many hours in in-kind contributions fo staff. The Initiative Foundation of Little Falls has committed $10,000 to promote the Avon Hills Initiative.

D. Time: 3 years ending on June 30, 2011.
VII. DISSEMINATION: The Avon Hills website will be the most accessible location for information. http://www.csbsju.edu/arboretum/avonhills
VIII. REPORTING REQUIREMENTS: Periodic work program progress reports were submitted not later than January 2009, August 2009, January 2010, August 2010, and January 2011. This is the final work program report.
.
IX. RESEARCH PROJECTS: N/A

Attachment A: Budget Detail for 2008 Projects - Summary and a Budget page for each partner (if applicable) 30-Jun-11

Project Title: Preserving the Avon Hills Landscape

Project Manager Name: Thomas Kroll

Trust Fund Appropriation: $ 337,000 **$337,000**

1) See list of non-eligible expenses, do not include any of these items in your budget sheet

2) Remove any budget item lines not applicable

2008 Trust Fund Budget	**Result 1 Budget:**	**Amount Spent** *(30 Jun 2011)*	**Adjusted Balance** (30 Jun 2011)	**Result 2 Budget:**	**Amount Spent** *(30 Jun 2011)*	**Adjusted Balance** *(30 Jun 2011)*	**Result 3 Budget:**	**Amount Spent** *(30 Jun 2011)*	**Balance** *(30 Jun 2011)*	**TOTAL BUDGET**	**TOTAL BALANCE**
	Community Outreach and Communication			*Complete New Conservation Easements*			*Local Ordinance Reviews and Field Visits*				
BUDGET ITEM											
PERSONNEL: wages and benefits (SJ Staff)	30,517	30,517	0	29,360	26,141	3,219			0	59,877	3,219
Contracts			0	0		0			0	0	0
Professional/technical (honorariums)			0	140	140	0	18,800	17,221	1,579	18,940	1,579
Minnesota Land Trust			0	32,500	28,804	3,696				32,500	3,696
Honararium s	9,073	9,073	0	0		0			0	9,073	0
Other direct operating costs *(for what? – be specific)*			0	0		0			0	0	0
Equipment / Tools *(what equipment? Give a general description and cost)*			0	0		0			0	0	0
Office equipment & computers - NOT ALLOWED unless unique to the project			0	0		0			0	0	0
Other Capital equipment *(list specific items)*			0	0		0			0	0	0
Land acquisition			0	0		0			0	0	0
Land rights acquisition (easements - Minnesota Land Trust)			0	128,000	106,968	21,032			0	128,000	21,032
Professional Services for Acq.			0	0		0			0	0	0
Printing	8,070	8,070	0	0		0	1,200	1,138	62	9,270	62
Other Supplies (folders, mailings)	11,950	11,950	0	0		0			0	11,950	0
Travel expenses in Minnesota	1,390	1,390	0	0		0			0	1,390	0
Travel outside Minnesota *(where?)*			0	0		0			0	0	0
Construction *(for what?)*			0	0		0			0	0	0
Other land improvement *(for what?)*			0	0		0			0	0	0
Other *(Easement Stewardship - funds dedicated to perpetually monitoring, managing, and enforcing acquired easements on an estimated 450-1,000 acres. - Minnesota Land Trust)*			0	66,000	63,000	3,000			0	66,000	3,000
COLUMN TOTAL	**$61,000**	**$61,000**	0	**$256,000**	**$225,053**	**$30,947**	**$20,000**	**$18,359**	**$1,641**	**$337,000**	**$32,588**

The Result 1 Adjusted Budget accurately reflects expenditures for Result 1 and includes a small shifting of funds between budget items within Result 1. All expenses were incurred to achieve deliverables in Result 1. Shifting funds between personnel and other expenses covers the difference between the budget and actual expenses without exceeding the Result 1 total budget.
The Result 2 Adjusted Budget reflects the changes approved to allow more funding for easement aquisition and less funding for staff personell time and MLT staff time. This allowed additional acres to be covered by easements.

Preserving the Avon Hills Landscape

COMPLETED PROJECT SUMMARIES

Avon Hills (1)

This 34-acre property contains relatively natural and undisturbed habitats of upland forest, wetland, grassland and a pond that support a variety of species in greatest conservation need. Surrounded by undeveloped hills, wetlands, and ponds, the property provides habitat to such animal species as the indigo bunting, scarlet tanager, mink, muskrat, and a variety of songbirds, amphibians, and waterfowl. Warbler species migrate through the property seasonally. As part of a wetland complex feeding into Watab Creek, this land helps preserve water quality. This easement was donated by private landowners and prohibits industrial, commercial and agricultural uses. The easement also prohibits division of the property and residential use is limited.

Avon Hills (2)

This 11-acre property contains relatively natural and undisturbed habitats of upland forest and wetlands that support a variety of wildlife species. This property lies adjacent to the first Avon Hills conservation easement, and contributes to the overall health of the wetland complex feeding into the Watab Creek. This easement was completed by a private company and prohibits industrial, commercial, residential and agricultural uses. The easement further prohibits division of the property.

St. Wendel Tamarack Bog (1)

This 41-acre property consists primarily of hardwood forest and wetlands fed by natural springs, as well as some small areas of wildlife food plots and grassland. The property also contains a pond, and two small perennial streams, which have a combined total of 775 feet of shoreline. The high-quality hardwood swamp and tamarack swamp on the property have both been mapped by the Minnesota County Biological Survey and are part of a larger wetland complex that connects with the adjacent St. Wendel Tamarack Bog SNA. This easement was donated by private landowners and prohibits industrial, commercial, residential and agricultural uses. The easement further prohibits division of the property.

St. Wendel Tamarack Bog (2)

This 56-acre property consists primarily of forest and wetlands with natural springs, and some patches of grassland. The property also contains two ponds, perennial streams, and shoreline along Swamp Lake, totaling of 3,697 feet of shoreline. The high-quality native plant communities of spring fen, black ash seepage swamp, graminoid rich fen, willow-dogwood shrub swamp, and tamarack swamp have been mapped by the Minnesota County Biological Survey and are part of a larger wetland complex that connects with the adjacent St. Wendel Tamarack Bog SNA. The property provides habitat for a variety of species in greatest conservation need, including trumpeter swans, common snapping turtles and red-shouldered hawks, which have all been seen on the property by the landowners. This easement was purchased from private landowners for a price below fair-market value and prohibits industrial use, commercial use and division of the property, and limits residential and agricultural uses.

Sand Lake

This 43-acre property has large, rolling hills that consist mostly of mixed hardwood forest, woodland, and grassland with scattered trees. The dominant trees include bur and white oak, green ash, birch and ironwood. There are three small ponds with numerous wetlands on the property that contribute to the ecological integrity of Sand Lake. The property also includes 4,793 feet of shoreline along the north side of Sand Lake, a natural environment lake by the Minnesota DNR, as well as a key habitat for species in conservation need as identified by Minnesota's Comprehensive Wildlife Conservation Strategy due to its shallow depth. This easement was purchased from private landowners for a price below fair-market value. This conservation easement prohibits industrial, commercial, residential and agricultural uses, and also prohibits division of the property.

Stumpf Lake

This 215-acre property consists of a rolling terrain with mixed hardwood forest, wetlands, 15-acres of planted pines, and about 35 acres of CRP native grasses. The property contains shoreline on Pfleuger Lake and Watab Creek, which connects Pfleuger Lake and Stumpf Lake. The maple-basswood forest and mixed hardwood swamp located on the west side of the property have been identified as sites of biodiversity significance by the Minnesota County Biological Survey, and are also key habitats for species in greatest conservation need according to Minnesota's State Action Plan. The existing farmstead has been designated a Century Farm by the Minnesota Farm Bureau and the Minnesota State Fair. This easement was donated by a private landowner and prohibits industrial and agricultural uses. The easement also prohibits division of the property and residential use is limited.

Protecting the Avon Hills Landscape – 2008
Summary of Purchased and Donated Easements

PURCHASED EASEMENTS

Project	**Acres**	**Funding Type**	**Funds Use**	**Funding Amount**
Sand Lake Stearns County	43	ENRTF – 2008 Avon Hills	Purchase price of conservation easement	$163,000
		Landowner donation	Donated value of conservation easement	$13,620
		ENRTF – 2008 Avon Hills	Stewardship	$15,000
St. Wendel Tamarack Bog Stearns County	56	ENRTF – 2008 Avon Hills	Purchase price of conservation easement	$19,000
		Landowner donation	Donated value of conservation easement	$5,000
		ENRTF-2009 Land Trust allocation	Stewardship	$12,000

DONATED EASEMENTS

Project	**Acres**	**Funding Type**	**Funds Use**	**Funding Amount**
Avon Hills Stearns County	34	ENRTF – 2008 Avon Hills	Stewardship	$6,000
		Landowner donation	Stewardship	$9,000
		Landowner donation	Donated value of conservation easement	Unknown
Avon Hills Stearns County	11	ENRTF – 2008 Avon Hills	Stewardship	*Included with the stewardship for the other Avon Hills project*

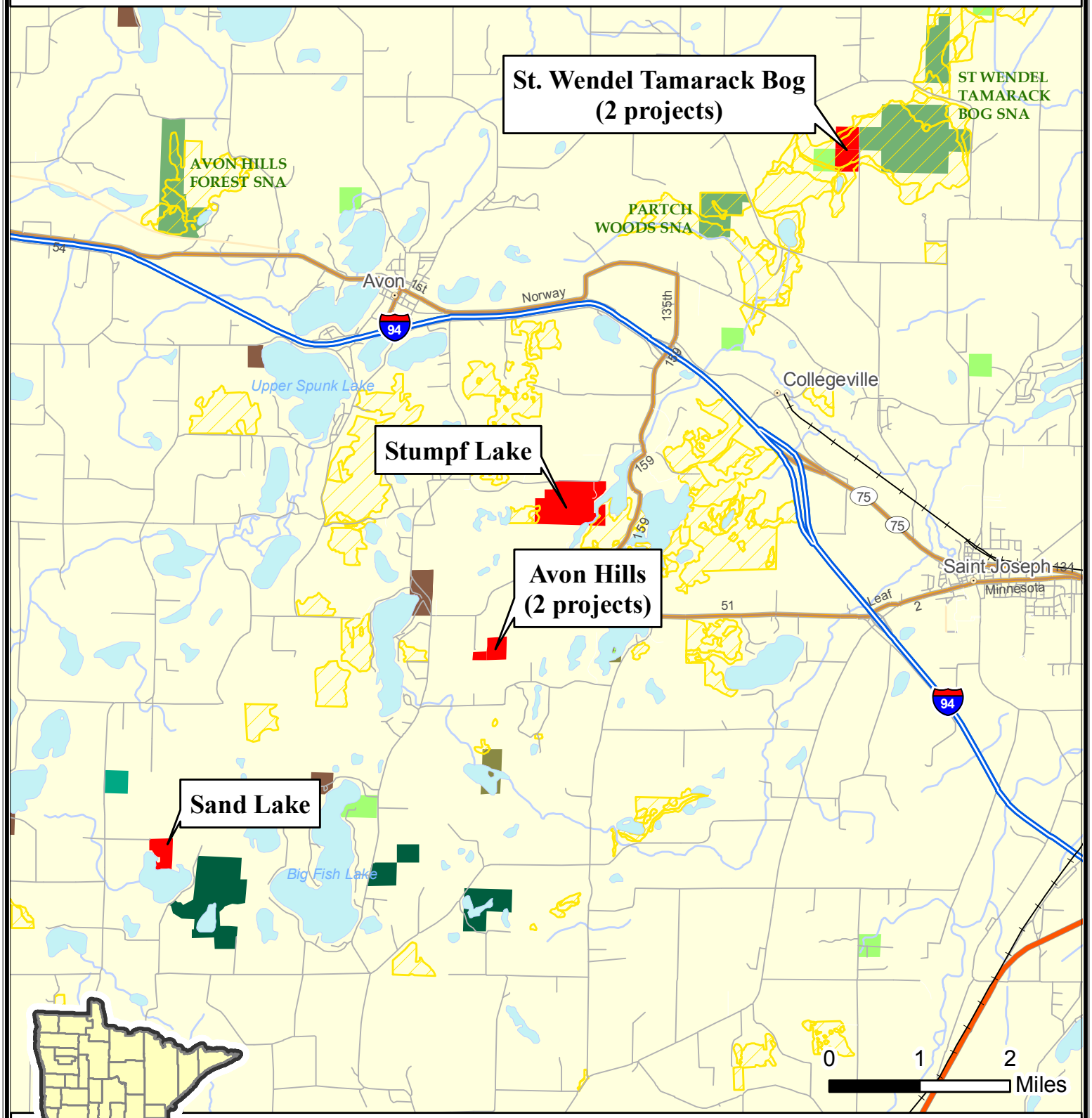
		Landowner donation	Donated value of conservation easement	Unknown
St. Wendel Tamarack Bog Stearns County	41	ENRTF – 2008 Avon Hills	Stewardship	$15,000
		Landowner donation	Donated value of conservation easement	Unknown
Stumpf Lake Stearns County	215	ENRTF – 2008 Avon Hills	Stewardship	$15,000
		Landowner donation	Donated value of conservation easement	Unknown

In addition to the expenses listed above, staff time and professional services expenses covering closing costs, title review, etc. were incurred and covered by the ENRTF Avon Hills funding. The Land Trust does not allocate staff time or professional services expenses to specific conservation projects.

Preserving the Avon Hills Landscape

LCCMR 2008 GRANT

Completed Conservation Easement Projects



Completed Projects
DNR Trails & Waterways Land
DNR Wildlife Management Areas
DNR Scientific & Natural Area
Waterfowl Production Areas
Other State Owned Land
Federally Owned Land
MCBS native plant communities

Saint John's University

Minnesota Land Trust

2008 Project Abstract
For the Period Ending June 30, 2010

PROJECT TITLE:	**Minnesota River Valley Green Corridor**
PROJECT MANAGER:	**Nancy Fasching**
AFFILIATION:	**Southwest Initiative Foundation**
MAILING ADDRESS:	**15 3rd Avenue NW**
CITY/STATE/ZIP:	**Hutchinson, MN 55350**
PHONE:	**320-587-4848**
E-MAIL:	**nancyf@swifoundation.org**
WEBSITE:	**www.swifoundation.org**
FUNDING SOURCE:	**Environment and Natural Resources Trust Fund**
LEGAL CITATION:	**ML 2008, Chap. 367, Sec. 2, Subd. 3e**

APPROPRIATION AMOUNT: $1,000,000

Overall Project Outcome and Results

The Green Corridor Legacy Program will provide Minnesotans public access to high quality game and wildlife habitat through a multi-year land acquisition plan.

The initial phase of this project included:

- Acquisition of 249.23 acres of easement free fee-title acquisition conservation lands from willing sellers. This program acquired land from willing and supportive landowners. The land is purchased and then transferred to the DNR for long-term habitat conservation, outdoor recreational access, sustainability, and monitoring. These properties include the Whispering Ridge Aquatic Management Area in Redwood County (182.87 acres), Beaver Falls Aquatic Management Area in Renville County (6.6 acres), and two additions to Fort Ridgely State Park in Renville County (29.85 acres and 30 acres).
- Development of a conservation plan guidance document that insures both the natural resources and the natural history of this corridor are restored, conserved, protected and utilized in manners that balance the ecological, cultural, socio-economic and recreational needs of today, while preserving these resources for future generations.
- Organization of a variety of stakeholders into a working partnership team committed to the vision for a Green Corridor in the Minnesota River Valley.

Project Results Use and Dissemination

Results from this project have been disseminated as follows:

- The conservation plan will be used to guide and vet proposed acquisitions by Green Corridor, Inc.
- More importantly, the plan will be used as a key decision support system by a wide variety of conservation partners and stakeholders within the project area to craft and implement a conservation and economic vision for the project area.
- The plan will be disseminated principally through the web, but is also available in limited numbers via CD and hard copy format. In the near future, once the new

Tatanka Bluff Council website is fully operational, a recap of these FY08 ENRTF appropriation accomplishments will be posted on this website under the “Green Corridor” icon tab. The website will ask viewers for comments and feedback concerning the various strategies and outcomes related to this project and the Conservation Plan. The project will also served as a cornerstone for future funding requests to the LCCMR and from the Outdoor Heritage Legacy Fund.

The communications and outreach activities that have been done for the Minnesota River Valley Green Corridor Project include:

- The plan has been adopted by Green Corridor, Inc. as its conservation vision for the Middle Minnesota Valley
- The final plan was presented to the public on May 6th, 2010 at the Tatanka Bluffs Council annual meeting at the Redwood Area Community Center in Redwood Falls MN.
- The conservation plan entitled, “Conservation in the Middle Minnesota Valley: A Blueprint and Action Plan” was produced in hard copy, CD and web format. The product will be available via the following web sites: Green Corridor, Inc. (www.tatankabluffs.com) and Great River Greening (www.greatrivergreening.org).
- Since the start of this project in the summer of 2008 numerous meetings, public forums, and media outreach activities have taken place that have illustrated the intended outcomes, accomplishments, and public benefits of this appropriation.

Trust Fund 2008 Work Program Final Report

Date of Report: June 30, 2010
Date of Next Status Report: Final
Date of Work Program Approval: June 17, 2008
Project Completion Date: June 30, 2010

I. PROJECT TITLE: Minnesota River Valley Green Corridor

Project Manager: Nancy Fasching
Affiliation: Southwest Initiative Foundation
Mailing Address: 15 3rd Avenue NW
City/State/Zip: Hutchinson, MN 55350
Telephone Number: Foundation (320) 587-4848
E-mail Address: nancyf@swifoundation.org
FAX Number: (320) 587-3838
Web Page Address: - www.swifoundation.org

Location: The project area is the Minnesota River Valley from Upper Sioux Agency State Park to Fort Ridgely State Park, located in Renville, Redwood, Yellow Medicine, Brown, and Nicollet counties. (See attached map)

Total Trust Fund Project Budget:	**Trust Fund Appropriation:**	$1,000,000
	Minus Amount Spent:	$1,000,000
	Equal Balance:	$0

Legal Citation: ML 2008, Chap. 367, Sec. 2, Subd. 3e

Appropriation Language:
Minnesota River Valley Green Corridor Land Protection –
$1,000,000 is from the trust fund to the commissioner of natural resources for an agreement with the Southwest Initiative Foundation for planning, acquisition, and easements in the Minnesota River Valley. The priority for acquisition must be on lands with native prairies, unique geological features, fens, and wetlands not currently under a permanent protection program. A list of proposed restorations and fee title and easement acquisitions must be provided as a part of the work program. All funding for conservation easements must include a long-term stewardship plan and appropriate funding for monitoring. No more than ten percent may be spent on planning and management.

II. & III. PROJECT SUMMARY AND RESULTS:
Overall Project Outcome and Results
The Green Corridor Legacy Program will provide Minnesotans public access to high quality game and wildlife habitat through a multi-year land acquisition plan.

The initial phase of this project included:

- Acquisition of 249.23 acres of easement free fee-title acquisition conservation lands from willing sellers. This program acquired land from willing and supportive landowners. The land is purchased and then transferred to the DNR for long-term habitat conservation, outdoor recreational access, sustainability, and monitoring. These properties include the Whispering Ridge Aquatic Management Area in Redwood County (182.87 acres), Beaver Falls Aquatic

Management Area in Renville County (6.6 acres), and two additions to Fort Ridgely State Park in Renville County (29.85 acres).

- Development of a conservation plan guidance document that insures both the natural resources and the natural history of this corridor are restored, conserved, protected and utilized in manners that balance the ecological, cultural, socio-economic and recreational needs of today, while preserving these resources for future generations.
- Organization of a variety of stakeholders into a working partnership team committed to the vision for a Green Corridor in the Minnesota River Valley.

Project Results Use and Dissemination

Results from this project have been disseminated as follows:

- The conservation plan is used to guide and vet proposed acquisitions by Green Corridor, Inc.
- More importantly, the plan is used as a key decision support system by a wide variety of conservation partners and stakeholders within the project area to craft and implement a conservation and economic vision for the project area.
- The plan was disseminated principally through the web, but is also available in limited numbers via CD and hard copy format. In the near future, once the new Tatanka Bluff Council website is fully operational, a recap of these FY08 ENRTF appropriation accomplishments are posted on this website under the "Green Corridor" icon tab. The website will ask viewers for comments and feedback concerning the various strategies and outcomes related to this project and the Conservation Plan. The project will also served as a cornerstone for future funding requests to the LCCMR and from the Outdoor Heritage Legacy Fund.

The communications and outreach activities that have been done for the Minnesota River Valley Green Corridor Project include:

- The plan has been adopted by Green Corridor, Inc. as its conservation vision for the Middle Minnesota Valley
- The final plan was presented to the public on May 6th, 2010 at the Tatanka Bluffs Council annual meeting at the Redwood Area Community Center in Redwood Falls MN.
- The conservation plan entitled, "Conservation in the Middle Minnesota Valley: A Blueprint and Action Plan" was produced in hard copy, CD and web format. The product is available via the following web sites: Green Corridor, Inc. (www.tatankabluffs.com) and Great River Greening (www.greatrivergreening.org).
- Since the start of this project in the summer of 2008 numerous meetings, public forums, and media outreach activities have taken place that have illustrated the intended outcomes, accomplishments, and public benefits of this appropriation.

IV. OUTLINE OF PROJECT RESULTS:

Result 1: Ownership acquisition of a minimum of 220 acres of easement free fee-title acquisition conservation lands

Description: The priority for acquisition was for high-quality natural resource or conservation lands with native prairies, unique geological features, fens, and wetlands not currently under a permanent protection program to provide natural buffers to water resources.

Ownership was transferred to the appropriate DNR divisions (or government entity) to best preserve and manage the specific property for its intended use, as outlined in the conservation guidance document:

- inholdings in state parks were transferred to state parks
- buffering lands in state parks were transferred to state parks pending boundary adjustments
- ecologically sensitive properties needing greater protection became SNAs
- appropriate acquisitions became WMAs or AMAs
- portions of acquisitions may become part of the Minnesota River Trail with the T&W Division State Canoe and Boating Routes public water access sites, rest areas and camp sites

The **Acquisition Process** of the project based was on the recommendation of the selection committee until the conservation plan was completed to determine the prime property for purchase. The selection committee included the following members:

DNR - Wildlife Division:	Local area wildlife manager (2)
DNR - Fisheries Division:	Local area fisheries manager (2)
DNR - Trails & Waterways:	Local area supervisor (2)
DNR - Eco Services:	Local regional supervisor (1)
DNR - State Parks:	Upper Sioux Agency & Fort Ridgely State Park rangers
Green Corridor Team:	Four executive board members
Tatanka Bluffs Corridor:	1 Redwood and 1 Renville County representative

The following **Acquisition Criteria** was used as the basis for determining the order in which land parcels were selected, based on key properties and characteristics.

The priority for acquisition was on high-quality natural resource or conservation lands with native prairies, unique geological features, fens, and wetlands not currently under a permanent protection program that provide natural buffers to water resources.

<u>Step 1 - Key Questions</u>

1. Does the property currently have a permanent conservation easement?
   If yes, do not pursue acquisition
   If no, go to step 2

2. Is the current property owner(s) a willing seller?
   If no, do not pursue acquisition
   If yes, proceed with ranking

<u>Step 2 - Select Appropriate Category</u>

Public Use other than Wildlife/Fisheries related

1. Does the property connect to existing trail easements? 10 points
   OR
2. Does the property have the potential for trail development? 5 points
3. Is the property suitable for a water access site? 10 points
4. Does the site have potential for other use (e.g. dog trial)? 5 points

Wildlife/Fisheries Related Recreation

1. Does the property offer at least fair opportunity for:

Deer hunting	5 points
Wild Turkey hunting	5 points
Pheasant hunting	5 points
Waterfowl hunting	5 points
Trapping and/or small game hunting	5 points
Shore Fishing	5 points

2. Does the property offer viewing opportunities for:

Raptors (e.g. bald eagles)	2 points
Wetland birds	2 points
Grassland Birds	2 points
Forest Birds	2 points

Water Resource Protection

1. Does the property contain frontage on the Minnesota River? 10 points
2. Does the property contain frontage on a tributary of the Minnesota River? 5 points
3. Does the property contain wetlands? 5 points
4. Does the property contain springs or seeps? 5 points

Biological Diversity Protection

1. Does the property contain or offer habitat to Federal or State listed species of conservation concern (e.g. endangered, threatened, special concern)? 10 points
2. Does the property contain habitat listed by the Minnesota County Biological Survey (MCBS)? 10 points
3. Does the property contain natural habitat not listed by MCBS? 5 points
4. Does the property buffer other protected conservation land (e.g. RIM, WMA) 5 points
5. Does the property have good potential for restoration of wetland, prairie, riparian forest, or oak savanna? 5 points

Acquisition List/Transaction Costs

- Beaver Falls AMA, 6.6 acres, 66 Points Received, Appraised Value $12,600, Purchase Price $12,600, Total Project Cost $12,892 (Partial DNR Funding of $6,300)
- Fort Ridgely State Park - Beltz tract, 30 acres, 48 Points Received + State Park In Holding, Appraised Value $150,000, Purchase Price $150,000, Total Project Cost $153,486
- Fort Ridgely State Park - Firle tract – 29.9 acres, 48 Points Received + State Park In Holding, Appraised Value $150,000, Purchase Price $150,000, Total Project Cost $151,653
- Whispering Ridge AMA – 182.9 acres, 113 Points Received, Appraised Value $593,290, Purchase Price $593,290, Total Project Cost $598,895

A budgeted amount of $900,200 covered actual land acquisition costs.

Deliverable	**Completion Date**	**Budget**	**Status**
1. 220 Acres Easement Free Conservation Land	June 30, 2010	$899,590	
Professional Services for Land Acquisition		$5,614	

Summary Budget Information for Result 1: Trust Fund Budget: $905,204
Amount Spent: $905,204
Balance: $0

Completion Date: June 30, 2010

Final Report Summary:
Property acquired includes Beaver Falls AMA for 6.6 acres with partnership funding by the DNR for 50% which closed on March 10, 2009; Whispering Ridge AMA for 182.87 acres with 100% funding by the Green Corridor which closed on June 29, 2009; Ft. Ridgely State Park – Firle tract – for 29.85 acres with 100% funding by the Green Corridor which closed on June 29, 2009; Ridgely State Park –Beltz tract for 30 acres with 100% funding by the Green Corridor which closed December 18, 2009. All

projects have been donated to the state of Minnesota and managed by the DNR by their respective divisions into perpetuity. The total number of acres acquired is 249.32 exceeding the project's goal of 220 acres.

Result 2: Conservation Plan for the Minnesota River Valley Green Corridor

Description: Engaged the multiple stakeholder groups to develop a conservation plan that identifies and includes the following:

1. known resources (natural area types, diversity, complexes; relevant plans & programs)
2. specific conservation & recreational priorities (especially bridging opportunities to existing resources)

This plan serves as a tool for future acquisition of land by priority area.

TASK	DELIVERABLE

I. Determine Initial Interest:
 	
o Public Meeting (Informational)
o Organize Technical Advisory Committee (DNR, county planners, and NGOs)
o Develop a Scope of Work;
  o Goals.
  o Objectives.
  o Criteria for land priorities
o Prepare a Time-Line, which includes coordination with UM trail study
	Adopted Conservation goals, objectives, and criteria
	
	Timeline for year process, including input from technical advisory committee, the general public, and any other stakeholders determined. At least quarterly meetings; see below for online input from public.
	
	List and Responsibilities of Technical Advisory Committee and of core management team
	
	Coordination with SWIF to set up public web page (recommended to keep public informed and to post ongoing documents for comment)

II. Collect and Analyze Resource Data: o Identify lands with native prairies, unique geological features, fens, and wetlands not currently under a permanent protection program. o Determine the relevant existing physical, natural and cultural resources, plans and studies o Ascertain the status of resource information; o Analyze resources; o As they relate to issues, concerns or problems. o In light of present and future conditions.	An inventory and analysis of resources, plans, and studies gathered (e.g., DNR County Biological Survey for the corridor). Determination of any missing information, which must be gathered by; o Donated professional services. o In-kind services. o Volunteer. o Contract.

III.	Prepare Draft River Conservation Plan: The Draft Plan shall contain: o Background information; o A map of the corridor. o Land use patterns. o An inventory of resources gathered. o An analyses of the appropriate resources o Listing of issues, concerns, opportunities and threats to ecological values. o Conservation options (issues, opportunities and concerns solution); o Consider options that promote resource awareness and stewardship. o A catalogue of implementation, acquisition and development actions. o Proposed time frame for implementation/development. o Proposed lead agency or contact person to undertake activity. o Other appropriate information.	The core of the plan is the conservation and open space alternatives and accompanying maps. While we cannot dictate at this point what that will look like, we anticipate various options or, if preferred, a sequence of prioritizations. For example: Conservation Alternative 1 -- existing public lands and certain critical Private Conservation Lands only (as determined by criteria in Task I). This alternative will assess the extent to which Existing Conservation Lands would suffice to protect the Critical Natural and Cultural Features Conservation Alternative 2 -- protect Essential Ecological Processes to sustain Critical Natural and Cultural and provide Recreational Corridors Conservation Alternative 3 -- include additional areas with potential Conservation value for recreation, habitat, corridor, and ecological processes.
IV.	Public Meeting to develop and use criteria for evaluating the conservation alternatives.	Documentation of comments
V.	Prepare Final Green Corridor Conservation Plan	Final Plan

Note: all steps imply working with a core management team (that includes SWIF and LCCMR project manager) and a technical advisory committee. Also, the National Park Service Trails and Conservation Assistance program has offered for free their services to help facilitate public meetings.

Great River Greening Estimated cost

Staff: $33,200
Ecologist @ 525 hrs
Planner or Landscape Architect @ 525 hrs
Ecological assistant @ 215 hrs
Mileage: $1800
Mapping and printing $5,000

Total: $40,000

Deliverable	**Completion Date**	**Budget**	**Status**
1. Conservation Plan – Great River Greening	**Jun. 30, 2010**	**$35,303**	

Summary Budget Information for Result 2:	**Trust Fund Budget:**	**$35,303**
	Amount Spent:	**$35,303**
	Balance:	**0**

Completion Date: June 30, 2010

Final Report Summary:

The concept for this Conservation Plan called for development of 3 independent plans (focusing on natural resources, cultural/historic, and recreation) merged together into a final conservation strategy.

Through this project we:

- Defined the boundaries of the project area
- Crafted a project team diagram with associated teams' responsibilities
- Drafted a timeline for completion of the plan
- Drafted a work breakdown structure for the project
- Undertook a stakeholder analysis as a step in developing a communication plan for the project
- Nominated possible team leads for each of the 3 sections of the plan (recreation, cultural/historic, and natural resources)
- Identified the variety of data available for use in the planning process
- Identified in concept the process and data structure underpinning the natural resources planning and prioritization component of the plan
- Reviewed the planning process utilized for the DNR Southern Minnesota Region to assess its utility as a framework for the Minnesota Valley Green Corridor.
- Identified specific data sets utilized and available from the DNR to this project.
- Undertook data collection and analyses related to the prioritization of lands

The conservation plan is complete and a public meeting unveiling of the information was held May 6, 2010.

Budget Amendment Request - to shift $882 of the conservation plan line for Great River Greening Travel to Great River Greening Printing. The MN River Valley Green Corridor Group has raised the funds of $4,697 to complete the full funding of the Conservation Plan.

Result 3: Coordination of Partnerships & Acquisition Process

This result will included the time associated with contacting property owners, partners, and overall coordination of the initiative efforts. Southwest Initiative Foundation was responsible for accounting and administrative efforts. The project manager was ultimately responsible for coordinating property acquisition including the responsibilities to develop, solicit approval from partners, and implement process for immediate land acquisitions. The position will also coordinated public relations and information outreach, along with cultivating partner relationships moving the project into the long term vision for area residents.

Deliverable	**Completion Date**	**Budget**	**Status**
1. Accounting Efforts			
7% FTE Direct Costs SWIF Accountant ($70,000 direct costs x 7%)	June 30, 2010	$4,900	
2. Administrative Efforts			

7% FTE Direct Costs SWIF Grant Officer ($70,000 direct costs x 7%)	June 30, 2010	$4,900
3. Coordination of land acquisition		
Project Manager Contract (600 hours @ $75 per hour = $45,000) (9,900 miles @ $.505 per mile = $5,000)	June 30, 2010	$49,693

Summary Budget Information for Result 3: Trust Fund Budget: $59,493
Amount Spent: $59,493
Balance: $ 0

Completion Date: June 30, 2010

Final Report Summary:

The Southwest Initiative Foundation provided the fiscal accounting and administrative lead for this project.

Billable compensation for contract services for Project Manager services performed by Green Corridor Consulting, Inc – Brad Cobb from July 1, 2008 – December 18, 2009. A brief overview of those activities (detail available for period 3/1/09 to 12/31/09) outlined as follows:

Project General Administration – 321 Total Hours

Based on the Acquisition Selection Committee criteria recommendations, the contract project manager coordinated the review of numerous proposals with six (6) different projects totaling 554.7 acres which were considered for funding. Numerous landowner and DNR agency meetings/process reviews/reports were conducted/performed to move each of these individual projects forward and coordinated on-going acquisition activities and processes. All projects have been transferred to the respective divisions of the MN DNR and have been approved by the regional director of the DNR.

Because this was a first year project funded by the E&NRTF, numerous public relation and information outreach activities were performed along with cultivating numerous partner relationships. Such activities are important for the success of the project and centered on providing area residents and stakeholders a long term vision of the Green Corridor initiatives. Groups informed of this project include the MN River Valley Scenic By-Way Association, Tatanka Bluffs Corridor group, National Wild Turkey Federation, Minnesota Deer Hunters, and area landowner groups.

Project Conservation Plan Assistance – 25 Hours

The contract project manager has been working closely with Great River Greening to develop a comprehensive and/or conservation plan by coordinating and attending stakeholder meetings and helping to develop key focus groups.

Beaver Falls AMA – Closed on March 10, 2009 – 20 Total Hours
This is a DNR lead project.
Detail available for period 3/1/09 to 12/31/09
Two (2) hours @ $75 per hour and 258 miles @ $.55 per mile. Billable activities associated to this project included coordinating and attending the closing, drive time, and post project closing meeting/discussion with DNR.

3/2/09: .25 hours Coordinated closing time with landowner & DNR
3/10/09 – 1.5 hours closing in Olivia and 138 miles – St. Joseph MN to Olivia and return
3/12/09 – .25 hours follow up with DNR Fisheries concerning Beaver Falls closing and 120 miles To/From St Joseph MN to Hutchinson MN

Brickyard AMA – Final disposition no acquisition – 7 Total Hours
Detail available for period 3/1/09 to 12/31/09
Two (2) hours @ $75 per hour. No mileage recorded. Billable activities associated to this project included coordinating the closure of this project. This project was pulled from the Green Corridor Accomplishment report because the DNR offer to the landowner exceeded the appraised value by more than 10%. The DNR did acquire this property with our financial assistance.
3/8/09: .5 hours preparation for end of March closing with DNR
3/19/09: 1.5 hours making final decisions w/DNR and SWIF to pull this project from Green Corridor project list

Ft. Ridgely State Park – Firle Tract – Closed on June 29, 2009 – 64 Total Hours
This is a Green Corridor lead acquisition. Action:

- Property selection
- Appraisal certified by the DNR.
- Negotiations with the landowner
- Access easement request has been submitted to the landowner
- Final purchase agreements delivered
- Resolution of title issues
- County board notified
- Verification of the LCCMR Exhibit F elements

Detail available for period 3/1/09 to 12/31/09
Twelve (12) hours @ $75 per hour and 378 miles @ $.55 per mile. Billable activities associated to this project included coordinating and presented to the Renville County Board of Commissioners meeting (5/19/09) of the notification of the pending sale/transfer, coordinating the final elements of the states title/abstract review , verification w/SWIF & DNR that all LCCMR Exhibit F elements were satisfied, and coordinating and attending the closing in Hutchinson MN.
5/11/09:1 hour to assist SWIF with compiling Exhibit F documents – e.g. abstracts
5/19/09: 4 hours to attend Renville County Board notification (Firle and Beltz tracts) in Olivia and 138 miles to/from St Joseph MN to Olivia MN
5/27/09: 1 hour to assist SWIF with Exhibit F documents – e.g. County Board Notification letters.
5/28/09: 1 hour meeting with landowner in Fairfax and 130 miles from Sanborn MN to Fairfax then to St Joseph.
6/4, 6/10, 6/11, 6/15, 6/16, 6/19, and 6/24/09: 3 hours total over these 7 days with numerous phone calls and emails concerning the missing trail easement language and reconstruction of warranty deed for this language with SWIF, DNR and AGO and then final resolution and verification of closing documents on 6/24/09.
6/29/09: 2 hours attended closing in Hutchinson MN and 50 miles from Clara City MN to Hutchinson and 60 miles from Hutchinson MN to St Joseph MN

Whispering Ridge AMA – the Zimmermann Tract – Closed on June 29, 2009 - 66 Total Hours
This is a Green Corridor lead acquisition. Action:

- Property selection
- Appraisal certified by the DNR.
- Negotiations with the landowner
- Access easement request has been submitted to the landowner

- Final purchase agreements delivered
- Resolution of title issues
- County board notified
- Verification of the LCCMR Exhibit F elements

Detail available for period 3/1/09 to 12/31/09

Twenty five (25) hours @ $75 per hour and 496 miles @ $.55 per mile. Billable activities associated to this project included purchase agreement negotiations (two visits) with landowner, assistance landowner with the delivery of the updated abstract (new survey of building site exclusion area) to DNR/state, coordinated and presented to the Redwood County Board of Commissioner (April 14, 2009) meeting for the purpose of notification of pending sale and transfer, verification of all Exhibit F elements have been completed, coordinated and resolved AGO/DNR with landowner concerning questions about an un-disclosed quick claim document, mortgage satisfaction with landowner bank in Iowa, and coordinated and attending closing in Clara City MN.

3/4/09: 1 hour spent confirming appraisal status via emails and phone calls w/SWIF and DNR.

3/14/09: 2 hours spent reviewing certified appraisal and phone call with landowner to discuss the purchase agreement process and scheduling a face to face meeting.

3/19/09: 6 hours spent travel and meeting time with landowners at their home in NW Redwood County to discuss purchase agreement negotiations and other processes. And 214 miles to/from St Joseph MN to Zimmermann home NW of Redwood Falls.

4/13/09: 1 hour spent for Redwood County Board presentation preparation and phone call with DNR Fisheries.

4/14/09: 5 hours spent travel and attending Redwood County Board of Commission notification. And 206 miles to/from St Joseph MN to Redwood Falls.

5/12/09: 1 hour spent clarifying with SWIF and DNR an abstract question concerning the legal (correct spelling) of the landowner name.

5/19/09: 2 hours spent reviewing abstract/deed description and clarifying the survey description concerning the approx 10 acres building site exclusion.

5/22/09: 1 hour spent determining a possible closing date with DNR and then sharing this information with the landowner.

6/16/09: 1 hour spent reviewing AGO questions concerning abstract; e.g. quick claim deed missing, better clarification of utility easement on property, the 2 mortgage satisfactions, and 2009 property taxes that still needed to be paid.

6/23/09: 1 hour spent confirming closing date details with SWIF, DNR, and landowner.

6/26/09: 1 hour spent working with SWIF and landowner to confirm payment of 2009 property taxes which still have not been satisfied. Landowner will take care by closing date.

6/29/09: 3 hours spent driving and attending closing in Clara City. And 76 miles from St Joseph MN to Clara City MN.

Turkey Foot WMA – Final disposition no acquisition – 20 Total Hours

This is a Green Corridor lead acquisition. Action:

- Property selection
- Appraisal certified by the DNR.
- Negotiations with the landowner
- Access easement request has been submitted to the landowner
- Final purchase agreements delivered
- Resolution of title issues
- County board notified
- Verification of the LCCMR Exhibit F elements

Detail available for period 3/1/09 to 12/31/09

Three (3) hours and 180 miles @ $.55 per mile. Billable activities associated to this project were for the final disposition or termination of this project from the Green Corridor Accomplishment report. This project had to be terminated due to DNR Fisheries withdrawal from 50% funding from the Whispering Ridge AMA so 100% of the funding of Whispering Ridge was made by the Green Corridor which left no funds for Turkey Foot WMA. This was a mutually agreed resolution with DNR Fisheries and Wildlife at a meeting in St Paul on 3/4/09. Turkey Foot WMA is now in the hands of the DNR and as of December 18, 2009 has not closed.
3/4/09: 3 hours spent coordinating, driving, and attending meeting at DNR St Paul offices with Kim Hennings –DNR Wildlife and Mike Halverson DNR Fisheries to discuss and finalize options on Turkey Foot. And 180 miles; to/from St Joseph MN to St Paul.

Ft. Ridgely State Park – Beltz Tract – Closed December 28, 2009 – 77 Total Hours
This is a Green Corridor lead acquisition. Action:

- Property selection
- Appraisal certified by the DNR.
- Negotiations with the landowner
- Access easement request has been submitted to the landowner
- Final purchase agreements delivered
- Resolution of title issues
- County board notified
- Verification of the LCCMR Exhibit F elements

Detail available for period 3/1/09 to 12/31/09
Twenty three (23) hours @ $75 per hour and 558 miles @ $.55 per mile. Billable activities associated to this project were higher in terms of the number of estimated hours back in February 2009 due to many unanticipated events and delays and landowner concerns. Activities associated to the completion of the project included three (3) face to face meetings, numerous phone calls and email exchanges with the landowner from March thru December 2009 to discuss and resolve reasons for project completion delays, survey and boundary questions, delays in receiving the final purchase agreement, and final resolution to several AGO question on mortgage satisfactions to name a few. Other billable activities included coordinating and presenting to the Renville County Board of Commissioners (5/19/09 – same county board meeting as the Firle notification) notification of pending sale/transfer, completion and review of all Exhibit F elements, and coordination and attending the closing in Fairfax MN.
3/2/09: 1 hour preparing and conducting conference call with landowner to discuss abstract and access easement questions
3/12/09: 2 hours to meet with appraiser D. Mattison to discuss Beltz appraisal and appraisal processes. And 206 miles attending this meeting.
3/24/09: 1 hour spent communicating with DNR (Thews) to discuss possible appraisal cost share w/DNR, confirming DNR abstract/title opinion agreements and 3rd Party Letters
3/25/09: 1 hour spent preparing and discussing status of appraisal, access easement requirements, and acquisition processes with the landowner
4/3/09: 1 hour spent preparing and coordinating with SWIF and appraiser status of appraisal and submission of Letter of Engagement letter for certified appraisal process.
4/22/09: 1 hour spent confirming and coordination the receipt of certified appraisal w/DNR and SWIF and next steps.
4/30/09: 1 hour spent coordinating with DNR the county board notification process and letter. This time also included Firle county board notification which was not billed in the Firle project.
5/19/09: No time billed. Attended the Firle/Beltz county board notifications in Olivia MN. This time and mileage was billed under the Firle project since both notifications were conducted at the same meeting.

6/10/09: 1 hour spent working with landowner on status of appraisals and the need and requirements for a recordable survey document and the associated elements of this document.
6/24/09: 1 hour spent reviewing certified appraisal
6/26, 7/1, 7/2, 7/8, 7/15, 7/20, 7/22, and 7/28/09: 4 hours spent over the course of these 8 days with numerous emails and phone calls developing, negotiating, coordinating and discussing all elements of the pending Purchase Agreement with SWIF, Landowner, and DNR.
8/11/09: 1 hour spent coordinating and discussing Purchase Agreement amendments by landowner with SWIF and DNR.
8/18/09: .5 hours spent discussing Purchase Agreement amendments and next steps with landowner.
9/8/09: 1 hour spent communicating with SWIF the status of the updated abstract and beginning to review /compile balance of Exhibit F elements.
10/15/09: 2 hours spent preparing and with meeting with landowner to discuss revised Purchase Agreement. And 176 miles to/from Fairfax MN and St Joseph MN.
10/27/09: .5 hours spent confirming receipt of revised Purchase Agreement by SWIF and ensuring DNR is receiving a copy to begin the title opinion review by state/DNR.
11/19, 11/20, 11/30, 12/7, 12/9, 12/10, 12/11, 12/14, and 12/15/09: 4 hours spent on numerous emails and telephone calls over the course of these 9 days discussing with SWIF, DNR, and/or landowner all of the remaining questions/details related to scheduling the 12/18/09 closing date and finalize remaining questions which included the remaining mortgage satisifactions.
12/18/09: 2 hours spent preparing and attending the property closing in Fairfax MN. And 176 miles to/from Fairfax MN and St Joseph MN.

IV. TOTAL TRUST FUND PROJECT BUDGET:

Staff/Administration & Contract Plan Development Services:	**$94,796**
Equipment: (None)	
Development: (None)	
Restoration: (None)	
Acquisition, including easements:	**$905,204**
Other: (None)	
TOTAL TRUST FUND PROJECT BUDGET:	**$1,000,000**

Explanation of Capital Expenditures Greater Than $1,000,000

VI. OTHER FUNDS & PARTNERS:

A. Project Partners that will receive project dollars

Great River Greening Organization (GRGO)	$40,000
Project Managing Consultant	$50,000
Southwest Initiative Foundation	$9,800
Land Owners for Property Acquisition	$900,200

Projected Site Specific Acquisition Partners:

- DNR State Parks Division for property ownership
- DNR Fisheries Division for property ownership
- DNR Wildlife Division for property ownership
- Minnesota Deer Hunters Association to support additional property purchases
- National Wild Turkey Federation to support additional property purchases
- Waukon RIM to support additional property purchases

B. Other Funds Proposed to be Spent During the Project Period:

Minnesota River Valley Green Corridor of Tatanka Bluffs - $4,697 to complete the conservation plan contract.

C. Past Spending: N/A

D. Time: 2008 – 2010 was the initial phase of establishing the Green Corridor of the Minnesota River Valley. This is a multi-year effort that we are embarking on, with a projected completion of potentially 20 years.

VII. DISSEMINATION: The conservation plan is available and the public is kept up to date as progress occurs. A web page is available for public posting and comments. Public relations material is available to tell the story and vision of the Minnesota River Valley Green Corridor.

VII. REPORTING REQUIREMENTS:

Periodic work program progress reports was submitted December 31, 2008, June 30, 2009, and December 31, 2009. A final work program report and associated products was submitted June 30, 2010.

IX. RESEARCH PROJECTS: N/A

Potential Acquisition List

- Proposed Beaver Falls AMA – new AMA along Minnesota River totaling 6.6 acres.
- Inholding in Fort Ridgely addition - approx. 30 acres – Beltz tract
- Inholding in Fort Ridgely addition - - 30 acres – Firle tract
- Upper Sioux Agency property along the Minnesota River with rock outcroppings and will provide a major linkage to significant geological, historical and recreational sites - approx. 182 acres – the Zimmermann tract

At completion of the plan, it is the guide in acquisitions.

Amendment request 10/22/2008 – approval date 11/14/08:
This amendment request is for section VI Other Funds and Partners by adding two (2) new partners and to section Potential Acquisition List by adding several new potential acquisition projects and made minor text changes to several others. Please note the new addition in this section called Beaver Falls AMA will likely close within the next 30-60 days.

Amendment request 12/23/08
This amendment request is for section Potential Acquisition List by removing the Jacobson, Cold Spring and Hayes tracts and adding the Brickyard AMA.

Brickyard tract is removed because the DNR purchased the Brickyard AMA tract with other funds because the purchase price was more than 110% of the appraised value.

There were no remaining Green Corridor funds available to acquire the Turkey Foot property since the Whispering Ridge acquisition was modified to a solo Green Corridor Acquisition (DNR dropped from the Whispering Ridge acquisition partnership due to lack of available funds).

Attachment A: Budget Detail for 2008 Projects - Summary and a Budget page for each partner (if applicable)

Project Title: *Minnesota River Valley Green Corridor*

Project Contact Name: Nancy Fasching

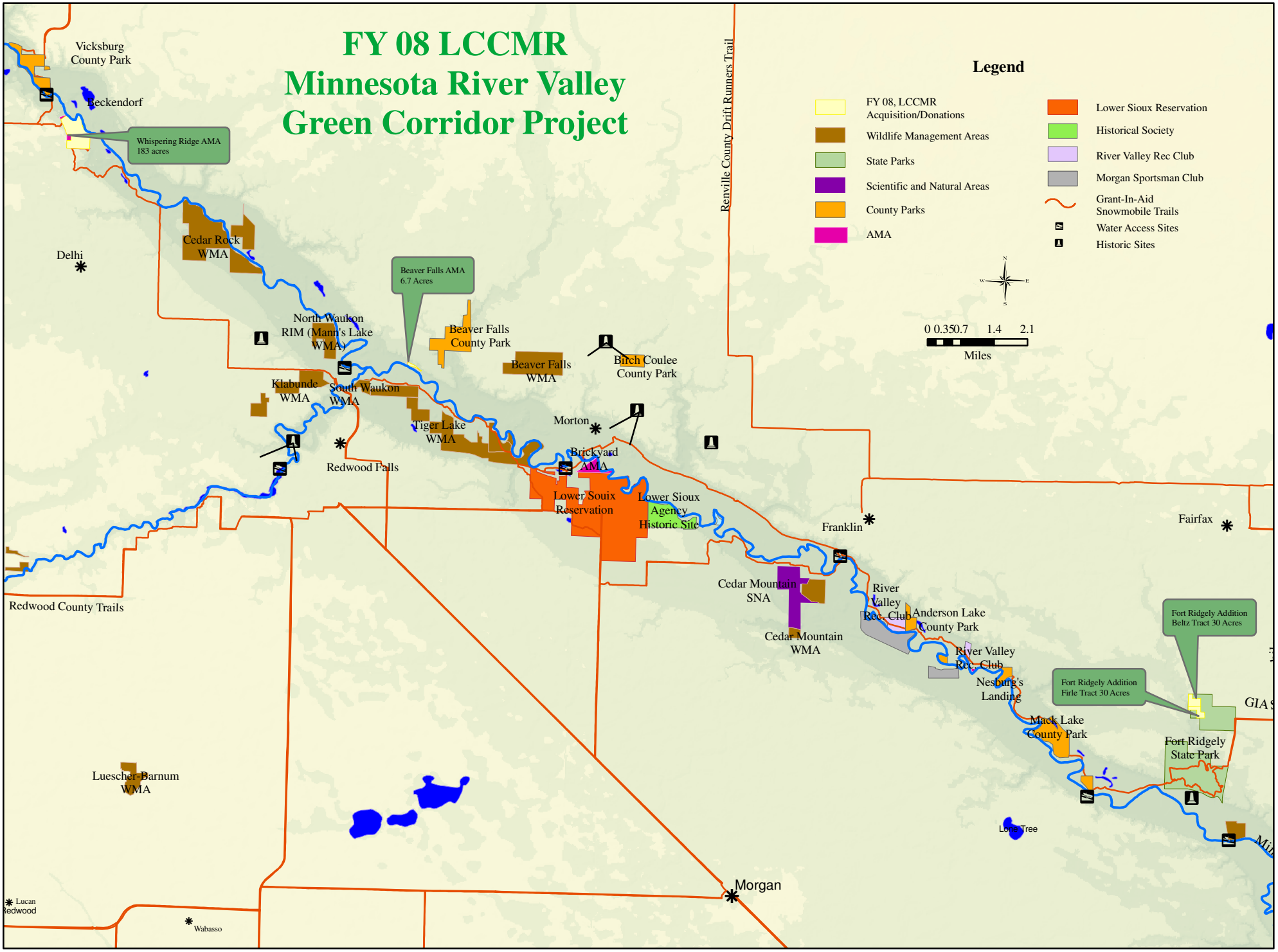
Trust Fund Appropriation: $ *1,000,000*

1) See list of non-eligible expenses, do not include any of these items in your budget sheet

2) Remove any budget item lines not applicable

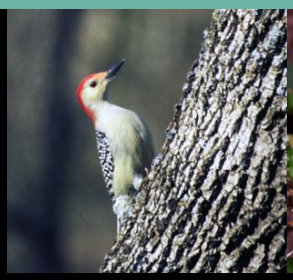
2008 Trust Fund Budget	Result 1 Budget:	Revised Budget	Amount Spent 6/30/10	Balance 6/30/10	Result 2 Budget:	Revised Budget	Amount Spent 6/30/10	Balance 3/1/10	Result 3 Budget:	Revised Budget	Amount Spent 6/30/10	Balance 6/30/10	TOTAL BUDGET	TOTAL BALANCE
	Land Acquisition				*Conservation Plan*				*Administration*					
BUDGET ITEM				0				0				0		
PERSONNEL: wages and benefits				0				0				0		
SWIF Accountant				0				0	4,900	4,900	4,900	0	4,900	0
SWIF Grant Officer				0				0	4,900	4,900	4,900	0	4,900	0
Contracts				0				0				0		
Great River Greening - Conservation Plan				0	~~33,200~~	28,503	28,503	0				0	28,503	0
GRG Printing					~~5,000~~	5,882	5,882	0					5,882	0
GRG Travel					~~1,800~~	918	918	0					918	0
Project Manager Consultant - Brad Cobb				0				0	45,000	45,000	45,000	0	45,000	0
Brad Cobb Travel				0				0	~~5,000~~	4,693	4,693	0	4,693	0
Land acquisition	~~900,200~~	899,590	899,590	0				0				0	899,590	0
Professional Services for Acq. (Coming from Land Acq. Line)	~~0~~	5,614	5,614	0				0				0	5,614	0
COLUMN TOTAL	**~~$900,200~~**	**$905,204**	**$905,204**	**$0**	**~~$40,000~~**	**$35,303**	**$35,303**	0	**~~$59,800~~**	**$59,493**	**$59,493**	**$307**	**$1,000,000**	**$0**

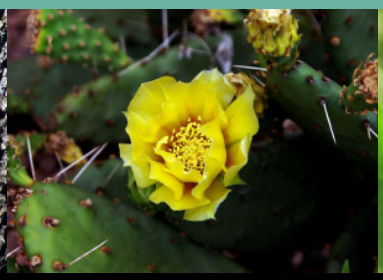
** an additional $4,697 has been raised by the Green Corridor Fund at SWIF to fulfill this commitment.

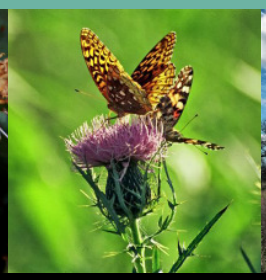

FY 08 LCCMR
Minnesota River Valley
Green Corridor Project
Legend
FY 08, LCCMR Acquisition/Donations
Wildlife Management Areas
State Parks
Scientific and Natural Areas
County Parks
AMA
Lower Sioux Reservation
Historical Society
River Valley Rec Club
Morgan Sportsman Club
Grant-In-Aid Snowmobile Trails
Water Access Sites
Historic Sites
0 0.35 0.7 1.4 2.1
Miles
Renville County Drift Runners Trail
Vicksburg County Park
Beckendorf
Whispering Ridge AMA 183 acres
Delhi
Cedar Rock WMA
Beaver Falls AMA 6.7 Acres
North Waukon RIM (Mann's Lake WMA)
Beaver Falls County Park
Beaver Falls WMA
Birch Coulee County Park
Klabunde WMA
South Waukon WMA
Tiger Lake WMA
Morton
Redwood Falls
Brickyard AMA
Lower Souix Reservation
Lower Sioux Agency Historic Site
Franklin
Fairfax
Cedar Mountain SNA
Cedar Mountain WMA
River Valley Rec. Club
Anderson Lake County Park
River Valley Rec. Club
Nesburg's Landing
Fort Ridgely Addition Beltz Tract 30 Acres
Fort Ridgely Addition Firle Tract 30 Acres
Mack Lake County Park
Fort Ridgely State Park
Redwood County Trails
Luescher-Barnum WMA
Lone Tree
Morgan
Lucan
Redwood
Wabasso

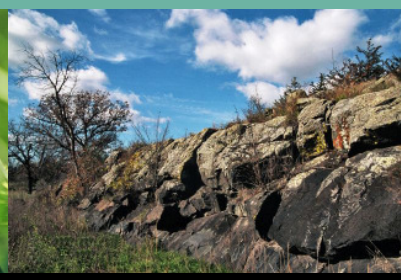
Conservation in the Middle Minnesota Valley:

A Blueprint and Action Plan









Conservation in the Middle Minnesota Valley: A Blueprint and Action Plan

Prepared for Green Corridor, Inc. and Southwest Initiative Foundation

by Great River Greening

Contributing Authors:

Wayne Ostlie, Great River Greening

Todd Rexine, Great River Greening

Loran Kaardal, Green Corridor, Inc.

Brad Cobb, Green Corridor, Inc.

Suggested Citation:
Great River Greening, Green Corridor, Inc. and Southwest Iniative Foundation, 2010. *Minnesota River Valley Green Corridor: Long-Term Conservation Plan*.

Front Cover Photographs: MN River Valley Overview - ©Brad Cobb; Red-bellied woodpecker, Prickly pear cactus in bloom, Butterfly, Rock out-cropping - ©Ron Bouoldan.

© 2010 by Great River Greening
Great River Greening
35 W Water Street, Suite 201
St. Paul, MN 55107

Funding for this project was provided by the Minnesota Environment and Natural Resources Trust Fund as recommended by the Legislative-Citizen Commission on Minnesota Resources (LCCMR).

GIS mapping for this publication was made possible by a software grant from the ESRI Conservation Program.

About the Authors

Wayne Ostlie, Director of Conservation Programs - Great River Greening
(M.A., Biology (Botany), University of Kansas).
Wayne directs new initiatives, projects, and partnerships for Great River Greening, and works to build the organization both geographically and programmatically. Wayne comes to Greening with 20 years of experience in the natural resources field with The Nature Conservancy, where he served in a variety of capacities Science Director for their Iowa and Great Plains programs and as Senior Conservation Scientist within their Central Science program. Principal areas of expertise include: conservation planning, prairie conservation and management, program management, and biological inventory. Wayne has been the author of several publications on natural resource and conservation management.

Todd Rexine, Operations Manager/Design Ecologist - Great River Greening
(M.L.A., Landscape Architecture, University of Minnesota)
Todd is Great River Greening's Conservation Program Operations Manager, and is responsible for providing ecologically sensitive and sustainable landscape design services as well as GIS analysis on a variety of Great River Greening projects. Projects have included river and stream bank stabilization, shoreline restoration, urban stormwater retrofits, rain gardens, and site specific best management practices. Todd is currently supervising the trails and interpretive plan for the Pilot Knob project (Mendota Heights) and many of the best management practices (BMPs) implemented to improve water quality within the St. Croix River. Todd has been the author on several management plans and installation manuals while with Great River Greening.

Loran Kaardal, Community/Conservation/Economic Development Volunteer
(B.S., Business, University of Minnesota; Blandin CLP and CALP)
Loran is a 30 year veteran of community, conservation and economic development leadership in the Mid Minnesota River Watershed. He has been an early paradigm pioneer of developing multiple recreational opportunities over a shared landscape (public habitat corridors/blocks) as a balanced recreation/conservation management paradigm, that would result in significant, renewable, corridor economic advantages within the Mid Minnesota River Valley. He has been instrumental in the development of various organizations and fundraising efforts with in the corridor. Loran has owned the Kaardal Insurance Agency in Redwood Falls since 1977.

Brad Cobb, Program Manager – Green Corridor Inc.
(B.S., Business, University of Minnesota – Crookston & St. Cloud State University)
Brad has over 20 years of experience in natural resource acquisitions, program implementation, fundraising, public relations, grant writing, and development.
He has served on numerous local and state wildlife/natural resource advisory boards/committees. He has also appeared on dozens of regional and national outdoor radio and TV programs and has been a contributing writer to several regional newspapers and outdoor publications.

Conservation in the Middle Minnesota Valley: A Blueprint and Action Plan

Table of Contents

Abbreviations Used in This Document **vii**

Preface **1**

Executive Summary **5**

Conservation in the Middle Minnesota Valley: A Blueprint and Action Plan. **7**

1. The Middle Minnesota River Valley - Its Resources and Its People **9**

1.1 Humans in the River Valley 11

1.2 Impacts on Natural Resources 15

1.3 The Minnesota River Valley Today 16

1.3.1 Natural Resources 18

1.3.2 Cultural 20

Designing the Conservation Plan **21**

2. Natural Resources Conservation Plan **22**

2.1 Conservation Targets 22

2.2 Assessing Viability and Ecological Integrity of Conservation Targets 22

2.3 Assigning Conservation Priorities 24

2.4 Threats and Ecological Legacies 31

2.5 Conservation Strategies 32

2.5.1 Overarching Strategies 32

2.5.2 Threat-Based Strategies 34

2.5.3 Key Policy Arenas 38

3. Cultural/Historical Resources Conservation Plan **41**

3.1 Conservation Targets 41

3.2 Building the Conservation Plan and Assigning Priorities 41

3.3 Threats and Historical Legacies 44
3.4 Conservation Strategies 47
4. Going Forward - Taking Conservation Action 49
4.1 How to Use the Plan 49
4.1.1 Illustrative Example 1 50
4.1.2 Illustrative Example 2 53
4.2 Next Steps and Feasibility Assessment 57
4.2.1 Historical/Cultural Resources 57
4.2.2 Natural Resources 59
4.2.3 Over-Arching Strategies 64
Acknowledgements 65
References 67
Appendices 73
Appendix A: Building a Foundation for Conservation Design 75
Appendix B: Documented Rare Flora & Fauna (Minnesota Heritage Data Base) 79
Appendix C: Documented Native Ecological Systems 83
Appendix D: Threats & Strategies 87
Appendix E: Historic/Cultural Site Descriptions 93

Abbreviations Used in This Document

AMA	Aquatic Management Area
BWSR	Board of Water and Soil Resources
C	Carbon
CRP	Conservation Reserve Program
CSP	Conservation Stewardship Program
DNR	Department of Natural Resources
EQIP	Environmental Quality Incentive Program
GIS	Geographic Information Systems
MCBS	Minnesota County Biological Survey
MPCA	Minnesota Pollution Control Agency
N	Nitrogen
NRCS	Natural Resources Conservation Service
P	Phosphorus
RIM	Reinvest in Minnesota
SGCN	Species of Greatest Conservation Need
SHPO	State Historic Preservation Office
SNA	Scientific Natural Area
SWCD	Soil and Water Conservation District
TMDL	Total Maximum Daily Loads
USFWS	United States Fish and Wildlife Service
WHIP	Wildlife Habitat Incentives Program
WMA	Wildlife Management Area
WRP	Wetlands Reserve Program

Preface

Why another study of the Minnesota River Valley?

This comprehensive conservation plan was initiated in 2008, the sesquicentennial year of the initial fragmentation of the northern half of the Minnesota Dakota Reservation, which straddled the Minnesota River for 10 miles on both sides from Big Stone Lake to the mouth of Little Rock Creek, just east of Fort Ridgely. In 1858, this northern portion of the reservation was ceded by the Dakota to the U.S. government through two treaties signed in Washington, D.C.; shortly thereafter, the land was opened for homesteading. Following the US – Dakota Conflict of 1862, the southern half was forfeited by Congressional Act and also opened to homesteading. For a brief moment, reflect upon how this landscape with its unique ecological, cultural and historical resources would be different today, if this land sale and subsequent forfeiture had not occurred 150 years ago. This landscape was once whole and belonged to all of the Dakota people. It is now splintered into fragmented, privately-owned land tracts.

The Minnesota River Valley is a unique and special place with natural, cultural and historical resources that need to be protected, preserved and restored for future generations to study, to explore and to enjoy, while living or recreating within this landscape. This comprehensive plan focuses on all three resources.

Understanding the Demographic Opportunity across the Landscape:

The caretakers of this landscape since the homesteading days of the 1860s have been the grass-fed cattle ranching families, who utilized the unique areas that were too rocky or difficult to farm as grazing land for their cow/calf herds. The landscape was fragmented into rather large blocks – most in excess of 160 acres and some in excess of 600 acres – that served as the foundation for these ranchers. Many of these original ranches have remained within the same families for over a century, but a dramatic paradigm shift has occurred in the last 30 years: when the parents retired, the younger generation had already chosen career paths other than ranching. The majority of these ranches are now rented to others. The average age of the river bottom landowners within many of the Minnesota River Valley townships in Redwood and Renville Counties is now over 75 years old.

With this changing of the guard, there is a window of opportunity over the next 25 years – one that has not been afforded us since that initial opportunity 150 years ago – to usher in a new vision for the Mid Minnesota River Valley. The unique opportunity to make significant strides in re-connecting this fragmented landscape is here now, at the same time that the citizens of Minnesota have chosen to constitutionally dedicate funding for a period of 25 years to preserve, protect and restore these types of natural resources. Although it is hard to look into a crystal ball and exactly predict the future, the core elements are in place to make lasting change. As willing landowners step forward, if the monies are available to acquire these connecting properties as part of Minnesota's public conservation lands legacy, the vision of reconnecting these fragmented blocks into a significant "Green Corridor" has the potential of becoming a reality. This Green Corridor along the Minnesota River would become one of the most significant and visible success stories of Conservation Legacy Funding.

Green Corridor, Inc:

The Green Corridor, Inc. was formed by a coalition of engaged citizens, community and business leaders within the mid section of the Minnesota River Valley, who recognized the need to protect, restore and enhance the natural, historical and cultural resources of the Minnesota River Valley and to develop outdoor recreational opportunities that would promote regional economic growth, development and tourism in this area.

Redwood and Renville Counties are two of the 34 "Minnesota Frontier Counties" that were identified, following the 2000 census. This is not a compliment! A frontier county in 1860 was the land of opportunity and the 2010 definition is that a Frontier County is a location where there are few job opportunities and where young families choose not to live and companies choose not to locate, because there is no available work force. The only viable economic strategy to remove Redwood and Renville Counties from this list is to create a recreation industry, a recreation economy, that is a competitive regional recreational destination for outdoor activities like canoeing, hiking, biking, trail riding, hunting, fishing, bird watching and many others; and, for ecological, cultural and historical education and exploration activities, that will create innovative entrepreneurial opportunities (jobs) to service this new economy. The Green Corridor board is economically driven to preserve, protect and restore our natural, cultural and historical resources to serve as the foundational infrastructure to support this outdoor recreation industry.

With a vision for "creating a landscape of habitat connectivity, public access and economic viability in the Mid Minnesota River Watershed", the Green Corridor board and its partners will use this comprehensive conservation plan to make that vision a reality on the ground. Within those partnerships, we must implement the full complement of conservation tools to protect, preserve, restore and provide appropriate public access to these ecological, cultural and historical resources. Certainly, acquisition will be a key strategy, but the partners must utilize the other tools, such as easements, buffer strips, and private landowner restoration, education and outreach as part of their long term strategical initiatives.

The Green Corridor board recognizes that we are at the beginning of an on-going project that will involve multiple partners and stakeholder groups with ever changing organizational leadership over the ensuing years. The challenge will not only be in nurturing those partnerships on our journey, but also preparing the future leadership of the Green Corridor and the partnering organizations to grab the baton for this shared landscape legacy vision and carry it forward until the window of opportunity closes. This comprehensive conservation plan is the baton that will be passed on to the next generation and serve as the connecting foundation, as new conservation leaders step up in the future and carry this landscape legacy forward on behalf of the partnering organizations.

Green Corridor, Inc. will partner with the Minnesota DNR and a host of other federal, state and local government agencies, non-profit organizations and the public to elevate the development of appropriate recreational opportunities tied to these lands (i.e., hunting, fishing, bird watching, park and trail use, and more). In all instances, recreational development will be considered in flexible combinations where feasible and with an educational component, when appropriate. This shared landscape legacy paradigm will serve as a model for balancing the preservation of the important ecological, historical and cultural resources within the Minnesota River Valley, while providing for the development of recreational opportunities that can be educational learning experiences when visitors are in the field or on the trails.

The Green Corridor board will regularly meet, discuss and update specific action items related to the implementation of this conservation plan, as an ongoing component of its responsibilities. Results and progress toward organizational goals will be compiled annually and will be available via the organization's shared web site at: *www.tatankabluffs.com*

Start Spinning:

Rumplestiltskin lamented for his inability to be able to spin straw into gold. Seldom in life are we given opportunities to spin straw into gold, but when that opportunity arises, we must not only recognize it, but must also start spinning and engage others to follow our lead. The opportunity of re-connecting the fragmented habitat blocks within the Minnesota River Valley is one of those rare occurrences. Let's start spinning and reconnect this fragmented landscape. Come, join us in this great endeavor!

Loran Kaardal
Board Member
Green Corridor, Inc

Executive Summary

The Middle Minnesota River Valley is recognized widely for its rich diversity of natural, historical and cultural resources. In 2008, funding from the Legislative and Citizens Commission on Minnesota Resources enabled the development of a Conservation Blueprint and Action Plan to prioritize and guide program activities of Green Corridor, Inc. toward the restoration, conservation and protection of these invaluable resources. This plan recognizes the importance of these resources to the State of Minnesota and its residents – Native American, Euro-American and other cultures – and provides recommendations that serve to ensure that they are both maintained and utilized in manners that balance the needs of today, while preserving them for future generations.

The resources of the Minnesota Valley have origins that extend back thousands of years before the present time. The native prairies, woodlands and forests of the region were shaped by climate, fire, and grazing patterns and influenced by the local Native American Indian inhabitants. Their village sites, burial mounds and other features provide the first historical/cultural sites in the Valley. Arrival by Euro-Americans and their interaction with the Dakota added to the historical/cultural story, culminating with the devastating U.S. – Dakota Conflict of 1862. The past 150 years has witnessed a considerable loss and degradation of the natural resources of the Valley, such that just over 2 percent now remains. Although strides have occurred in protecting some of the major historical/cultural resources of the Valley, much has been lost and much remains to be done.

The Mid-Minnesota Valley Conservation and Action Plan

The Conservation Blueprint and Action Plan is a bifurcated plan, with two components focusing on natural resources, and cultural and historical resources. Both components followed a process of: 1) identification of conservation targets that served to focus the plan, and their locations within the project area, 2) identification of threats to these resources and their sources, and 3) identification of strategies to abate those threats and conserve the resources going forward. The natural resources plan is built around a robust existing data set resulting from comprehensive inventories of the Minnesota County Biological Survey. The historical/cultural plan, on the other hand, is based on preliminary information obtained through widely available state sources and locally through experts; a much more in-depth assessment of the cultural/historical resources of the project area is required to bring this plan up to the level presented in the natural resources counterpart.

The Natural Resources Conservation Plan

Focal conservation targets of the natural resources plan included all natural ecosystems occurring in the project area and 62 species tracked by the Minnesota Natural Heritage Program as being of statewide significance. Conservation priorities stemming from the natural resources plan encompass a mere 9.2 percent (77 square miles) of the project area and are located principally within the Minnesota Valley proper. Over 80 percent of the project area is considered a low conservation priority, much of these lands being agricultural uplands farther removed from the Valley. Although land acquisition efforts by public agencies have done a good job of targeting

areas of high resource value, over 75 percent of all lands ranked as good, very good or outstanding value are held by private landowners, suggesting a need for targeted conservation programs and outreach to these individuals.

Threat-specific conservation strategies were identified to alleviate impacts associated with seven key threats to natural resource values: Agriculture, Mining, Invasive Species, Development and Urbanization, Hydrologic Alterations, Point Source Pollution, and Aquifer Depletion. In addition, five key overarching strategies were identified to address pervasive issues that impact natural resource conservation as a whole: Civic Engagement, Capacity Building, Communication, and Economic Development. Finally, three key policy arenas were identified where engagement with local and state governments might have an impact: Farm Policy and Subsidies; Minnesota Drainage Law, and Zoning.

The Cultural/Historical Conservation Plan

The cultural/historical conservation plan focused on a suite of nine conservation targets (themes) that served to capture a full array of historical and cultural sites of significance in the project area: Dakota Culture, Native American Indian Culture, Early Commerce, Religion, Military, Transportation, Historic (Ghost) Towns, Important People, and Other. Thirty-nine historical/cultural sites were identified in the plan, occurring in each of the nine target themes. However, sites principally relate to Military (44 percent) and Dakota (33 percent) themes, acknowledging the importance of these themes in the project area. Approximately half of all identified sites are considered protected.

Due to challenges in procuring data related to important sites within these themes, no prioritization was undertaken. Rather, we point to an overarching need for an in-depth cataloguing of historical/cultural features in the project area as a pre-requisite to such a prioritization.

Conservation Strategies were developed around 8 principal threats: Development and Urbanization, Loss of Knowledge, Land Use and Land Use Legacies, Maintenance Deficiency, Economic and Social Changes, Insufficient and Inadequate Conservation Standards, Tourism-Related Degradation and Loss, and Lack of or Inadequate Protective Heritage Legislation.

Going Forward

With a vision for “creating a landscape of habitat connectivity, public access and economic viability in the Mid Minnesota River Watershed,” the Green Corridor Board and its partners will use this conservation and action plan to make that vision a reality on the ground. Within those partnerships, a full complement of conservation tools will be employed to protect, preserve, restore and provide appropriate public access to these ecological, cultural and historical resources.

Conservation in the Middle Minnesota Valley: A Blueprint and Action Plan

Green Corridor, Inc. is a 501 (c)(3) non-profit conservation organization based in Redwood Falls, Minnesota that has as its mission the creation of a legacy of habitat connectivity, public access, and economic viability in the Mid-Minnesota River Valley Watershed. The *Minnesota River Valley Green Corridor Blueprint and Action Plan* was recommended for funding to state legislature by the Legislative Citizen Commission of Minnesota Resources through a grant to the Southwest Initiative Foundation and Green Corridors, Inc. Great River Greening was contracted to begin the development of this plan in 2008.

The purpose of this Conservation Blueprint and Action Plan is to prioritize and guide future program activities of Green Corridor, Inc. and other stakeholders toward the restoration, conservation and protection of both natural and cultural/historical resources of the Middle Minnesota Valley. The Minnesota Valley is recognized widely for its rich array and diversity of important resources. This plan recognizes the importance of these resources to the State of Minnesota and its residents – Native American, Euro-American and other cultures – and provides recommendations that serve to ensure that they are both maintained and utilized in manners that balance the needs of today, while preserving them for future generations.

Balancing the needs of long-term protection and resources use cannot succeed without strong involvement by a diversity of key stakeholders with interests in the Valley. This Plan will be a tool to assist and organize future stakeholders into a working partnership team committed to the vision for a *Green Corridor* in the Minnesota River Valley, and will assist in planning and implementing strategic activities that create or expand outdoor recreational opportunities and foster increased economic vitality and tourism in a region of Minnesota that is showing significant signs of population and economic decline.

To this end, the authors lay out the Plan in a format that first describes the project area and places its current natural and historical/cultural resources within a historical context essential in crafting a long-term conservation plan. This is followed by a review of existing information pertaining to both natural and cultural/historical resources in the Valley and an overview of the methodology utilized for assigning conservation priorities. Finally, results of the prioritization are discussed, coupled with a review of identified strategies that may serve to move this effort forward in meaningful ways.

Images: Tufto, Buck in Snow, Fort Ridgely - © Ron Bouldan; Canoer - © Loran Kaardal

1. The Middle Minnesota River Valley - Its Resources and Its People

The Middle Minnesota River Valley, as defined for this conservation plan, encompasses 450 square miles along a 45-mile reach of the Minnesota River in south-western Minnesota, buffered laterally from the river 5 miles in both directions (north and south). The project area extends from the Upper Sioux Agency State Park (southeast of Granite Falls) on the upstream end to Fort Ridgely State Park at Highway 4 (south of Fairfax) on the downstream end; Redwood and Renville Counties are at the core (Figure 1.2). The project area is situated within the Northern Tallgrass Prairie ecoregion, as defined by The Nature Conservancy (1998) and Minnesota's Prairie Parkland Province (MN DNR 2010).

The Minnesota River Valley owes its origins to the Wisconsinan Ice Age, when a 2-mile thick sheet of ice parked itself over much of Minnesota. With its retreat approximately 12,000 years ago, meltwaters pooled in a series of large glacial lakes at the southern terminus of the ice sheet, the largest of which was Glacial Lake Agassiz. The largest freshwater lake ever known to occur on Earth, it extended from present-day west-central Minnesota north to the retreating ice front (Figure 1.3). During a cataclysmic event approximately 9,700 years ago, the waters of Lake Agassiz broke

Figure 1.1: River in the fall
©Brad Cobb

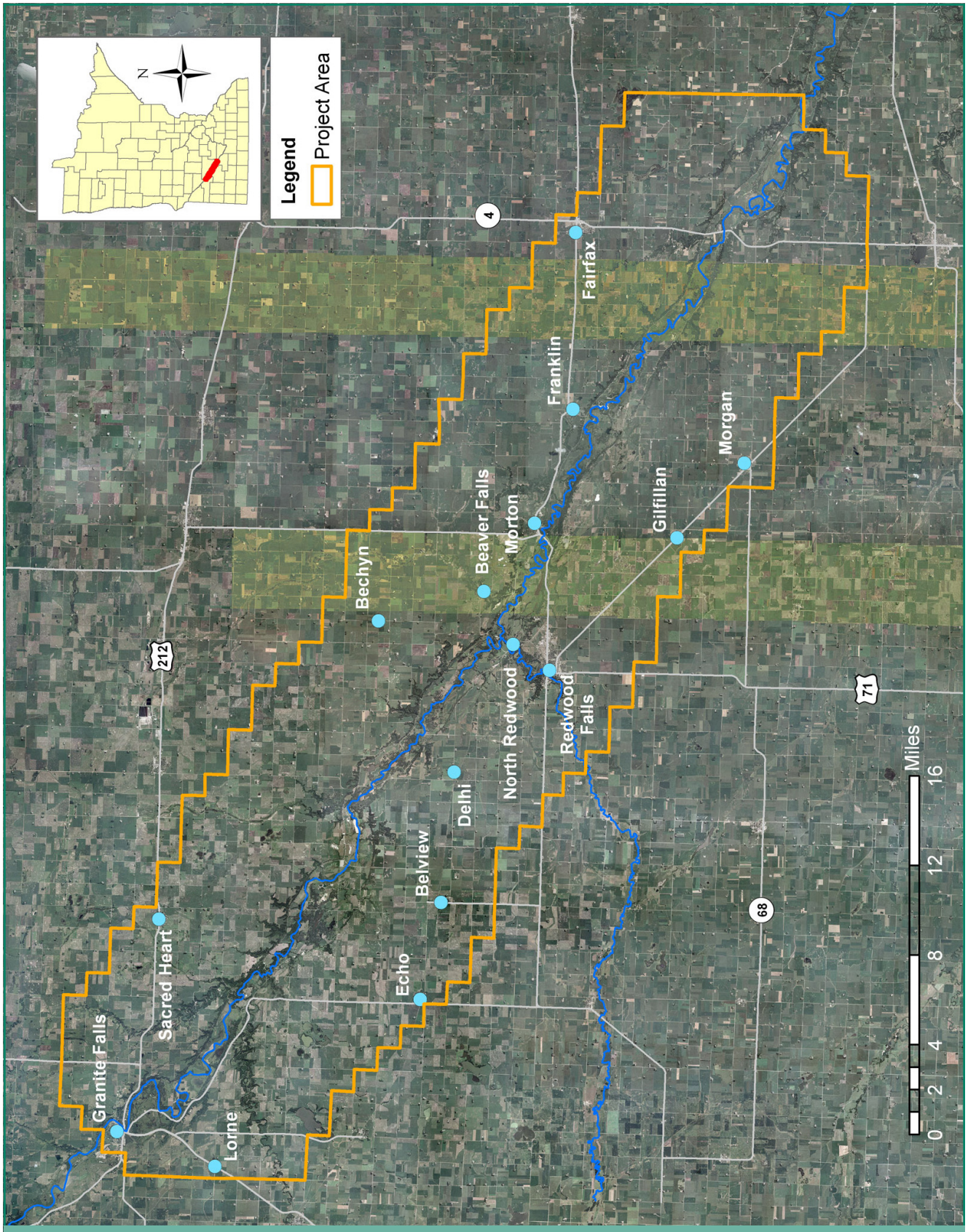


Figure 1.2: Minnnesota River Valley Green Corridor and Surrounding Area

through a natural earthen dam, releasing a torrent of floodwater – Glacial River Warren – that carved a 200-foot deep channel (down to bedrock in many places) through which the more diminutive Minnesota River now flows (Fisher 2004). The result is one of the state's most scenic and historic landscapes that displays unique geology (e.g., 3.8 billion year-old granite rock outcrops), plant communities (Minnesota DNR 2007b), cultural history, and sites that provide reminders to the most devastating settlement history in all of Minnesota – the U.S. - Dakota Conflict of 1862.

Figure 1.3: Glacial Lake Agassiz
©Minnesota Historical Society

The current climate of the project area is much different than that of 10,000 years ago. Situated centrally within the North American continent, the existing climate is characterized as continental, with frigid winters and hot summers. Average temperatures range from 73˚ F in July (on par with the average US temperatures this time of year) to 12˚ F in January (well below the U.S. average). Precipitation averages just over 4" in June (above the U.S. average) to approximately 0.6" in December and February (below the U.S. average).

Notes and maps compiled by government surveyors conducting the General Land Office's Public Land Surveys across the region (1858-1864) provide the most detailed documentation of vegetation within the project area immediately prior to Euro-American settlement (Minnesota Land Management Information Center 2010). These notes, compiled in map form for the entire state in 1930 by Marschner (1974), illustrate that tallgrass prairie was the dominant vegetation type in the project area, giving way in more fire-protected areas to forests, woodlands and savannas. An array of animal life (including bison and elk, now extirpated) inhabited the region, having evolved with and adapted to the ecological forces that shaped the region's character and that of the broader Great Plains.

1.1 Humans in the River Valley

The Minnesota River Valley has supported humans for much of the past 9,000 years, as evidenced by the Browns Valley Man find in the Upper Minnesota Valley, dated at 9,160 years before present. Warming climate, facilitated by the use of fire by early inhabitants, gave rise to the grassland biome in Minnesota and across the Great Plains. In turn, these grasslands shaped the culture of the people living there. Many cultures of native people resided in the Valley over the last 9,000 years, coming and going as the climate and environment changed. The Dakota, who are most associated with the Valley, occupied the area only after 1700 (Table 1.1).

Table 1.1: Native American Indian Traditions in the Minnesota Valley

The following section in italics is excerpted from the Institute for Minnesota Archeology (2010) web site: http://www.fromsitetostory.org/stculture.asp.

Paleo-Indian Tradition

As the post-glacial climate warmed, the vegetation during this period changed from tundra and spruce forest to mixed deciduous and coniferous forest, with prairie to the west. The Paleo-Indian tradition is thought to have included small, nomadic groups of people who hunted large mammals such as woolly mammoth and the giant bison present in the region. Archaeologists estimate these people followed a nomadic lifestyle from about 12,000-8,000 years ago. This cultural period is associated with various forest types and it probably witnessed the warming climate and the changing of forest to grassland in this part of the North America and Minnesota.

Archaic Tradition

The cultures living at this time (8,000-3,000 years ago) are thought to have been the more western prairie inhabitants who hunted bison, in addition to the more eastern woodland inhabitants who were general hunters and gatherers.

Woodland Tradition

During the Woodland tradition (3,000-350 years ago), changes in the landscape, climate and vegetation of the Minnesota River Valley were slowing down and the resulting cultures are thought to have been more stable or least more sedentary. Ceramics, earthen mounds and horticulture started to appear during this time.

Plains Village/Oneota/Missisippian/Missouri Traditions

Traditional nomadic hunting and gathering was slowly becoming a basic subsistence and settlement pattern (1,000-350 years ago). This change was made possible through the development of limited horticulture and ceramics. Crops such as corn, beans and squash were cultivated. There is evidence of long-distance trading between complex regional cultures. People of this cultural time period located habitation sites on islands, peninsulas and isthmuses of lakes. Later they moved to terraces above floodplains, which allowed them easy access to floodplain gardens that were easily cultivated and watered.

Dakota People and Culture

The Dakota have lived in the Lower Minnesota River Valley since at least 1700 A.D. Accounts of the Dakota Culture can be found alive today in the stories told by current members of the tribes (Mdewakanton, Wahpeton, Sisseton and Wahpekute) and by historical records from European explorers, missionaries, traders and settlers. In essence, their lives centered on the changing seasons and the resources that were seasonally available in the Minnesota River Valley for use in food, shelter and clothing. They were the dominant culture in central and southern Minnesota.

Tensions Grow

Understanding current demographics and tensions between cultures in the Minnesota Valley necessitates a review of the past two centuries and interactions between Euro-American explorers, missionaries, traders, settlers, the U.S. government, and the Dakota who lived in the area.

Figure 1.4: Treaty of Traverse des Sioux 1851
©Minnesota Historical Society

In the mid-1800s, numerous treaties were signed between the Dakota and U.S. Government that resulted in the ceding of large portions of Dakota land to the United States. Of these, the most significant occurred in 1851 with the treaties of Traverse des Sioux and Mendota. The former (between the United States and upper bands of Dakota [Sisseton and Wahpeton]) and the latter (between the United States and lower bands of Dakota [Mdewakanton and Wahpekute]) resulted in the ceding of 24 million acres of land to the U.S. Government, thereby confining tribes to a 20-mile wide reservation along the Minnesota River (10 miles laterally in both directions from the river) (Figure 1.4). In 1858, the tribes ceded the 10-mile strip on the north side of the Minnesota.

With the signing of the two treaties, the U.S. Government promised payments of approximately $3 million and annuities for the ceded lands; in addition, Upper Sioux (near present-day Granite Falls) and the Lower Sioux (near Morton) agencies were created at this time.

The culmination of unfulfilled treaties, reservation encroachment, continued western expansion, and crop blight in the spring/summer of 1862 was the tipping point in the Valley. In August 1862, Dakota leaders were convinced by tribal members that it was time to rise up against the settlers (Meyer 1993; Neill 1882). The resulting war lasted for barely more than a month, but resulted in hundreds of casualties among Euro-Americans and Dakota alike. The war ended with a decisive battle at Wood Lake and the release of 262 captive white women and children at Camp Release. Many of the Dakota fled to Dakota Territory and north into Canada to escape capture or death. After the war, all treaties with the Dakota were declared null and void by the United States government and all Dakota were effectively banned from the state.

Corn as High as an Elephant's Eye

The U.S. - Dakota Conflict led to a lasting change in the landscape of the Minnesota River Valley. Former reservation lands were opened for settlement not long after the conflict ceased. By this time, the Homestead Act of 1862 (which gave settlers 160 acres of free land for filing a claim and improving the land) had been enacted, providing for a ripe opportunity for settlement by Euro-Americans. Change happened quickly.

Renville County was created by state legislature in 1855, and significant settlement had occurred along the north banks of the Minnesota River by the time of the U.S. - Dakota conflict in 1862. Most of these settlements were abandoned until the area began repopulating in the mid-1860s, and it was not until 1866 that the county was fully organized. Unlike Renville County, Redwood County was not established until 1865, due in large part to the fact that it was largely located within the existing Dakota reservation.

The Homestead Act of 1862 - gave 160 acres of undeveloped land outside of the original thirteen colonies to heads of household who were 21 years of age or older, and who had not taken up arms against the United States. With this land acquisition, applicants agreed to file a claim, improve the land (build a dwelling and cultivate), and file for a deed of title. After five years, the original filer was entitled to the land free and clear (NPS 2009).

The Timber Culture Act of 1873 - gave 160 acres of additional free land if filers set aside 40 acres to grow trees to solve the problem of lack of wood on the Plains. After planting the trees, the land could only be completely obtained if it was occupied by the same family for at least 5 years. After this period of time, a certificate of ownership could be obtained for $30. Lands acquired under this Act were frequently called, "Tree Claims."

After the Conflict, settlement of both counties began again in the mid-1860s, and then more earnestly in the 1870s. Lands that had not been surveyed prior to the Conflict were surveyed from 1864-1868, and were officially opened for settlement shortly thereafter. In Redwood County, lands were surveyed in 1864, opened for settlement in 1865, and offered at public sale in 1867 (Neill 1882).

Settlers began arriving via the Minnesota River, established roads, and across the prairie. Railroads arrived in southern Redwood County in 1872 (Winona and St. Peter Railroad) and reached Redwood Falls in 1878. The Chicago, Milwaukee and St. Paul Railroad reached Renville County in 1878, followed by the Minneapolis and St. Louis Railroad in 1882.

Towns of Redwood Falls, Renville, Olivia, Morgan, Fairfax, Morton and others emerged and flourished as commerce centers, supporting a diverse economic base catering to the immigrants that were arriving in search of free lands and new lives.

The rich agricultural lands of the Minnesota River Valley were readily tilled for agricultural production, and in a short 10-year timeframe much of what had been tallgrass prairie a few years prior had been converted. Ditching in earnest began in the first decade of the 20th century and continued for the ensuing two decades. By that time, Renville County boasted 3000 miles of drainage ditches. Agriculture was the principle economic game in town and the fortunes and failures that would ensue over the following century would be in large part tied to this agricultural base.

1.2 Impacts on Natural Resources

The primary ecological processes that shaped the natural character of the prairies of the Middle Minnesota River prior to Euro-American settlement were climate, grazing and fire, each operating at multiple scales, frequencies and intensities (Weaver and Albertson 1956, Axelrod 1985, Risser 1985, Anderson 1990). Fire, interacting with the effects of grazing and climate, promoted the development of the tallgrass prairie system. Seasonal precipitation and temperature patterns influenced the growth of vegetation, and consequently the availability of fuels for burning and forage for grazing.

Seasonal fires created a patchwork of burned and unburned areas across the flat prairie landscape. Bison and elk, the principal large herbivores, grazed preferentially on vegetation in burned areas because of greater productivity and nutritive quality of forage following fire (Risser 1985, Risser 1990, Collins and Gibson 1990, Ostlie et al. 1996). Their transitory grazing patterns allowed the vegetation to recover from intermittent and sometimes intensive grazing events. These grazing patterns further impacted the availability of fuel for fire and, in turn, impacted and helped maintain a subtle, yet important vegetation mosaic that provided an array of habitats for a diverse suite of grassland animal and plant species. People living on the land influenced these patterns (by hunting, setting fires, etc.) and thus played a large role in shaping the historic landscape prior to Euro-American settlement.

Yet, this grassland system was quickly moving out of kilter by the early- to-mid-1800s, well before wholesale settlement by Euro-Americans occurred. Many of the large native mammals were extirpated or were in serious decline prior to settlement and the subsequent conversion of habitat for agricultural purposes (Ostlie et al. 1996). By the mid-1800s, bison were largely extirpated from the ecoregion, with the last wild bison in Minnesota recorded in 1880; elk (*Cervuus elaphus*) were effectively eliminated by the late 1800s, disappearing from the state altogether in 1896 (Nordquist and Birney 1988). Wolves (*Canis lupus*) persisted in remote areas of the state, but were driven out of the prairie lands. Trumpeter swans (*Cygnus buccinator*) and whooping cranes (*Grus americana*) were extirpated from the ecoregion long before their marshes were drained (Green 1988).

The vast accumulations of carbon-rich organic soils – some of the most agriculturally productive sites in the temperate world – set the stage for settlement and exploitation of the state's prairie lands. The Homestead Act of 1862 was the catalyst that enticed throngs of Yankees and immigrants (Germans, Scandinavians, Irish and those of other nationalities) to try their luck in the American Northwest.

Euro-American settlement had a major impact on the landscape of the Minnesota Valley. In fact, few places in the world have experienced anthropogenic alteration to the extent documented in the tallgrass prairie regions of the central United States (Noss et al. 1995). Rapid settlement and conversion of the Minnesota Valley – much of it occurring in a mere 10 years (approximately 1870-1880) - transformed the great sea of grass that was the tallgrass prairie into an agricultural system with only small vestiges remaining on the landscape (Krenz and Leitch 1993). Today, less than 1 percent of the native tallgrass prairie remains in Minnesota; much of what remains is relegated to small, highly isolated tracts.

As upland prairie habitat was converted to agriculture, focus of settlers turned toward improving the productivity of land by removing water from the landscape. In 1883, state drainage law gave counties the authority to construct ditches or water courses, including the drainage of shallow, grassy, meandered lakes under four feet in depth (BWSR 2010). In 1897, the state drainage commission was established to "*have care, custody, control and supervision of all drainage ditches in the state*." Complex and pervasive systems of tiles, drainage ditches and river/stream channelization expedited water runoff from the landscape and did the job in terms of improving lands for agricultural purposes.

Ditching began in earnest in Redwood and Renville counties during the first decade of the 20th century, and continued in haste for another two decades. By that time, Renville County was boasting of having installed 3000 miles of tile and ditches (Rootsweb 2010a). Today, more than 90 percent of the presettlement wetlands have been lost from the tallgrass prairie region (Lant et al. 1995).

The conversion of prairie and other natural systems within the Northern Tallgrass has resulted in increased soil loss through wind and water erosion, and resultant water quality degradation within the majority of streams, rivers and wetlands in the region. The Minnesota River, for example, has often been referred to as the most polluted river in Minnesota, an outcome of the immense sediment and nutrient loads now carried by the river. Declines in freshwater mussel (Bright et al. 1990, Williams et al. 1993) and fish (Cross and Moss 1987) populations have been directly linked at least in part to the degradation of water quality resulting from erosion of agricultural lands.

1.3 The Minnesota River Valley Today

The Minnesota Valley today, although greatly altered relative to what it was in 1800, retains a rich cultural, historical, and natural heritage. Unlike uplands farther removed and now largely in agricultural production, the Valley retains a rich diversity of high-qualiy natural areas that provide home to an array of animal and plant species, and a glimpse into what the Valley was like 200 years ago. This rich diversity is reflected in a study of the state's natural resources conducted by the Minnesota DNR, where the Minnesota River Valley was identified as its priority focal area (Figue 1.5). Tied to this natural history are robust Dakota and Euro-American cultural heritages, each with important sites, events, and individuals that made and are making a mark on the local, state and national scene. In this section, we detail the current status of the natural and cultural/historical resources of the Mid-Minnesota Valley.

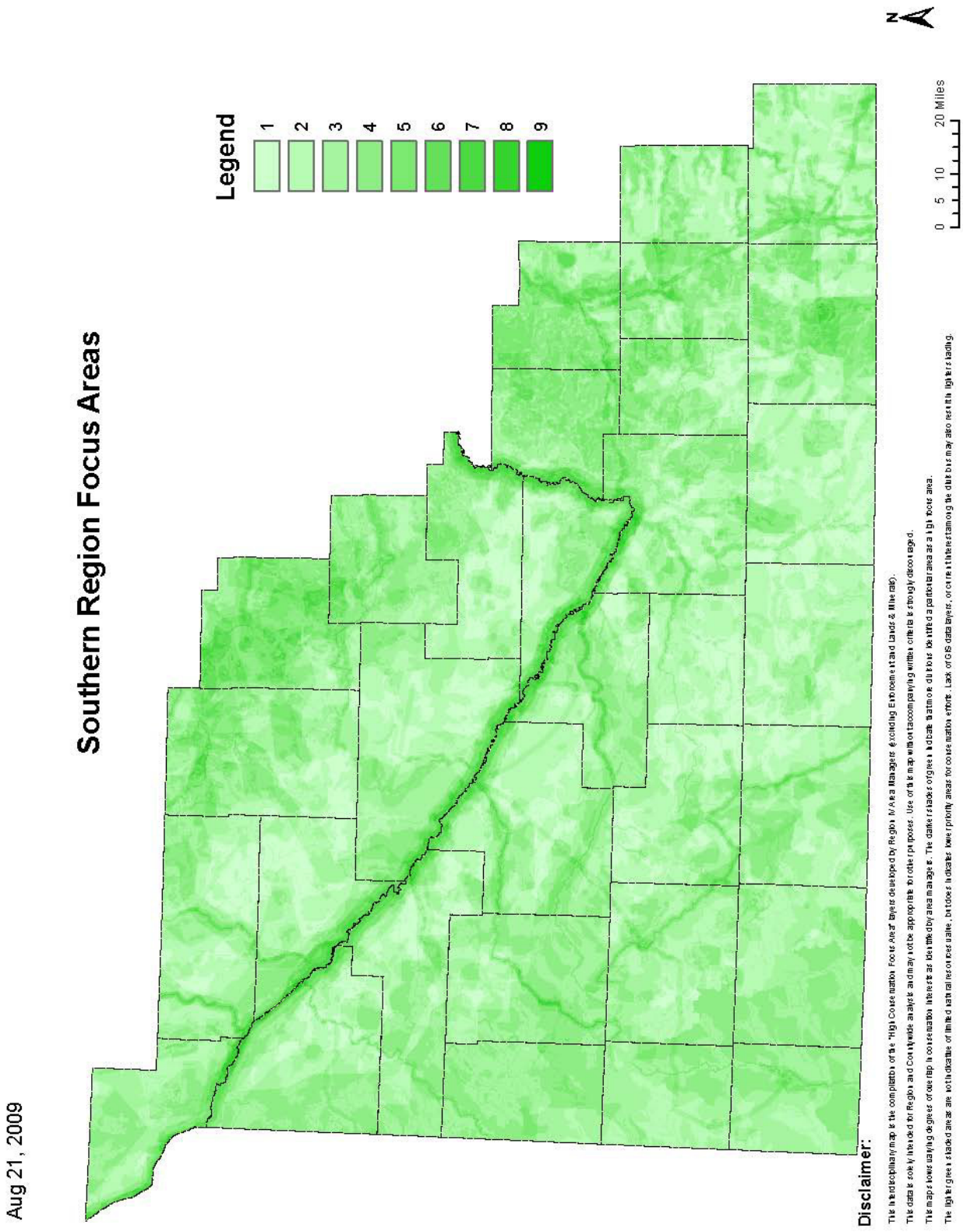


Figure 1.5 Minnesota DNR Southern Region Focus Areas

© Minnesota DNR

1.3.1 Natural Resources

The current ecological framework of the Minnesota River Valley today is at best, a patchwork of remnant ecosystems (Figures 1.6-1.9) scattered throughout the project area, but principally occurring between the bluffs of the Minnesota River Valley. Outside of the Valley proper, land is largely in agriculture production.

Remaining natural ecological systems in the project area include a mix of tallgrass prairie, woodland and forest types (see Appendix C for a complete list of ecological systems identified in the project area). Native ecological systems now account for a mere 2.15 percent of the total project area, a 97.85 percent decline over the past 150 years. Conversion of lands to agriculture has been the principle reason for this decline, although associated land use activities (grazing, logging, fire suppression and invasive species encroachment) have accentuated this decline.

Of the remaining native ecosystems in the Valley, approximately 75 percent are considered of moderate quality, with 20.5 percent of high quality, and 4.5 percent of outstanding quality. Without adequate long-term management, remaining examples are likely to degrade in quality over the coming years.

Row-crop agriculture is the principle land use in the project area, with corn, soybeans or sugar beats being the dominant crops planted. Agriculture land amounts to 87 percent of the combined acreage of Redwood and Renville Counties. The remaining 13 percent of land is divided amongst residential, municipality, industrial and public lands (SRF 2002; Biko 2007).

Natural resources that are extant in the project area today are bombarded by an array of threats to their quality and long-term viability. Principal threats to natural resources include:

Figure 1.6: Rock Outcropping
© Ron Bouldan

Figure 1.7: Floodplain Forest
©Great River Greening

Figure 1.8: Oak Savanna
©Great River Greening

Figure 1.9: Prairie
©Great River Greening

Water Resources

- Water quality degradation – sedimentation, elevated nutrient levels, erosion
- Abnormal spikes, duration and seasonality in flows
- Declines and loss in fish, mussel and other aquatic species populations
- Drainage and alteration of wetland and riverine habitat
- Exotic species

Terrestrial Resources

- Broad-scale conversion, fragmentation and degradation of native ecosystems
- Loss of natural processes that support native ecosystems and associated species (e.g., fire)
- Loss and decline of native species (elk, bison, birds, etc.)
- Exotic species

With the alteration of the natural processes under which the native ecological systems evolved (principally fire, grazing, and climate) as well as the arrival of non-native flora/fauna, has enabled select species to dominate and out-compete less aggressive species. In terrestrial systems, typical invasive species that are prevalent in the region include, but are not limited to: European buckthorn (*Rhamnus cathartica*), Exotic honeysuckle (*Lonicera sps.*), reed canary grass (*Phalaris arundinacea*), smooth brome (*Bromus inermis*), garlic mustard (*Alliaria petiolata*), leafy spurge (*Euphorbia esula*), Kentucky bluegrass (*Poa pratensis*), Canada thistle (*Cirsium canadense*), musk thistle (*Carduus nutans*), sweet clover (*Melilotus sp.*) and spotted knapweed (*Centaruea maculosa*). In aquatic systems, common carp (*Cyprinus carpio*) is major problem, impacting the quality of riverine habitat and competing with native fish species for resources. To date, zebra mussels (*Dreissena polymorpha*) have not been found within the project area, but pose a major threat none the less. Purple loosestrife (*Lythrum salicaria*), reed canary grass, cattail (*Typha angustifolia, Typha x glauca.*), and a host of other non-native species are principle threats to wetland systems across the project area. These species can out-compete less aggressive native species and/or alter the composition and health of natural systems.

1.3.2 Cultural

Demographics for the region were compiled in both the Redwood County Comprehensive Plan (Bilko 2007) and Renville County Comprehensive Plan (SRF 2002). The information for the two counties was combined to give a larger socio-economic view as it relates to the project area.

Population

The 2000 census data for both counties indicates a steady decline in population since the mid part of the last century (circa 1950). This trend is a result of residents leaving rural areas in favor of jobs and amenities in larger metropolitan areas. Together, the two counties have exhibited a population decline of 23.7 percent since 1960.

The majority of the population is composed of white Americans (92 percent), of which over 50 percent are of German ancestry (see Table 1.2).

Renville County currently posses a population of just over 17,000 individuals, with a population density of 18 people per square mile; Redwood County's population is just under 17,000 individuals, with a density of 19 people per square mile.

Median Income:

Renville County:
The median income for a household = $37,652; per capita income was $17,770. About 6.3 percent of families and 8.8 percent of the population were below the poverty line, including 10.8 percent of those under age 18 and 8.1 percent of those ages 65 or over.

Redwood County:
Median income for a household is $37,352; per capita income was $18,903. About 5.5 percent of families and 7.7 percent of the population were below the poverty line, including 8.3 percent of those under age 18 and 8.8 percent of those ages 65 or over.

Table 1.2: Population Composition

Age of Population:

Renville County: Median age = 40 years

Under Age 18	26.50%
18-24 Years	6.60%
25-44 Years	25.30%
45-64 Years	21.70%
65 Years +	19.80%

Redwood County: Median Age = 40 years

Under Age 18	26.50%
18-24 Years	6.60%
25-44 Years	24.80%
45-64 Years	22.700%
65 Years +	19.30%

Racial Composition:

Renville County (2000 census)

White	95.0%
Hispanic	5.1%
Native American	<0.1%
African American	<0.1%
Asian/Pacific Island	<0.1%
Other	3.5%

Redwood County (2000 census)

White	95.0%
Hispanic	1.1%
Native American	3.2%
Black	<0.1%
Asian/Pacific Island	<0.1%
Other	1.3%

Designing the Conservation Plan

Conservation planning in the Middle Minnesota River Valley was focused on two principal thematic areas – 1) natural resources and 2) cultural/historical resources. Specific conservation plans were pursued and developed for each of these components independent of the other. Both identify, and to the extent possible, prioritize lands for conservation action within the project area. In addition, conservation strategies to realize long-term conservation of these important resources are detailed for each respective section. Each of these products will serve to enable informed judgments for resource conservation and prioritization of actions by those charged with the implementation of this plan.

Figure 2.1: Minnesota River Valley
©Brad Cobb

2. Natural Resources Conservation Plan

A standard protocol for assembling a conservation action was used for both natural and cultural/historical resources components of the overall plan. This protocol – adapted from The Nature Conservancy (2006) and World Wildlife Fund (2004) – uses the following process:

1. Identify Conservation Targets
2. Identify Threats to these Targets and their Sources
3. Develop Strategies to Abate these Threats
4. Measure Progress toward Established Goals

2.1 Conservation Targets

Conservation targets focus a conservation plan. They serve as the elements around which a plan takes shape. Targets identified for use in this planning exercise included: 1) all natural ecological system types (both terrestrial and aquatic) found within the project area, 2) all species tracked by the Minnesota Natural Heritage Program as Endangered, Threatened or of Special Concern, and 3) other species tracked by the Heritage Program for a variety of reasons, including Species of Greatest Conservation Need. This resulted in a total of 80 conservation targets - 17 terrestrial communities (Appendix C) and 62 species (Appendix B).

2.2 Assessing Viability and Ecological Integrity of Conservation Targets

In the context of natural resource conservation planning, viability or ecological integrity is the likelihood that a conservation target or its component occurrences (e.g., a specific population or example) will persist over a given period of time. This concept underpins any credible conservation plan. Viability is a function of a conservation target's condition, size and landscape context.

Viability = Size + Condition + Landscape Context

Blocks of habitat – as defined and mapped by the Minnesota County Biological Survey (for moderate- to outstanding examples of native ecological systems) and 2001 National Land Cover Database (MRLC 2010; for degraded native and all non-native systems, i.e., agricultural, urban or barren) – served as the framework around which the conservation plan was assembled. These habitat blocks in many ways served as surrogates for conservation targets (species and ecological systems). In turn, these blocks of habitat were linked to specific target occurrences (species and ecological systems) contained within them and provide a basis for estimating long-term persistence of these embedded conservation targets.

Figure 2.2: Key Elements: Assessing Vitality & Ecological Integrity

Size - the relative size of a habitat patch on the landscape. Larger blocks of habitat tend to support a more complete array of natural processes that sustain ecological systems over time, and support populations of species that are more viable than found in smaller examples.

Habitat Size

Score	*Size Class*
10	> 940 acres
9	590 – 940 acres
8	349 – 590 acres
7	244 – 349 acres
6	160 – 244 acres
5	93 – 160 acres
4	55 – 93 acres
3	30 – 55 acres
2	10 – 30 acres
1	< 10 acres
0	Agricultural, Developed or Barren

Condition - the quality of an ecological system or habitat patch relative to historic norms (pre-1850). Examples in excellent condition (i.e., devoid of invasive species, physical impacts and such) will tend to persist longer and support populations of species that are more viable than found in disturbed or degraded examples.

Habitat Condition

Score	*Condition Class*
10	Outstanding MCBS
9	High MCBS
8	Moderate MCBS
6	Natural, Lake, River
4	Semi-Natural
2	Agricultural
0	Urban/Developed

Landscape Context - The position of natural or semi-natural habitat patch relative to other habitat patches, and the impact of neighboring lands on a habitat patch. Patches isolated from others are more likely to suffer from edge effects, and therefore are less resilient in the face of threats and supportive to a full array of species over time.

Landscape Context

Score	
10	Intact Landscape
8	Largely Intact
6	Moderately Intact
4	Moderately Fragmented
2	Highly Fragmented
0	Isolated Patch

In this conservation planning process, a protocol was developed for assigning numeric scores for each viability/ecological integrity factor (size, condition, or landscape context) to each specific habitat block, as detailed in Figure 2.2. Although specific relationships between these three factors are highly target-specific, general guidelines related to target viability hold true: 1) large habitats are better than small ones; 2) pristine natural conditions are better than degraded ones; and 3) habitats surrounded by other natural habitats are better than natural habitats surrounded by highly altered systems (i.e., isolated). With this protocol in hand, numeric scores were assigned to blocks of habitat (as opposed to specific occurrences of conservation targets) occurring within the project area in order to rank habitat blocks relative to one another.

2.3 Assigning Conservation Priorities

Conservation priorities were established by building off of the viability/ecological integrity assessment as detailed in Section 2.2 above. Scores for each of the three factors were combined to produce a composite Integrity score ranging from a maximum of 30 points to a low of 0.

Along with viability/ecological integrity as an underpinning factor in assigning conservation priorities, two additional factors were included to further focus conservation priorities toward protecting lands that provided greatest conservation benefit as detailed in Figure 2.3. Therefore, a maximum total score for any habitat polygon is 50 points, with a minimum of 0.

Figure 2.3: Conservation Priorities

1) Number of occurrences of species tracked by the Minnesota Natural Heritage Program within a habitat patch. Highest point scores went to habitat patches with large number of rare species occurrences.

Presence of Rare Species

Score	*Number of Occurrences*
10	>11
8	5 - 10
6	3 - 4
4	1 - 2
0	0

2) Proximity to MCBS habitat patches. Points were awarded to lands in close proximity to MCBS quality habitat patches as a means of providing buffer to those important habitat remnants.

Proximity to MCBS

Score	*Distance*
10	Within MCBS
6	<1/8 mile from MCBS
4	1/8 – 1/4 mile
2	1/4 – 1/2 mile
0	> 1/2 mile

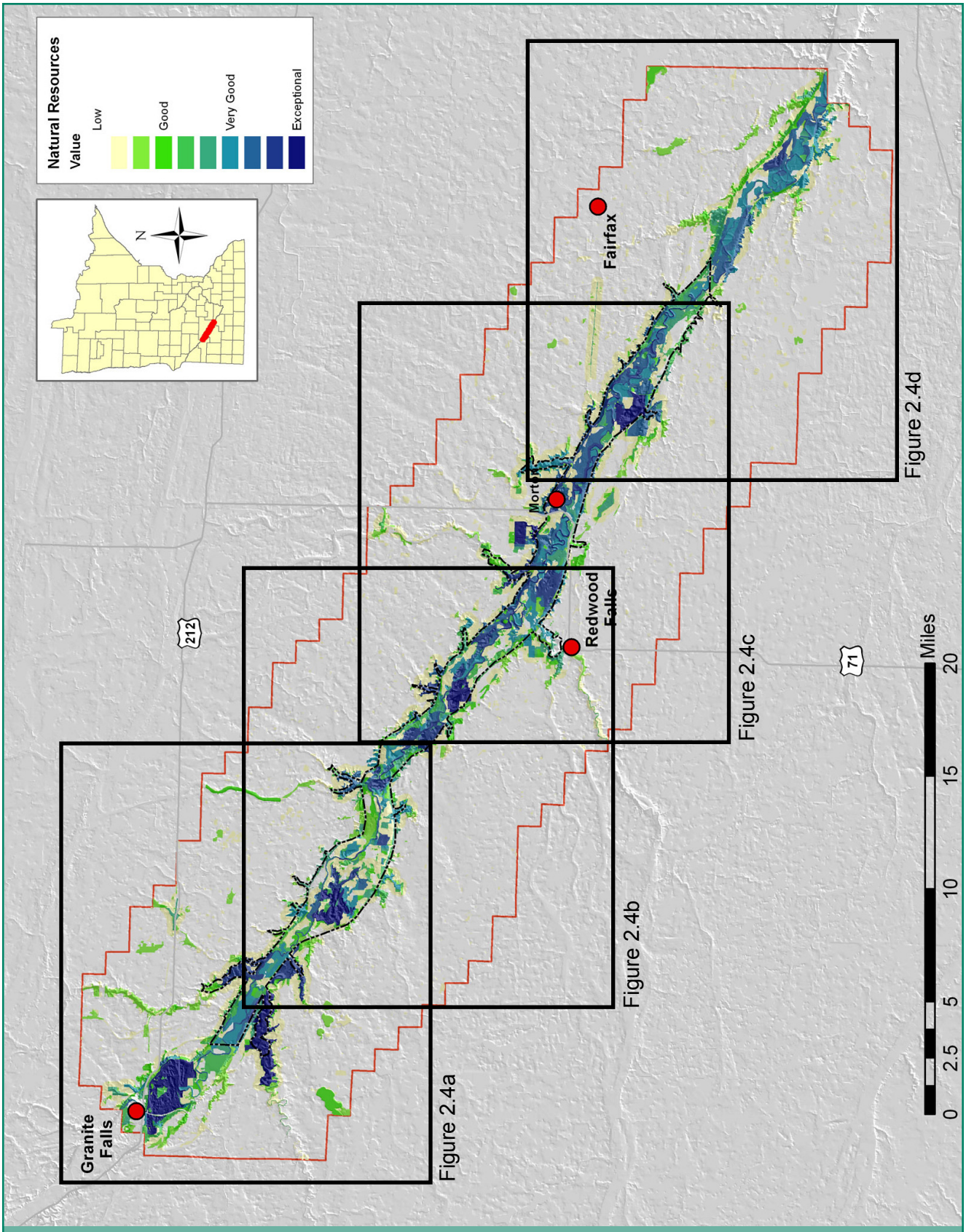


Figure 2.4: Middle Minnesota River Valley Natural Resources Opportunities

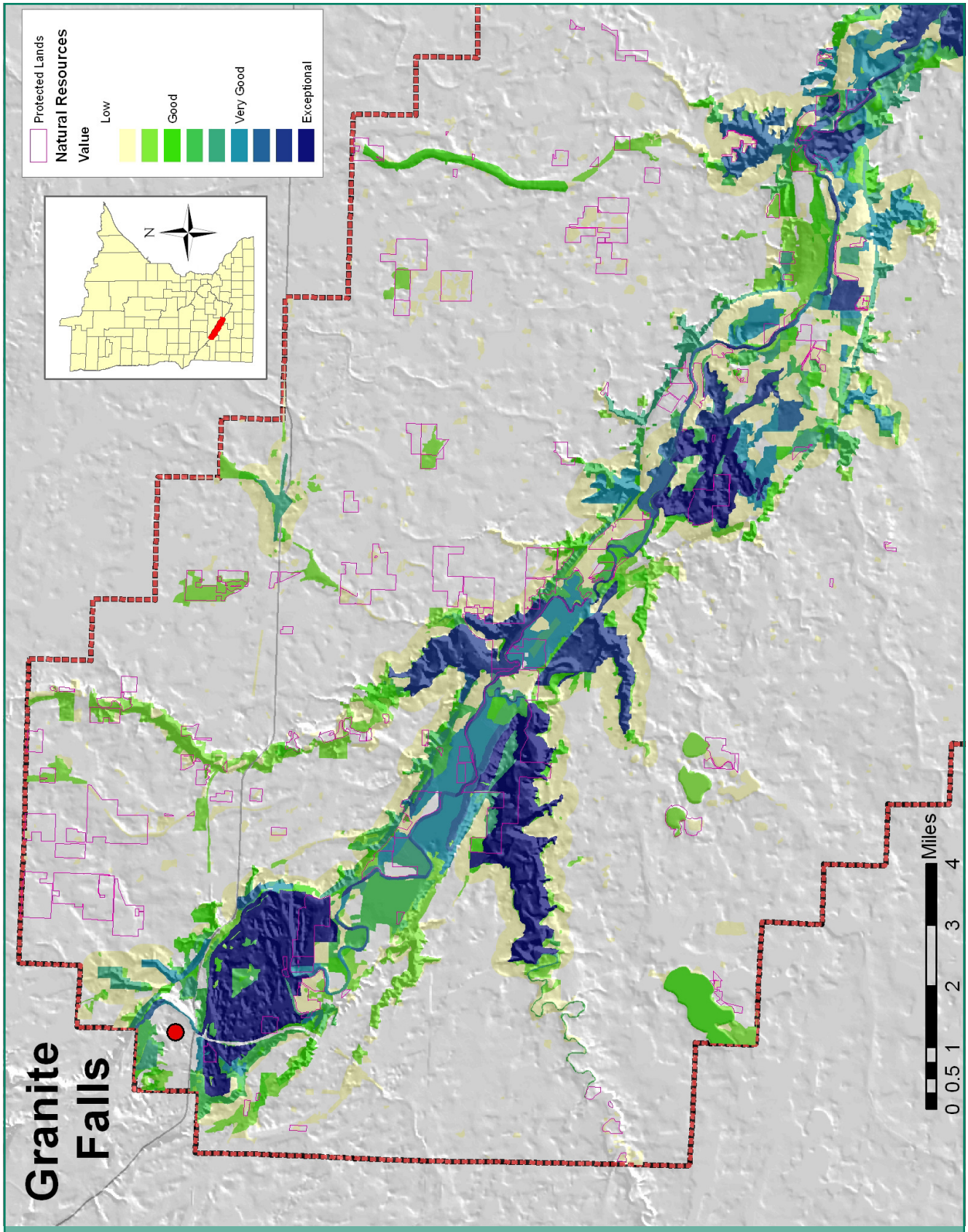


Figure 2.4a: Middle Minnesota River Valley
Natural Resources Opportunities & Protected/Managed Lands

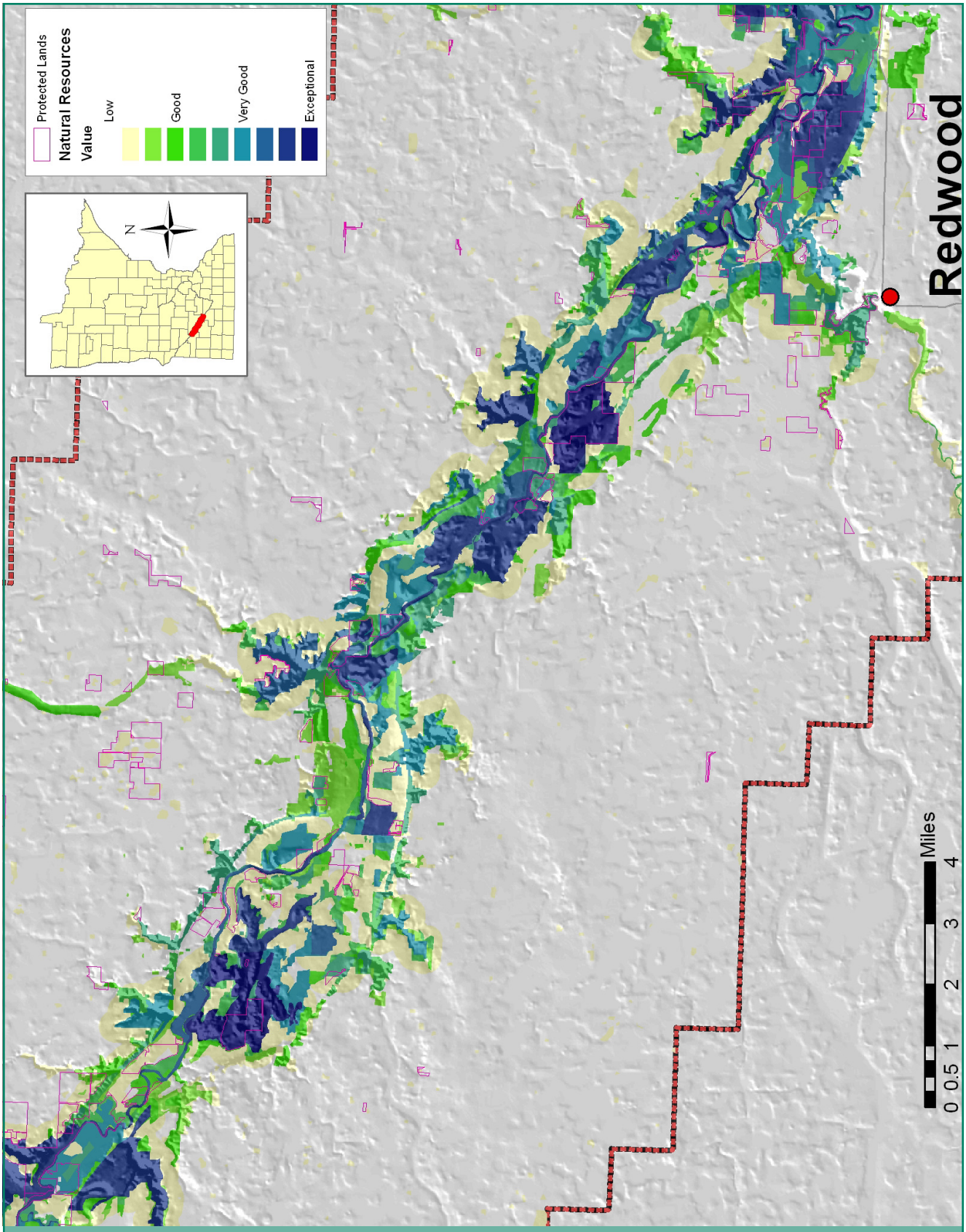


Figure 2.4b: Middle Minnesota River Valley
Natural Resources Opportunities & Protected/Managed Lands

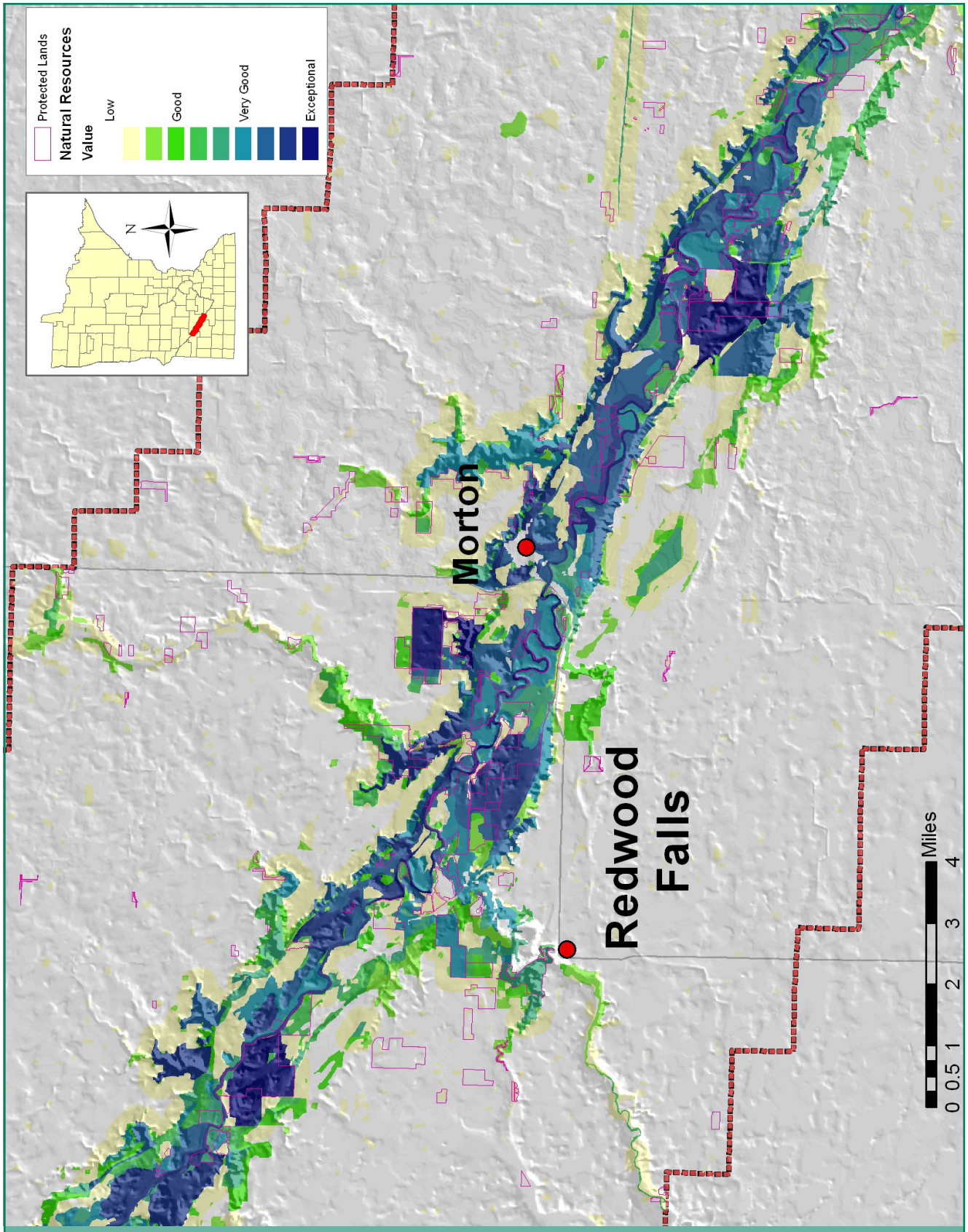


Figure 2.4c: Middle Minnesota River Valley
Natural Resources Opportunities & Protected/Managed Lands

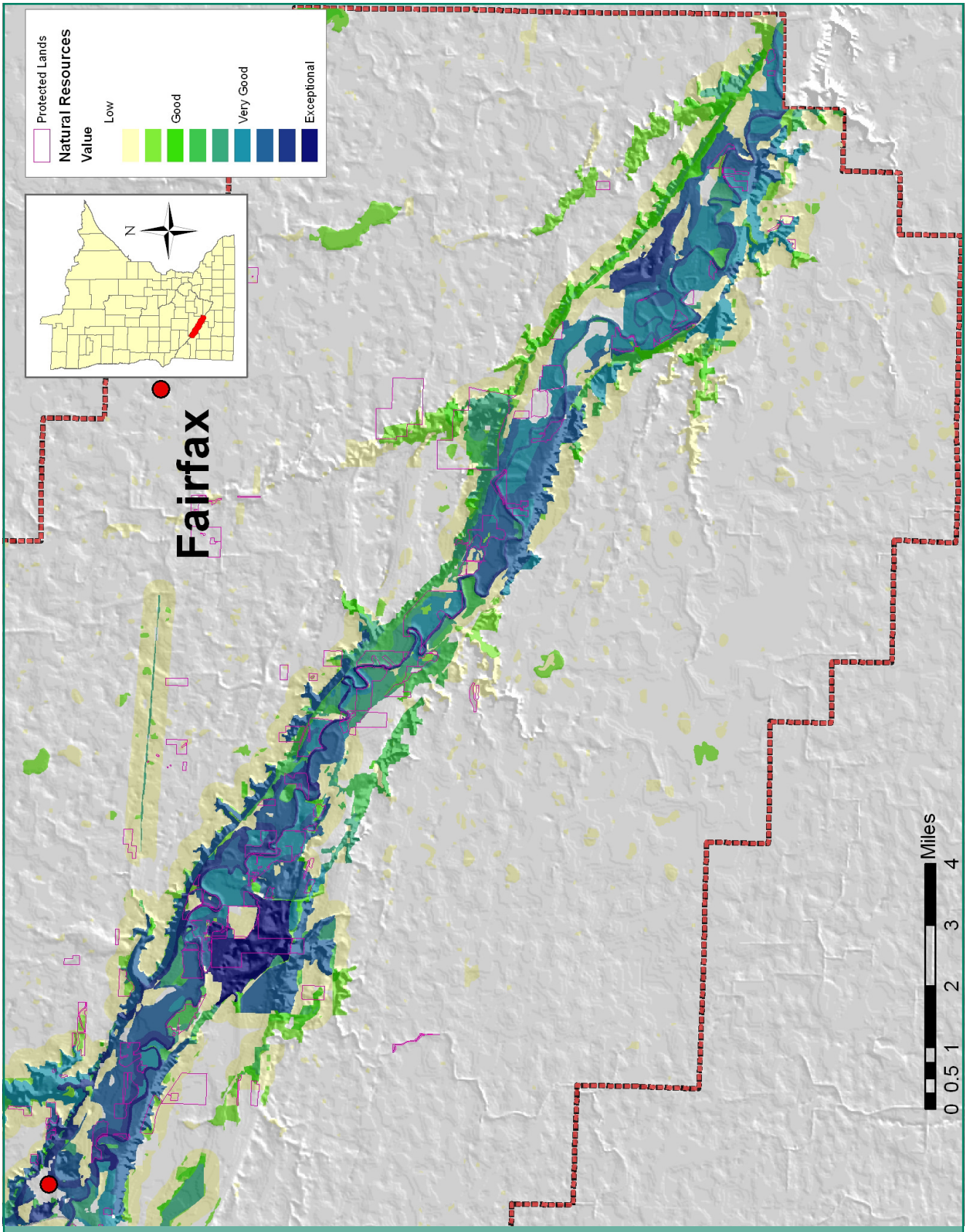


Figure 2.4d: Middle Minnesota River Valley
Natural Resources Opportunities & Protected/Managed Lands

Value	Area (Acres) within Category	Managed Area (Acres) within Category	Percent in Private Lands
Exceptional	12,283.75	2,883.75	76.52
Very Good	18,402.29	3,677.44	80.01
Good	18,963.29	3,699.78	80.49
Moderate	24,016.51	3,565.99	85.15
Low	372,515.88	14,857.84	96.01
Total	446,181.75	26,684.80	94.12

***Table 2.1**: Distribution of Lands Relative to Value Score*

The result of the prioritization process is detailed in Figures 2.4a - 2.4d and Table 2.1. An analysis of the product reveals that only 9.2 percent (49,649 acres; 77 square miles) of the project area is ranked in good, very good, or excellent categories; in large part, lands within these categories are within the Minnesota Valley and associated tributaries.

Alternatively, the vast majority of land within the project area (83.5 percent; 582 square miles) is considered low priority for conservation action. These lands typically have little or no remaining natural vegetation, are far removed from natural habitats, and have no target species associated with them. Much of this land is located on the flat agricultural uplands removed from the Minnesota Valley and its tributaries.

A review of conservation lands in the project area (i.e., those owned and managed by the Minnesota DNR, U.S. Fish and Wildlife Service, respective counties, and Bureau of Land Management; private lands with easements administered by the Board of Water and Soil Resources; and CRP lands with short-term agreements) illustrate that protection efforts to date have been skewed towards lands of good, very good, and exceptional value as determined through the prioritization process. Still, over 75 percent of lands in those categories are in private hands, suggesting a strong need to focus efforts on private landowners in the Valley.

It should be noted, however, that agricultural and other lands that scored low in this prioritization process may be priorities for conservation actions aimed at improving water quality in the Minnesota River and its tributaries. Because analyses for that purpose are best addressed along watershed lines (whose boundaries stretch far beyond those of this project area), and because ongoing TMDL and other planning efforts are already underway in the Minnesota Valley designed to this end, we did not attempt to duplicate those efforts here. Our prioritization is based largely on terrestrial systems, noting of course the direct linkage between the two that can be made in many areas of the Valley.

2.4 Threats and Ecological Legacies

Conservation, in its simplest term, is the abatement of threats to focal conservation targets. Threats (also called stresses), if inadequately addressed, can serve to undermine any action that is carried out under the banner of conservation. Without a strong recognition of threats and their sources, strategies embarked upon or implemented in the name of conservation can be ill-targeted and often fail. Similarly, restoration efforts initiated without an understanding of past activities, events, and the legacy of those actions (ecological legacies) may fail to achieve the desired results.

Threat: An activity or process that has caused, is causing, or may cause the destruction, degradation and/or impairment of biodiversity and natural processes.

Ecological Legacy: Lasting impacts on biodiversity and natural processes as a result of an activity or process happening in the past.

The legacy of past events can reverberate through ecosystems for hundreds to thousands of years (Dupouey et al. 2002). These legacies often become drivers of ecosystem function that may be otherwise hidden from a static view of landscapes in the present (Rhemtulla and Mladenoff 2007). Studies at forest and grassland sites across North America have shown that levels of P, C or N imposed by agriculture can endure for decades and centuries after practices have ceased (Foster et al. 2007). Soil horizons may take centuries to rebuild. Native

Table 2.2: Threats

Terrestrial Threats:

1) Land Use & Land Use Legacies
    - Habitat Loss, Conversion & Fragmentation
2) Invasive Species
3) Loss/Alteration of Natural Processes
    - Fire, Grazing
4) Development & Urbanization
5) Incompatible or Unsustainable Recreational Activities
6) Incompatible Ecosystem Management
7) Mining
8) Climate Change
9) Aquifer Drawdown

Freshwater Threats:

1) Invasive Species
2) Hydrologic Alteration
    - Surface Drainage & Hydrologic Alteration
    - Dams & Culverts
    - Elevation of Magnitude and Duration of Peak Flows
    - Floodplain Alteration
3) Non-Point Source Pollution & Runoff
    - Nutrient Flow – Land Use Practices
    - Erosion & Sedimentation – Land Use Practices
4) Climate Change
5) Point Source Pollution
    - Mining
    - Feed Lot Contamination
6) Aquifer Drawdown

prairies that exemplify what occurred pre-1800 may not be possible without reintroduction of bison and other herbivores (Collins et al. 1998). Research focused on stream systems has shown that modern composition and diversity of fish and invertebrates are best predicted by watershed land use occurring as much as five decades earlier (Harding et al. 1998).

All too often, acquisition is considered the "be all, end all" conservation action pursued, with little consideration given to the threats that have occurred, are occurring, or expected to occur at a given site. Often, acquisition may not be the most critical action required to maintain natural resource targets at a site. Rather, a robust suite of conservation tools designed with an eye toward ameliorating a full spectrum of threats (legacies of past actions/processes occurring at present, or expected to occur in the coming years) and targeted toward the specific conditions of an area should be considered.

As a key component of the planning process, principal threats to both terrestrial and freshwater conservation targets were drafted and reviewed during a workshop designed to propose a suite of conservation strategies to achieve conservation success in the Middle Minnesota River Valley. A list of those threats appears below; Appendix D lists these same threats, along with sources of each threat, and strategies identified to abate those threats. These strategies are discussed in the following section (2.5).

2.5 Conservation Strategies

Four identified for abating threats and conserving the unique and valued natural resources of the Middle Minnesota River Valley are numerous and highly varied (see Appendix D). Many of these arose in discussion during a Strategies Development meeting held in Redwood Falls on November 30, 2009. What follows below is a summary of priority strategies. We lead with several overarching strategies that pertain to conservation of natural resources as a whole, then lay out strategies targeting specific threats.

2.5.1 Overarching Strategies

Several identified strategies do not pertain specifically to a single or small group of threats, but are broadly applicable to natural resources conservation in the Minnesota River Valley as a whole. These include:

Civic Engagement:

The Challenge: Local individuals, business men and women, lawmakers, and children do not adequately know, respect or appreciate the inherent value of the natural resources in Mid-Minnesota Valley. As such, there exists little community support for long-term actions that can serve both to protect these resources and also drive economic revitalization in the Valley.

Strategies to Address the Challenge:

- Teach conservation and the environment to our students.
- Educate and inform elected officials.
- Build a culture of societal responsibility and civic engagement in the protection of natural resources.

Capacity Building:

The Challenge: Insufficient capacity exists at many levels related to the protection and long-term management of the region's natural resources. These capacity gaps exist among public land management agencies (DNR, USFWS, etc.), agencies that deliver services to private land owners (BWSR, SWCDs and NRCS offices), those tasked with enforcement of existing laws, and non profit organizations.

Strategies to Address the Challenge:

- Identify and procure resources to deliver on-the-ground capacity to address challenges, enforce laws and regulations, and implement strategies.
- Build broad partnerships among local, state and federal government agencies, non profit organizations and individuals to share limited resources and elevate impact.

Communication:

The Challenge: Strong and effective messages are required to elevate the recognition of the importance of natural resources in the Mid-Minnesota Valley, galvanize and inform local stakeholders, and successfully implement conservation strategies. These messages can be targeted locally to change an existing culture of apathy or to build an engaged citizenry, and at the state and national levels to build support among elected officials and government agencies.

Strategies to Address the Challenge:

- Develop and deliver focused communications, hitting key messages in a variety of formats, targeting key audiences.
- Market the conservation plan as a key conservation strategy, to build awareness and respect for the region's natural resources and the Minnesota River.

Economic Development:

The Challenge: Natural resource conservation is often viewed as the antithesis of economic progress. Yet, many vibrant economic centers have successfully blended economic progress with resource conservation, making them highly attractive places to live.

Strategies to Abate the Threat:

- Where possible and appropriate, link conservation strategies to economic development (e.g., recreational trail development).
- Use full cost accounting techniques to accurately detail costs and benefits related to proposed conservation practices.
- Pursue and showcase successful strategies designed to both build the local economy while building appreciation for the region's natural heritage (e.g., trails, Minnesota Valley History Center).

2.5.2 Threat-Based Strategies

What follows is a discussion of the primary threats to natural resources in the Middle Minnesota River Valley, and identified strategies to abate these threats.

Figure 2.5: Row Crop harvesting
© Ron Bouldan.

Key Threat 1: Agriculture

With agriculture being the primary use of land within the Minnesota Valley, it is not surprising that the majority of threats to natural resources stem from actions related to this activity. Many of the threats posed by agriculture can be characterized as ecological legacies, resulting from the large-scale conversion of prairie and floodplains, drainage of wetlands, and intensive grazing of blufflands and bottomlands. Threats – to both terrestrial and freshwater systems – playing out today are a result of intensification of agriculture practices, greater use of pesticides and fertilizers, development of larger animal containment facilities and feed lots, and are in many ways driven by the U.S. Farm Bill and other economic drivers operating on the landscape. Among these is the drive for ethanol production as an alternative fuel source. In coming years, threats are likely to emerge as a result of continued pressure to develop alternative fuel sources and the resulting intensification required to balance needs of fuel production and food supplies. The U.S. Farm Bill will continue to play a main driver on both the conservation and threat side of the equation.

Key Strategies:

- Ensure a strong and effective Farm Bill with economic incentives and associated conservation programs for natural resource protection, a Bill that gives farmers good options.
- Implement and enhance funding for the Conservation Stewardship Program (Farm Bill) that delivers commodity payments based on conservation practices.
- Influence development, enhancement and deliver effective use of state/federal programs – targeting private landowners – for wetland restoration, habitat restoration, erosion control, and associated protection efforts.
- Create incentives for permanent vegetation through economically attractive means (e.g., working lands for biofuels, grazing wildlife management areas behind fire, allowing for mid-term grazing of CRP lands).
- Enforce existing laws and regulations related to stream/river buffers and other areas by building capacity at the local level and awareness of laws/regulations by landowners.
- Track recommendations coming forth from Lake Pepin TMDL; develop/implement strategies in line with recommendations, tapping funding that will emerge to address stated need.
- Pursue protection of remaining natural areas on private lands through a variety of tools: acquisition, easements, and landowner agreements tapping federal and state cost-share programs.

Key Threat 2: Mining

Mining, although limited geographically within the project area, has had and is having a significant impact on the limited, remaining natural resources of the Valley proper. Two types of mining – hard rock associated with granite outcrops, and sand/gravel associated with alluvium and glacial drift – are found in the Valley, and threaten remnant prairies and rock outcrops. Quarrying of rock outcrops has emerged as a major threat in the Valley in recent years.

Figure 2.6: Sand/Gravel Quarry
©Great River Greening

Key Strategies:

- Pursue protection of priority remnant prairies and rock outcrops through conservation easements, acquisition, and landowner agreements. Focus RIM program efforts in priority sites; reinvigorate the State's Wild and Scenic River Program and protection that it can afford.

Key Threat 3: Invasive Species

Non-native and native species alike can be damaging to ecological systems (both freshwater and terrestrial) and their associated biota. An array of exotic species (e.g., European buckthorn, multiflora rose, leafy spurge, reed canary grass, smooth brome, Canada thistle, zebra mussel, carp) introduced via federal and state agencies, nursery trade, ballast dumping in the Great Lakes, and illegal import, are having an immediate impact and threaten the future of natural areas and lakes and streams within the project area. In addition, lack of fire and abatement of other natural processes have allowed trees and shrubs to invade remnant prairies, rock outcrops and oak savanna systems, modifying their composition and placing their continued existence at risk.

Figure 2.7: Buckthorn closeup
©Great River Greening

Key Strategies:

- Collaborate with state and federal agencies to eliminate exotic species currently included in their standard planting mixes.
- Outreach to the local nursery industry to ensure highly invasive cultivars are eliminated from stock.
- Develop and enhance effective eradication programs for invasive species at priority sites by bringing resources to bear through state and federal programs, non profit organizations, and local stakeholders.

- Build strong programs that bring local communities to bear in elevating resource management on public lands.
- Enact early detection/rapid response protocols for problematic species that are in very low densities or are on the verge of entering the Valley.

Figure 2.8: Subdivision Development
© Northwest Associated Consultants.

Key Threat 4: Development and Urbanization

Pressures on the natural resources of the Minnesota River Valley stemming from development and urbanization are significant. Land holdings along the River Valley, particularly in close proximity to existing towns, are being subdivided and sold as ranchettes or lots for homes. The River Valley, for those wanting to escape town living, affords a more attractive housing site than agricultural lands. As land ownership changes, opportunities for subdivision emerge.

The former glacial river bed is primarily riparian and is subject to annual spring flooding from Upper Sioux Agency State Park to Fort Ridgely State Park. The real development pressure will not be on the river bed itself, but rather along the sides of the former glacial river banks and the blufflands on top. These areas would be more susceptible to linear housing developments, which are common in the New Ulm and Mankato areas.

There is limited development potential on the south side of the Minnesota River in Redwood County due to:

- The lack of a township road running along the base of the bluff from Redwood Falls through the Lower Sioux Community. Most of the available upper bluff line has already been developed near Redwood Falls and there is a modest amount controlled by three landowners, east of the Lower Sioux Community.
- The presence of a commercial rendering facility and previous DNR acquisitions have limited development along the river bottom road to the west.

The greater residential development potential is on the north side of the River in Renville County due to:

- Accessibility provided by the river bottom road that stretches from one end of the county to the other, providing great access to the side bluffs of the river valley.
- Many of the existing coulees were developed a century ago as pioneer farm sites and additional rural residential development has occurred over the last three decades.

Key Strategies:

- Strengthen land use planning and zoning at the county level.
- Build relationships with key private landowners and acquire conservation easements on priority parcels through RIM, DNR Wild & Scenic River Program, or non-profit conservation organizations.

Key Threat 5: Hydrologic Alterations

Physical modifications to streams and rivers over the years, coupled with exacerbated flows (in magnitude and duration) due to wetland drainage and loss of upland vegetation, have had major impacts on freshwater systems and associated biota.

Key Strategies:

- Change the Minnesota Drainage Law which drives wetland drainage and stream/river channelization across much of the state.
- Enhance efforts to keep water on the land through wetland restoration and other practices, tapping and delivering funding through BWSR, MPCA, and an array of other state and federal programs, and non-profit organizations like Ducks Unlimited.
- Track and develop strategies linked to the Lake Pepin TMDL process which will set limits on nitrogen, phosphorous and sediment loads in the Minnesota River.
- Start small, working to implement an array of practices to achieve demonstrable change in small "proof of concept" watersheds.
- Remove obsolete dams on waterways to reestablish flow through river sections and allow for free movement of fish and other aquatic species.
- Create incentives through Farm Bill and other programs for putting permanent vegetation on lands.
- Expanding working lands concepts for biofuels production, grazing WMAs behind fire and so forth.

Key Threat 6: Point Source Pollution

Several types of point source pollutants pose noteworthy threats to natural resources in the Minnesota Valley, most notably mining, feed lot contamination, and septic systems.

Key Strategies:

- Enforce existing laws and regulations.
- Conduct assessment of septic systems along the Minnesota River and its tributaries; secure cost-share funding to correct problems.

Key Threat 7: Aquifer Depletion

Although not a major issue at present, this threat looms significantly larger in the near future as demands related to ethanol production expand, and into the future as climate warms and rainfall decreases.

Key Strategies:

- Tighten ethanol production regulations.
- Restore wetlands to increase aquifer recharge.

2.5.3 Key Policy Arenas

Farm Policy and Subsidies

Similar to other countries, the United States has sponsored farm subsidies since the early twentieth century. Farm policy and subsidies tend to ebb and flow in popularity depending on the current socio-economics. Farm policy itself is strongly tied to economics and protection of agricultural interests. These policies can, at times, be at odds with the natural resources conservation, while at other times can contain strong conservation incentives. Farm policy is directly tied to how much subsidy is available for placing agricultural lands into various conservation programs such as the Conservation Reserve Program (CRP), Wetland Reserve Program (WRP), Wetland Habitat Incentive Program (WHIP) and others.

Minnesota Drainage Law

Minnesota's extensive tracts of agricultural land rely heavily on an interconnected drainage network of ditches, channels and drain tile. This network operates to drain wet soils by expediting water from the land to local streams and rivers, to the detriment of the hydrological cycle of the region. This can cause greater amplitudes in stream and river flow relative to historic norms during spring runoff and major rain events. In turn, these transport systems can serve as direct conduits for sediment, chemicals and nutrients (e.g., phosphorus and nitrogen) directly into streams. The drainage law is overseen at the local level by a County Board, Joint Drainage Authority, Watershed District, or Soil & Water Conservation District (Busman 2002).

Zoning

Continued human population growth and landscape urbanization will create ongoing pressure on lands with the project area with natural and open space values. Although there is currently a lull in the market for lands as a result of poor economic conditions, pressures are likely to increase as economic conditions and land prices increase. This pressure will appear in the form of future city and subdivision expansion, along with single-home expansion in rural areas. Table 2.3 provides a summary of current zoning regulations related to residential diversity in Redwood and Renville Counties.

Table 2.3: Minimum Density - Redwood and Renville Counties

Redwood (residential minimum density)
MN Scenic River - 1 dwelling unit/5 acres (R-LD, Ag2, Minnesota River Valley Corridor)
Agriculture - 1 dwelling unit/2.5 acres (Ag1, R1)

Renville (residential minimum density)
MN Scenic River - 1 dwelling unit/5 acres (Minnesota River Valley Corridor)
Agriculture - 1 dwelling unit/40 acres
Rural Residential – 1 dwelling unit/5 acres

Minnesota Scenic River Regulations

Both Redwood (Redwood County 2009) and Renville (Renville County 2009) counties have land use ordinances that apply to the State of Minnesota's Scenic River Regulations.

Permitted uses of land within the scenic river district of both counties are largely identical, and include opportunities for governmental campgrounds, public access and trails, agriculture and forestry, sewage treatment facilities, private roads, single family residential housing, and governmental open space recreational uses.

Conditional uses (those requiring a conditional use permit), although largely similar between the two counties, have some notable differences. Private campgrounds, temporary docks, private open space recreational uses, public roads and mining are considered conditional uses in both counties.

Table 2.4: County Zoning Differences

Principle differences in Scenic River zoning between the two counties fall in the following areas:

Conditional Use	**Redwood County**	**Renville County**
Livestock operations	Not listed	>300 animal units
Transmission corridors	Not listed	Power lines and pipelines
Zoning Dimensions		
Lot width at building line	250 feet	300 feet
Subdivisions		
Land unsuitability	Not addressed	None for unsuitable lands
Planned unit development	Not addressed	If clustering allows for better protection of ag land, open space, scenic views, wetlands and other features.

Agriculture and Rural Residential Regulations

Lands within the project area outside of the Minnesota Scenic River District (i.e., uplands beyond the Valley proper) are also subject to zoning restrictions. Again, differences between Redwood and Renville Counties occur relative to minimum lot size for new residential development. Redwood County provides a minimum residential lot size of 2.5 acres, while Renville County requires a lot size of no less than 5 acres [rural residential] (Biko 2007, SRF 2002).

3. Cultural/Historical Resources Conservation Plan

The Cultural/Historical Conservation Plan follows the principal framework established for developing the Natural Resources Conservation Plan. However, unlike the Natural Resources process, this planning process lacked comprehensive data sets to effectively drive a planning and prioritization process. Despite repeated attempts to procure data from both state and local sources, a robust data set was not achieved; this paucity of data had significant implications related to the outcomes of the plan. These are discussed in the following sections of this report. Still, the results of this undertaking are noteworthy.

3.1 Conservation Targets

Conservation targets selected for the cultural/historical component of the Middle Minnesota Valley Conservation Plan include sites and features that effectively tell the story of the area. Through several workshops and meetings, nine principle themes were identified to focus this plan:

- Dakota Culture – Historic village sites, sacred sites, etc.
- Native American Indian Culture – Archeological sites (pre-1700) timeframe
- Early Commerce – Mining, milling, agriculture, quarrying, retail
- Religion – Missions, churches, cemeteries, etc.
- Military – U.S.- Dakota Conflict of 1862, forts, etc.
- Transportation – Railroads, ox cart trails, ferries, early roads, etc.
- Historic (Ghost) Towns – Historic towns and associated features
- Important People – Local people on a regional/national stage
- Other – Noteworthy sites that do not fall into one of the above categories

3.2 Building the Conservation Plan and Assigning Priorities

Within each category, identification of sites were pursued that served to capture the full breadth of these historical/cultural themes as they played out within the project area.

Challenges in Procuring Data

From the onset, the data compilation strategy from which to build this conservation plan hinged on a “top-down, bottom-up” process of gathering data available through the State Historic Preservation Office (SHPO) and other state and federal sources, augmented by data supplied at the local level through county historical societies and local experts.

This approach, although attractive in many ways, failed to produce the quantity and quality of data required to build a robust conservation plan. Although we obtained a full complement of historic and archeological data for the project area from SHPO, data restrictions made it impossible to share this site-specific information with

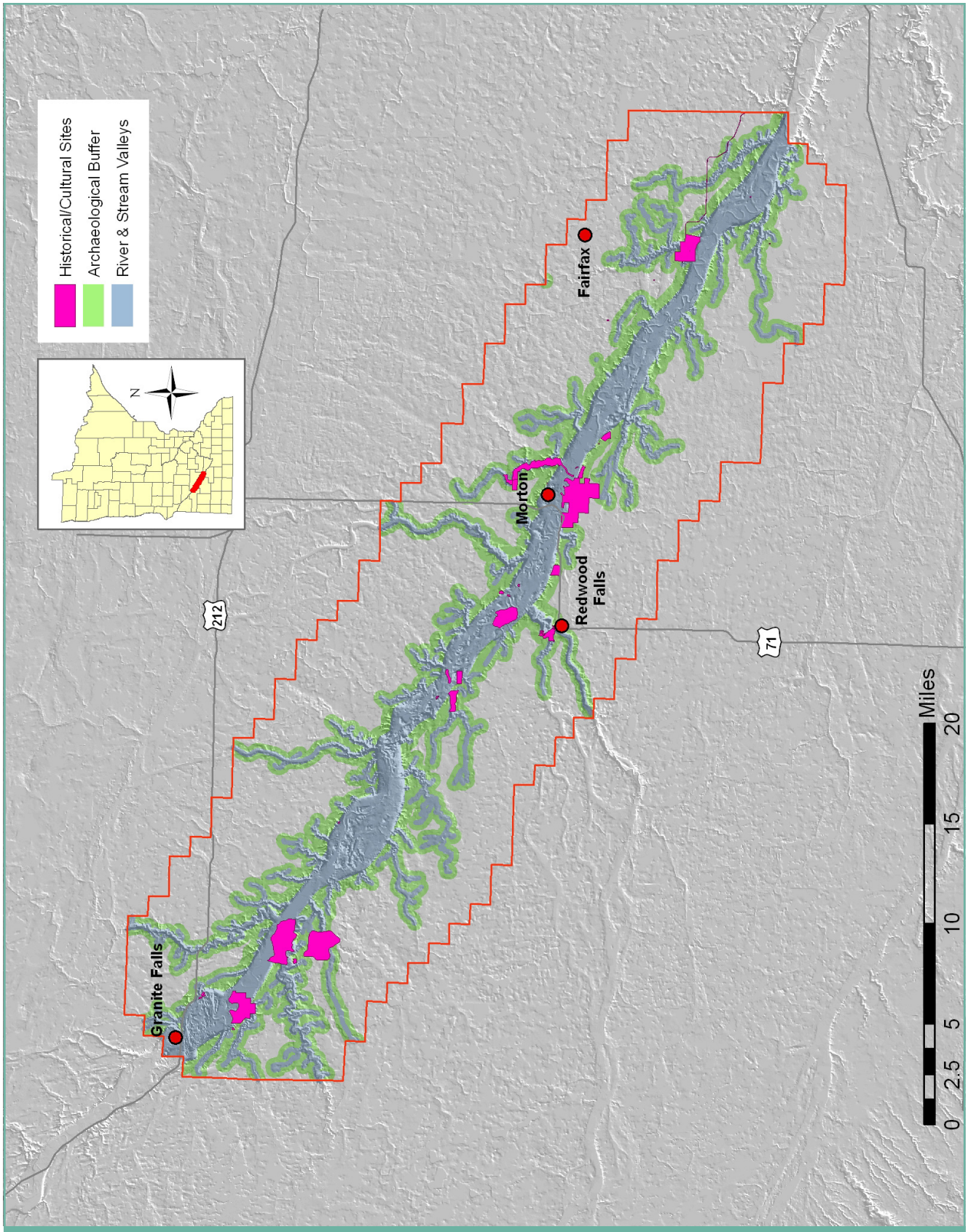


Figure 3.1: Minnesota River Valley Green Corridor Historical/Cultural Opportunities

[Adjust Map color layout]

project partners or include it in the conservation plan per se. Our approach at the local level was to identify and request assistance from experts in providing site nominations, spatial maps, and supporting data related to important historical sites within the categories identified above. That approach, although partially successful, failed to produce as expected. As a result, the process adopted for assembling a conservation plan around these features was considerably different than that described for natural resources. As such, this conservation plan – although identifying an array of important historical and cultural sites and strategies to conserve them – lays the groundwork for a more robust, locally-led process that should follow in the near term.

Outcomes

Local input from knowledgeable experts served to identify 39 historic/cultural sites within the project area, representative of each of the 9 principal themes (Figure 3.1). However, sites principally relate to Military (44 percent) and Dakota (33percent) themes, acknowledging the importance of these themes in the project area.

***Table 3.1**: Identified Historical/Cultural Sites by Theme*

Theme	Number of Sites
Dakota Culture	13
Early Commerce	8
Religion	7
Military	16
Transportation	4
Historic (Ghost) Towns	5
Important People	6
Pre-Dakota Culture	0
Other	3

For each nominated site, we compiled both a spatial boundary (to the extent that was obtainable) and associated tabular data (see Appendix E). Spatial boundaries of sites were drawn to encompass all features necessary for the protection and interpretation of the resource from a historical standpoint. Breakdowns of identified sites relative to each of the respective themes are detailed in Figure 3.1.

Pre-1700 archeological sites associated with the broader Native American Indian theme were excluded from the mapping exercise due to their sensitivity. Instead, a probability map depicting likelihood of encountering archeological resources was developed by Great River Greening, based on distance from existing water sources (Table 3.1).

Assigning Conservation Priorities

Due to the paucity of data associated with historic sites in the Middle Minnesota Valley, the project managers and project Executive Committee determined that it made little sense at this time to assign conservation priorities to sites. Rather, a more thorough, locally-led historical assessment should be undertaken in the near future to augment data collected through this effort, which would in turn lead to a compelling prioritization process. It is unlikely that direct action by Green Corridor, Inc. will be taken specifically to conserve historical features in the coming half decade, allowing time to make the historical/cultural plan more robust.

When undertaken, we propose that priorities be set around the following criteria:

- Historical significance of the site (global, national, regional, statewide, or local)
- Condition of the site (excellent to poor/degraded)
- Interpretive value (high to low)

Approximately half of all identified sites are considered protected. The level of protection afforded identified sites to date by theme shows that most protected sites in the project area are associated with the U.S. – Dakota Conflict of 1862. Few sites related to early commerce, transportation, etc. are protected and their historical story is largely untold. A more intensive conservation planning process in the future should ensure that all of these themes are adequately addressed.

3.3 Threats and Historical Legacies

Cultural and historical resources in the Middle Minnesota Valley are threatened by an array of direct and benign stresses. These threats stem from the lack of a thorough assessment and knowledge/understanding of historical/cultural resources in the region, insufficient financial resources, capacity, and legal covenants to protect and maintain those that are known, and inadequate appreciation/support among local communities and legislative representatives to make protection of these resources a priority. A list of identified threats to historical/cultural resources in the Middle Minnesota Valley appears below; Appendix D lists these same threats, along with sources of each threat, and strategies identified to abate those threats.

Principal Threats:

- *Development & Urbanization* – loss and degradation of resources due to encroachment via urban sprawl, loss through development and urban revitalization, and other associated actions.
- *Loss of Knowledge* – loss and degradation of resources due to inadequate documentation of history (especially at the local level) leading to an inability to locate and interpret historical sites, and a failure to recognize the importance of sites.
- *Land Use and Land Use Legacies* – loss or degradation that has already occurred stemming from a variety of historical sources (agricultural conversion of lands, etc.).
- *Maintenance Deficiency* – loss and degradation through insufficient resources to protect and maintain sites over time.
- *Economic and Social Changes* – loss and degradation due to changes in perceived value of sites by stakeholders, particularly in dire economic times.
- *Insufficient and Inadequate Conservation Standards* – loss and degradation of resources due to insufficient and inadequate application of conservation standards to historical/cultural resources.
- *Tourism-Related Degradation and Loss* – loss and degradation due to the over-use and inadequate protection of resources by visitors.
- *Lack of or Inadequate Protective Heritage Legislation* – loss and degradation as a result of inadequate protective legislation at the local, state, or national levels, and/or the enforcement of existing legislation.

A global assessment by the International Council on Monuments and Sites (ICMOS 2010) identified a suite of resources at risk across the world. Many of these globally threatened resources are also threatened in the Middle Minnesota Valley as well, and include:

Rural and Vernacular Architecture

Modest, traditional buildings and places are especially vulnerable because of their transient materials and unassuming character.

The risks include:

- Lack of recognition for simple vernacular heritage and thus lack of legal protection;
- Loss of traditional building skills;
- Loss of function, leading to lack of maintenance;
- Redundancy, neglect, abandonment or imposed modernization.

Figure 3.2: Beaver Falls Town Hall
©Gary Revier

Industrial Heritage

With rapid changes in technology and socio-political structures, industrial complexes of heritage significance are under pressure for redevelopment or modification. Sites located in urban areas are particularly vulnerable, as land values, living conditions and environmental expectations and controls change. The large scale of some redundant sites is often attractive for incompatible redevelopment, and their pragmatic value as real estate is seen to outweigh their heritage values and interpretative potential for adaptive reuse.

Figure 3.3: Kittelsland Water Wheel
©Ron Bouldan.

Major issues faced by industrial heritage sites include:

- Scale and complexity forcing economical rationalism to prevail in reuse decisions;
- Lack of widespread vocal support constituency;
- Location in prime redevelopment areas;
- Environmental management (e.g. remediation) precluding heritage values.

Religious Heritage

Changes to religious practice and observances are a major threat to heritage worldwide. The complexity of the functions of religious buildings - spiritual, public, social and administrative - can support some flexibility of use, but for many the lack of congregation, or changing worship practices have led to abandonment or massive internal changes. Parish churches are often neglected or adapted for other functions, not always with respect for or regard to the spirit of the place.

Risks affecting religious buildings include:

- Unsuitable use for other purposes;
- Lack of maintenance.

Archaeological Sites

Lack of adequate inventories to locate archaeological sites is at the root of this problem, as are increasing acts of vandalism to these sites. Physical damage through land conversion to agriculture and other practices also poses significant threats. Natural forces are also the enemy of these sites - erosion by wind and water threaten artifacts and sites alike. Urban development poses the threat of sudden destruction.

Threats affecting archaeological sites include:

- Illicit excavations, particularly in remote sites;
- Resource extraction;
- Infrastructure development, such as roads, bridges and dams;
- The antiquities trade.

Figure 3.6: Tepee
Redwood County Historical Society

Dakota Values and Places

An ongoing challenge is the appropriate recognition and conservation of Indigenous values in landscapes, sites and communities. Much work is needed to negotiate appropriate conservation protocols in diverse cultures - from the cultural and social necessity of maintaining language, to the identification and protection of cultural sites, to recognizing the intangible values in spiritual landscapes, and to the importance of specific sites of conflict or contact.

3.4 Conservation Strategies

Strategies identified for abating threats and conserving the nationally significant cultural and historical resources of the Middle Minnesota River Valley are numerous and highly varied (see Appendix F). Many of these arose in discussion during a Strategies Development meeting held in Redwood Falls on November 30, 2009. What follows below is a summary of the priority threats and strategies that emerged.

Development and Urbanization

Pressures on the historical/cultural resources of the Minnesota Valley stemming from development and urbanization are significant. Important features throughout the project area are being lost through development and urbanization.

Key Strategies:

- Initiate land use planning at the county level.
- Pass zoning language for historic districts and implement at the county level.
- Build relationships with key private landowners and acquire historic conservation easements on priority features through non-profit organizations.
- Develop a robust historical/cultural conservation plan to drive conservation action.

Loss of Knowledge

Critical information related to historic and cultural sites, unless adequately captured through historical documents, is being lost daily as memories fade, local community member pass away, and sites degrade.

Key Strategies:

- Conduct a comprehensive inventory of historical/cultural features in the Middle Minnesota Valley, and identify priority sites for conservation action.
- Undertake research to accompany the above inventory in order to understand and set priorities for conservation action.

Maintenance Deficiency

Lack of maintenance is perhaps the single most important threat facing historical resources in the Middle Minnesota Valley. Often, historical surveys have not been conducted to identify buildings and sites of historical value. As a result, landowners, communities and government officials fail to recognize the historical significance of a given building, site or feature. Buildings – whether occupied or not – degrade over time without sufficient resources put toward their maintenance.

Key Strategies:

- Conduct comprehensive inventory of historical/cultural features in the Middle Minnesota Valley, and identify priority sites for conservation action.
- Develop cost-share funding, tax relief or other funding sources to alleviate cost of maintenance by owners.
- Develop and implement attractive and convincing marketing/education campaign to raise awareness of resources and build endowment to fund maintenance over the long term.
- Develop or lure an effective historical/cultural nonprofit organization to the Valley to begin the work of conserving and managing these important resources.

Economic and Social Changes

Economic downfalls can destroy the best intentions and programs that were put in place when funds were plentiful. Successful, long-term solutions are required that provide funding sources that withstand economic downturns and social changes within a community.

Key Strategies:

- In companionship with a viable protection campaign, set aside funding for a maintenance endowment.
- Develop innovative practices that serve to maintain historic buildings while making them attractive for continued use.

4. Going Forward - Taking Conservation Action

4.1 How to Use the Plan

Conservation planning as a discipline has evolved significantly over the last decade. Where once the emphasis was on a completed plan, the focus of conservation planning today lies with its products – the underpinning data and maps – and how they will be effectively used by the many conservation organizations, and federal, state and local units of government working within a project area. In the end, the strength of a given plan lies not with the plan itself, but in how effectively it is used in achieving conservation success. This change in focus from a hard-copy product to an effective decision support tool is at the heart of this transformative change in planning. Far too often, planning processes have failed to impact on-the-ground conservation; although looking nice, many have been quickly relegated to the proverbial and literal bookshelves.

Figure 4.1: Looking down a tributary to the Minnesota River ©Brad Cobb

The Middle Minnesota River Conservation and Action Plan reflects this evolution in conservation planning. At the onset of the planning process, project managers in conjunction with Executive and Facilitation committees reached consensus that this undertaking would result in strong deliverables that could be used by a broad suite of practitioners to inform their actions within the project area. To this end, the planning process produced the following deliverables:

- A conservation plan for both historical/cultural and natural resources (via hard-copy, CD and worldwide web),
- Large-scale, plotter-sized maps of natural and cultural/historical resources (available on CD and via the worldwide web), and
- GIS shapefiles for respective coverages (available on CD and via the worldwide web).

Resource prioritization maps and shapefiles produced through this planning process are intended to serve as:

- Vehicles through which the proposed conservation actions of an organization – whether fee-title or easement acquisition, restoration, or delivering state cost-share programs to private landowners – are vetted.
- Visual resources around which groups of stakeholders and conservation practitioners jointly discuss collective strategies, laying out long-term game plans to achieve demonstrable impact.
- A tool for land management agencies in reviewing existing site-based management plans informed by a broader regional context.

As a means of showcasing the utility of these tools to potential users, we provide two illustrative examples. Although drawn from actual data in the Middle Minnesota Conservation Plan, it is important to emphasize that these examples are put forward merely for illustrative purposes only, and are not meant to promote or suggest that these strategies are being considered by any respective stakeholder.

4.1.1 Illustrative Example 1

Key Players:

Minnesota Department of Natural Resources - protects the state's natural heritage by conserving the diversity of natural lands, waters, and fish and wildlife that provide the foundation for Minnesota's recreational and natural resource-based economy.

Green Corridor, Inc. - is a non-profit conservation organization dedicated to the conservation and recreational use of the Middle Minnesota Valley. The organization is interested in assisting the DNR in meeting its goals in the project area, but also providing greater recreational access to and along the river valley corridor.

Overview:

The Minnesota DNR manages a state wildlife management area (WMA) along the south bank of the Minnesota River. The WMA captures a significant portion of an area characterized as having exceptional natural resource value; some areas of lesser quality are also included within the WMA. The DNR has identified this area as being

a cornerstone to its conservation efforts in the Middle Minnesota Valley, and is willing to employ a variety of strategies to achieve its goals in protecting areas of exceptional natural resource value and species of greatest conservation need that live in the Valley and on the WMA.

A review of the resource prioritization map relative to existing managed areas (Figure 4.2) finds the following:

- Two areas of exceptional natural resource value in private hand immediately adjacent to the WMA. These include a large area of approximately 50 acres off the west edge of the WMA, and a smaller 15-acre area sandwiched between two legs of the WMA along its south border.
- Three areas of lesser quality (very good to low natural resource value) are included within the WMA: 1) northwestern corner along the Minnesota River, 2) southeastern corner along the Minnesota River, and 3) a small inclusion in the center of the unit.
- A small privately-owned tract of land enrolled in the Reinvest in Minnesota (RIM) program (a perpetual conservation easement program held by the State of Minnesota) is located adjacent to the Minnesota River along the northwest corner of the WMA.

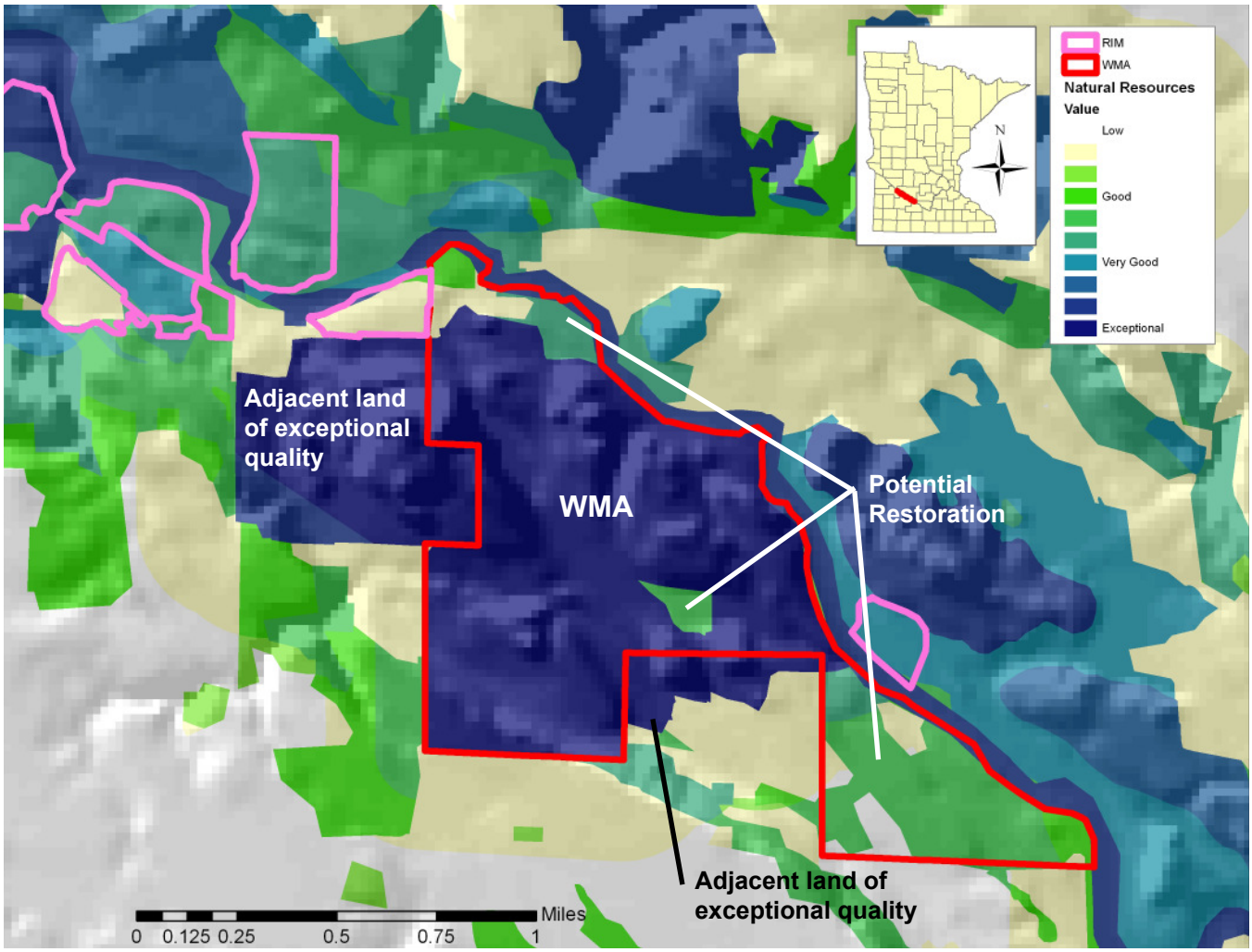


Figure 4.2: Illustrative Overview Example 1

- Privately owned lands of low to very good natural resource quality are located adjacent to the WMA along its south and western borders.

Illustrative Strategies

Based on this overview, a number of potential strategies might be employed to enhance conservation of existing state investments and areas of exemplary natural resource value located in the project area. These are described below, but reference Figure 4.3:

Strategy 1: Fee Title and Easement Acquisition

Both areas currently in private ownership but of exceptional natural resource value (given their proximity to the existing WMA) are likely candidates for acquisition. Acquisition of these parcels – via directly by MN DNR or via Green Corridor, Inc. – would not only protect the high quality resources on these lands, but also afford greater protection to resources now partially protected within the WMA. Acquisition of the private land located along the managed area's south border would strengthen the linkage between two existing legs of the WMA and provide a better corridor for species movement along the valley.

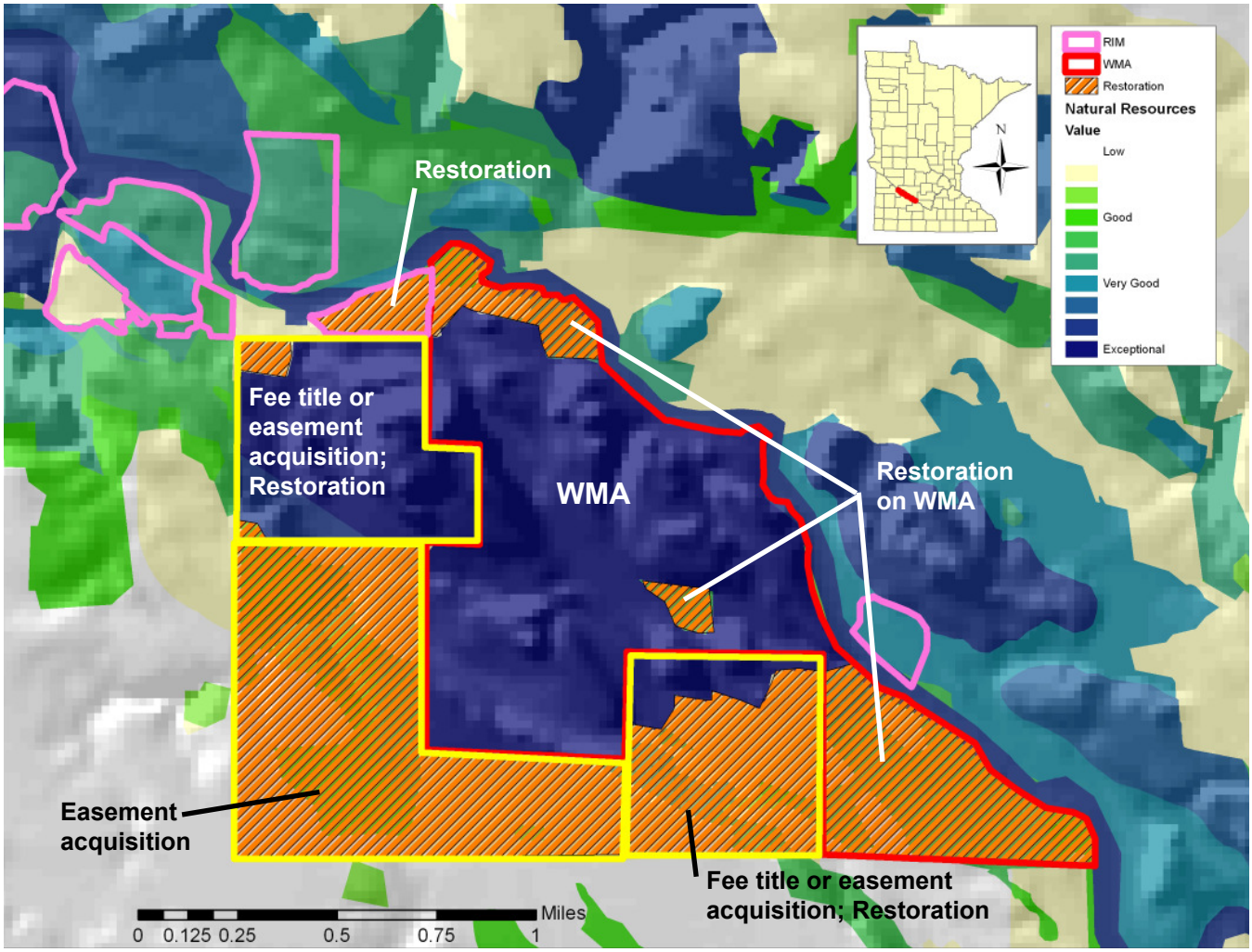


Figure 4.3: Illustrative Strategies Example 1

If landowners are unwilling to sell, the DNR might pursue long-term conservation easements on these same tracts as a mechanism for affording limited but critical conservation action. In addition, easements might be warranted on other private lands immediately adjacent to the WMA (south and west borders) as a way to offer greater buffer and protection to investments already made by the State of Minnesota. To this end, the DNR may collaborate with Green Corridor, Inc., the Minnesota Board of Soil and Water Resources (BWSR) which administers the RIM program through its local Soil and Water Conservation Districts, or other conservation partners in procuring these easements.

Strategy 2: Restoration and Management

Restoration and resource management – as a means of improving the size, condition and landscape context of habitat within and adjacent to the WMA – might be pursued on both state and private lands. Portions of the WMA (northwest and southeast corners, and centrally) are of relatively low natural resource quality. Restoration of these areas to their historic condition would greatly improve the overall viability of natural resources of the WMA by reducing edge effect, buffering existing high quality lands and creating more contiguous habitat for wildlife species. Finally, the DNR might review its existing management plan to ensure that existing management practices within the WMA are in line with the long-term maintenance of the WMA's exceptional natural resources.

Similarly, restoration of privately owned lands adjacent to the WMA could be pursued by the DNR through collaboration with county NRCS or SWCD offices, tapping a broad suite of state and federal cost share assistance programs for these explicit purposes. Collaboration with BWSR could also bring resources toward restoring and managing the state-held RIM easement located along the northwest corner of the WMA. These actions, again, would serve to buffer the existing WMA and offer greater level of protection to the state's conservation investments. It should be noted that these state and federal cost share assistance programs do not offer perpetual protection, as programs typically have a lifespan of 10-30 years.

4.1.2 Illustrative Example 2

Key Players:

Minnesota DNR – protects the state's natural heritage by conserving the diversity of natural lands, waters, and fish and wildlife that provide the foundation for Minnesota's recreational and natural resource-based economy.

Redwood SWCD – is a special purpose unit of government that manages and directs conservation programs, such as the state Cost-Share Program and the Reinvest In Minnesota (RIM) Program. Water quality is a primary emphasis of the District.

Overview:

The Minnesota DNR manages a state Scientific and Natural Area (SNA) that protects a significant portion of an area identified for its exceptional natural resource value. SNAs preserve natural features and rare resources of exceptional scientific and educational value in the State of Minnesota. The DNR also manages a WMA – considered to be of relatively low natural resource value – that lies immediately adjacent to the SNA. A stream draining agricultural lands enters the SNA from the south, laden with silt and nutrients, and flooding frequently during rain and snow melt events. The creek is having significant negative impacts both on the SNA and other lands along its course, and water quality within the Minnesota River.

A review of the resource prioritization map relative to existing managed areas (Figure 4.4) finds the following:

- Approximately half of the land designated as being of exceptional conservation value is on private land, and has no formal protection.
- The Minnesota DNR manages a WMA of relatively low natural resource value that lies immediately adjacent to the SNA.

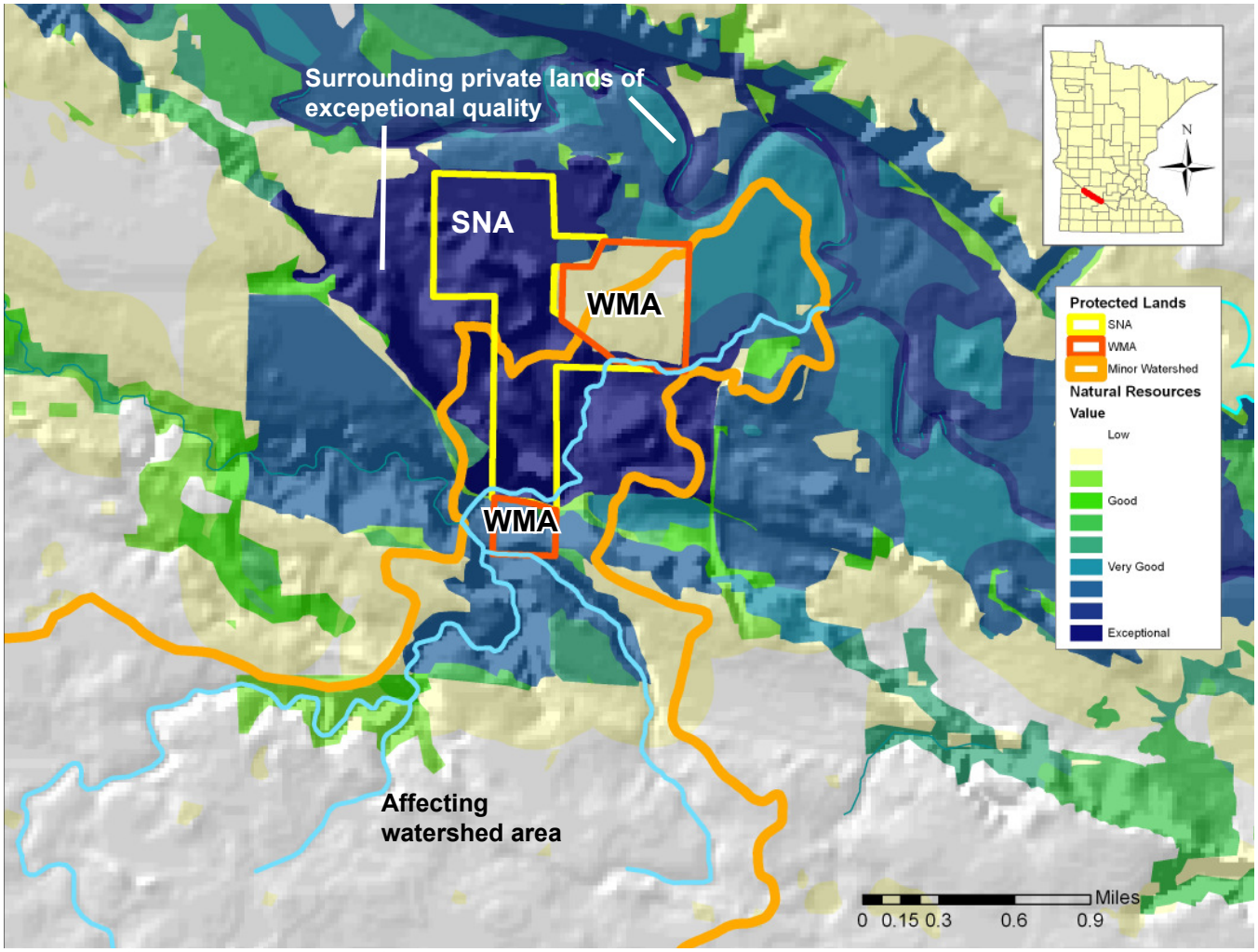


Figure 4.4: Illustrative Overview Example 2

- A number of privately-owned tracts of land enrolled in the Reinvest in Minnesota (RIM) program (a perpetual conservation easement program held by the State of Minnesota) are located immediately adjacent to the SNA and WMA. Most of these are considered to be of very good natural resource value.

Illustrative Strategies

Based on this overview, a number of potential strategies might be employed to enhance conservation of existing state investments and areas of exemplary natural resource value located in the project area. These are described below, but reference Figure 4.5:

Strategy 1: Fee Title and Easement Acquisition

Areas currently in private ownership but of exceptional natural resource value (given their proximity to the existing SNA) are likely candidates for acquisition. Acquisition of these tracts would not only protect the high quality resources of these lands, but also afford greater protection to resources now partially protected within the SNA.

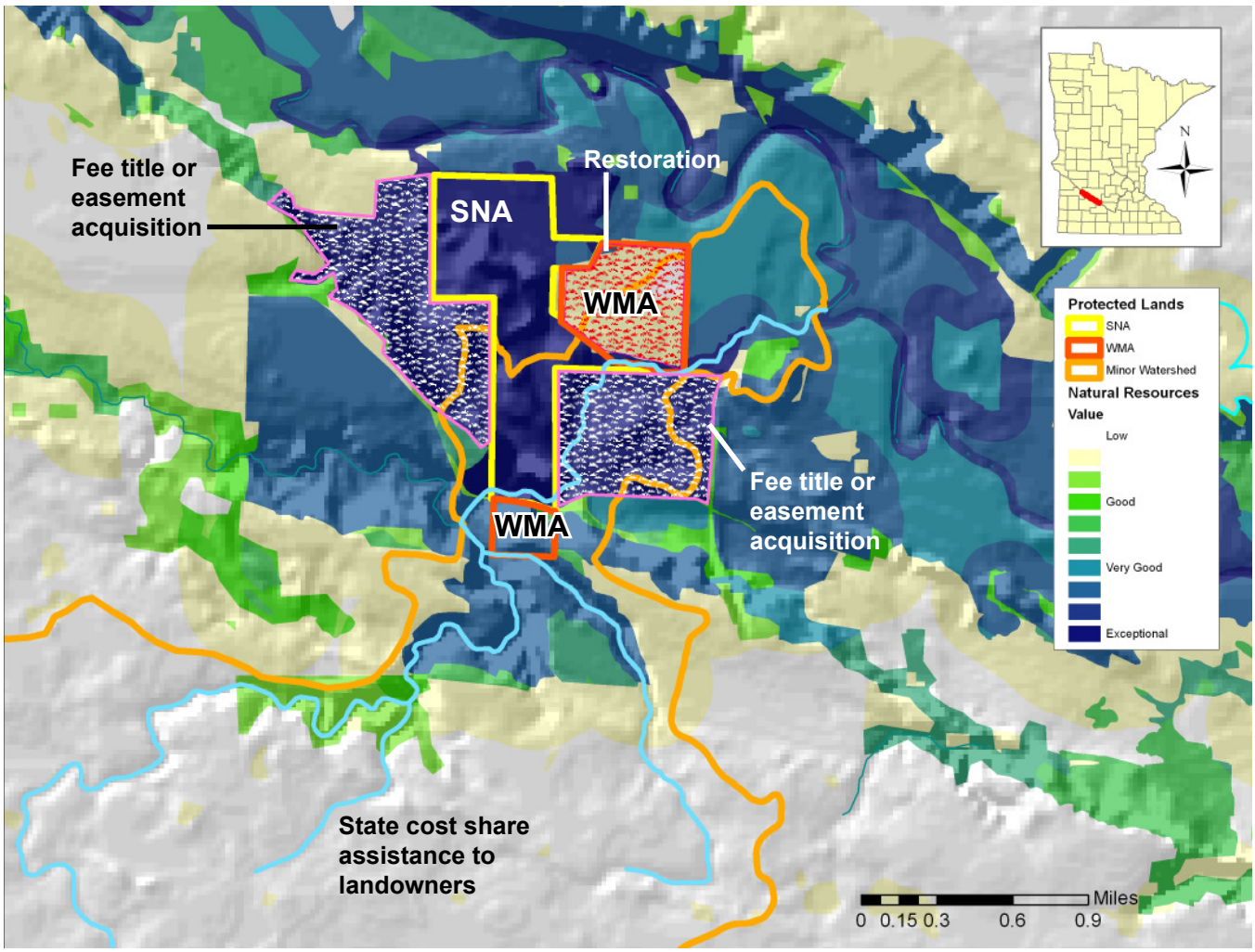


Figure 4.5: Illustrative Strategies Example 2

If landowners are unwilling to sell, the DNR working collaboratively Redwood SWCD using the state's RIM program might pursue long-term conservation easements on these same tracts as a mechanism for affording limited but critical conservation action. In addition, easements might be pursued on other private lands adjacent to or in close proximity to the SNA as a way to offer greater protection to the complex of natural areas.

Strategy 2: Restoration and Management

Restoration and resource management is a key strategy for this site. The WMA, when viewed relative to all other ownership tracts, ranks low and serves to degrade the integrity of the natural resources at the SNA and across the broader complex of private/public lands. Restoration of this WMA to its historic conditions would greatly improve the overall viability of natural resources of this complex of lands, reducing edge effect, buffering existing high quality lands and creating more contiguous habitat for wildlife species. The DNR might review its existing WMA management plan to better complement that of the SNA.

Aside from the WMA, lands in public and private hands within this portion of the Minnesota Valley generally of very good or exceptional natural resource value. Ongoing management of this resource, however, is important and likely to be a challenge to private landowners. Collaboration between MN DNR and Redwood SWCD to effectively target state cost share programs to private landowners in the area would be an important strategy. These actions would serve to buffer the existing SNA and offer greater level of protection to the state's conservation investments. It should be noted that these state and federal cost share assistance programs do not offer perpetual protection, as programs typically have a lifespan of 10-30 years.

Strategy 3: State Cost-Share Assistance to Private Landowners

Improving the quality and hydrology of the stream running through the SNA is a challenge that must be addressed at its source – the agricultural uplands associated with headwaters and mid-stretches of the creek. Reducing these threats will require broad application of strategies that serve to retain water on the landscape, buffer stream courses, protect highly erodible soils, and reduce tillage. To this end, the Redwood SWCD is a logical lead, tapping a variety of state cost share programs. Collaboration with the Redwood County Natural Resources Conservation Service (NRCS) office would broaden this resource base to include federal funds. Finally, as TMDL assessments and implementation plans are finalized, these will open the door to additional funding sources targeting a reduction in phosphorous, nitrogen and other sources of impairment to the Minnesota River.

4.2 Next Steps and Feasibility Assessment

Key strategies to abate major threats and conserve the natural, cultural and historical resources of the Mid-Minnesota Valley are outlined in the discussion of conservation strategies (Section 2.5). In this section, the authors expand upon that discussion, identifying a small suite of priority strategies designed to move the conservation bar significantly forward in the short term. Each of the priorities would require major collaboration and planning to fully develop and implement. And so, at this point, we would not presume to suggest whether or not moving forward on any particular strategy is feasible.

We offer here only the outlines of how such a process might begin. Integral to that discussion is:

1. A review of organizational capacity within partner organizations at the local and state levels to make progress in each respective area,
2. An outline of concrete next steps to make demonstrable progress, and
3. Identification of who is best poised to lead those efforts and otherwise participate.

It is acknowledged here that conservation in this or any other region is a moving target. Circumstances on the ground regularly change as landowners sell property, as the natural and cultural/historical resource base changes, as new laws and regulations are passed, as new conservation programs and funding sources become available, and as conservation organizations and their roles grow or morph over time. Although the authors put forth a suite of priority conservation strategies for the region, an intentional effort is made to ensure that the plan is not overly prescriptive on that front.

4.2.1 Historical/Cultural Resources

The conservation plan for historical and cultural resources as pursued through this planning effort failed to materialize to the extent that was achieved for natural resources. The principle reason for this was due to a lack of robust information from which to draw in developing the plan. As such, the key next steps are targeted squarely at pulling together the base information and developing a robust plan to guide historical and cultural conservation efforts.

Strategy 1. Conduct a comprehensive inventory of the cultural/historical resources.

A solid base of data is critical to the development of a conservation plan that subsequently supports and drives conservation of target resources. As such, a first priority is a comprehensive inventory of the cultural/historical resources of the Middle Minnesota River Valley, tied to the focal themes identified earlier in this plan.

Key Players:

- Local Organization Leader – There exists a number of individuals with deep knowledge of the history of this portion of the Minnesota Valley, but we were unable to effectively tap that knowledge. A locally led planning process will likely have better success in engaging these individuals. Tatanka Bluffs Corridor, Green Corridor, Inc. and the local county historical societies could play this role effectively.

- Support of Statewide Organizations/Agencies – Capacity and expertise in procuring resources to fund the inventory and planning process may be insufficient at the local level. Collaboration with Minnesota Historical Society, James Ford Bell Museum of Natural History, Great River Greening, and other organizations can greatly facilitate this process.
- Technical Expert – Inventory and compilation of historical and cultural features around which the conservation plan will be built must engage an individual or organization with deep knowledge and abilities in these areas.

Strategy 2. Complete the Conservation Plan for Historical and Cultural Resources

Completion of the conservation plan is a critical follow-on step to the inventory of resources within the project area. The authors recommend a process similar to that conducted for natural resources, in that a spatial prioritization of features – around each individual theme, but also across all themes – is a principle outcome. When completed, the historical/cultural planning priorities could be overlaid with those from the natural resources plan to identify areas of overlap and complementary conservation strategies.

Key Players:

- Local Organization Leader – Again, as above, this process must be owned and supported locally. In order to be effectively implemented, the conservation plan must be derived with the full support and buy-in of all key stakeholders in the area. Tatanka Bluffs Corridor, Green Corridor, Inc. or the newly organized Minnesota Valley History Learning Center could play this role.
- Conservation Planner – Building the conservation plan requires an individual with a strong skill set in conservation planning to deliver a product(s) that informs and meets the needs of the conservation community. Great River Greening or another organization employing individuals with this skill set could play this role effectively.

Strategy 3. Identification, Development and Implementation of Priority Strategies

Conservation strategies for historical/cultural resources will become more detailed and complex once the conservation plan is completed. However, those with an interest in the conservation of these resources should begin to assemble and discuss how a robust historical/cultural conservation strategy might be employed in the Middle Minnesota Valley. Relative to the arena of natural resource conservation, few effective non-profit organizations and government agencies have historical/cultural resource conservation as their mission. In many ways, this is indicative of the support and funding base available for this work. A strong, effective organization supported by a broad complement of partner organizations and borrowing from the successful strategies of natural resource organizations can achieve success in this arena.

Key Players:

- Local Organization Leader – Likely the same organization leading the planning process is the one that leads its implementation. Regardless of the organization, it must be savvy, talented, driven, and ultimately well-funded. As before, Tatanka Bluffs Corridor, Green Corridor, Inc. or Minnesota Valley History Learning Center could play this role across the planning area. At individual sites, groups like Wood Lake Battlefield Association, Minnesota Historical Society, Friends of Upper Sioux Agency State Park, Friends of Fort Ridgely State Park or Minnesota DNR can play leadership roles. Local historical societies can play significant roles within respective counties.
- Support of Broad Spectrum of Local, State and Federal Organizations and Agencies – Success on this front can only occur with the broad backing and support of individuals and organizations at the local level, coupled with that of those from outside the Valley. Collaboration with Minnesota Historical Society, James Ford Bell Museum of Natural History, National Park Service, and many other individuals and organizations can greatly this process.

4.2.2 Natural Resources

The conservation plan for natural resources identified geographic priorities in addition to a slate of important key strategies to achieve conservation success in the Middle Minnesota Valley. Although each of these identified strategies plays a role in the ultimate success of conservation efforts in the Valley, the authors have identified a small number that are timely, have capacity in place for implementation, and can have significant impact across the project area.

Strategy 1. Acquisition (Fee Title and Easement)

Acquisition is a common and important strategy for both protecting and providing public access to natural resources. There are a significant number of conservation organizations and state and federal agencies conducting this work, and funding for acquisition is at an unprecedented level as a result of the Outdoor Heritage Fund. The natural resources conservation plan should serve as a primary resource for determining priorities among this collective group of practitioners. Coordination between these organizations will be a key requirement to ensure effective conservation.

Key Players:

- Local/Regional Coordinator – With the array of players and the amount of funding on the table, coordination among these players is a major need. Although many conservation organizations could play this role, Green Corridor, Inc. or the Minnesota DNR's Southern Region are perhaps best suited for this role.
- Implementers – A slate of conservation organizations with expertise in acquisition (fee title and easements) are required to achieve significant conservation gains. Although each has their own specific mission, these overlap between organizations in significant ways. Key acquisition implementers likely include: Green Corridor, Inc., Pheasants Forever, Minnesota DNR, BWSR, USFWS and others.

Strategy 2. Agriculture-Based Strategies

The Middle Minnesota Valley sits amidst a broad, highly productive agricultural region. Although being the region's principle economic engine, agriculture has been a major source of many of the threats to the health and abundance of the Valley's natural resources. Since agricultural lands are largely in private hands, organizations and agencies with a mission of working with these individuals are likely to play primary roles in implementing strategies related to agriculture. Two key agricultural-based strategies are discussed here:

Cost-Share Incentive Programs to Private Landowners – Federal Farm Bill and State Cost Share programs are the principle vehicles through which conservation practices are implemented on private lands in the Minnesota Valley. These programs are numerous and varied, and include Conservation Stewardship Program (CSP), Conservation Reserve Program (CRP), Environmental Quality Incentive Program (EQIP) and others at the federal level, and a host of programs at the state level. Effectively targeting and utilizing these programs can achieve significant impact at the local and broader regional scales.

Key Players:

- County NRCS and SWCD Offices – Federal and state cost-share programs to agricultural land owners are delivered out of respective county NRCS and SWCD offices. As such, these programs are key to the success of this strategy in the Middle Minnesota Valley. Redwood and Renville NRCS and SWCD offices are the key players in this geography.
- Conservation Organizations and Agencies – Conservation organizations and state and federal land management agencies can play a lead role in collaborating with county NRCS and SWCD offices to effectively target delivery of funding to private landowners to achieve maximum conservation benefit in line with the conservation plan. In addition, non-profit conservation organizations can work effectively to shape conservation programs at the state and federal levels and lobby for sufficient funding for implementation of these programs on the ground.

Biofuels Demonstration, Testing, and Feasibility Assessments – As the countries of the World look for new energy sources, biofuels are emerging as competitors with food for available farmland. This tension can lead to intensification of agricultural practices, but can also – if proven to be economically viable – place perennial vegetation on the land, thereby reducing runoff and siltation of streams and serving as a conservation tool. The impact on natural resources stemming from biofuel production is likely to be one of the major issues of concern and focus of research by conservation organizations, state land management agencies, and universities over the coming decades. The Middle Minnesota Valley can serve as a venue for a world-class demonstration site for biofuel production.

Key Players:

- County NRCS and SWCD Offices – These two agencies are the primary deliverers of federal and state conservation programs to private landowners, particularly farmers. Minnesota's Board of Soil and Water Resources (BWSR) delivers State Cost Share Programs to county SWCD offices. Engagement of these agencies will be key in working effectively with private landowners through any related project.

- Research Facilities – Colleges and universities across the state, including University of Minnesota Extension, are conducting ongoing research on all facets of biofuel production and their potential impacts on the environment. The University of Minnesota, including its Southwest Research and Outreach Center in Lamberton, will be key players on the research side of the equation.
- Conservation Organizations and State/Federal Agencies – Groups such as The Nature Conservancy, Minnesota DNR and others are working to test the feasibility of conservation-friendly biofuel production (cellulosic ethanol, biomass) as a conservation strategy.
- Strategy Leader – Strategy development, coordination and fundraising to secure resources to float this concept will require a seasoned program manager housed in one of the partner agencies/organizations. ,

Strategy 3. Strategies to Combat Invasive Species and Enhance Ecosystem Health

Ecosystem health underpins the ability of the native flora and fauna of the Middle Minnesota Valley to persist over time. As such, it is critical that the remaining natural areas of the region be managed effectively to control invasive species and enhance the health of these declining ecosystems. Two key strategies are identified here:

Private Lands Management - Invasive native and exotic species increasingly are posing major threats to remaining natural ecological systems. Awareness of and actions to abate these threats, however, have not been adequate to stem their impact. Education, awareness and incentives to landowners (cost-share funding) are key components of a strategy to better control these species on privately-held lands. In the project area, county NRCS and SWCD offices are the principle vehicles through which private cost-share funding is delivered. For a detailed description of this strategy, see Strategy 2 (Agriculture-Based Strategies) above.

Public Lands Management – A state legislative audit of the DNR in 2010 identified that the agency did not have the resources to adequately manage the lands that it owned. This audit effectively elevated, in the eyes of the conservation community and legislators alike, the need for greater resource management and restoration of our treasured public lands. Similarly, inadequate management of state interests on private lands (easements) was also flagged. This is a key second strategy related to invasive species control and restoration of ecosystem health in the Middle Minnesota Valley.

Key Players:

- Public Land Management Agencies – Government agencies such as the DNR and US Fish and Wildlife Service are tasked with managing the natural resources in the state and nation, respectively. Effective management and protection of these investments is a critical need in the Valley.
- Public and Non-Profit Easement Holders – The State of Minnesota (via DNR and BWSR) and various non-profit conservation organizations hold conservation easements on private lands. Effective management and protection of these investments is a critical need in the Valley.
- Non-Profit Conservation Organizations – Non-profit conservation organizations can assist state and federal agencies with management and restoration needs on publicly held lands, and can assist in elevating the resource stream to these activities through fundraising, grant writing and other means. Key players in this arena include Great River Greening, Pheasants Forever, Ducks Unlimited, and others.

Strategy 4. Strategies to Address Water Quality Impairments in Streams and Rivers

The Minnesota River has long been known for the poor quality of its waters. Excessive sedimentation and nutrients within the waters have led to a near complete loss of native freshwater mussel populations and degradation in many other associated species. In addition, the river has been flagged as one of the largest contributors to the dead zone within the Mississippi Delta region of the Gulf of Mexico. Two strategies to address this issue are identified below:

Lake Pepin TMDL – Strategies designed to enhance the Minnesota River and its tributaries should be identified through a basin-wide assessment and planning process, and as such, recommendations put forth here are merely preliminary to such an undertaking. Fortunately, such an undertaking is now underway associated with the Lake Pepin TMDL (Total Maximum Daily Load) assessment, which will include the entire stretches of the Minnesota, St. Croix, and upstream portions of the Mississippi rivers. Implementation strategies will ultimately flow from that assessment. Recommended strategies will likely include (among others) practices to: 1) reduce runoff and keep water on the land, 2) reduce stream bank erosion, 3) increase permanent vegetation in key areas (along stream corridors, etc.), and so forth.

Key Players:

- Minnesota Pollution Control Agency (MPCA) – The MPCA works with Minnesotans to protect, conserve and improve our environment and enhance our quality of life and is the lead agency for conducting TMDL assessment and for developing subsequent implementation plans in collaboration with local agencies and organizations.
- Implementation Partners – An array of government agencies and organizations will be tasked with identifying implementation strategies to achieve the TMDL recommendations stipulated in the Lake Pepin TMDL assessment. Key implementation partners will likely include: Renville and Redwood SWCD and NRCS offices, Minnesota DNR, BWSR, and others.

Conservation Practices with Economic Incentives – Several promising initiatives are underway or proposed that could be applied within the Middle Minnesota Valley that serve to create economic incentives for installing or managing permanent vegetation. These include: 1) working lands for biofuels, 2) allowing for mid-term grazing of CRP lands within the federal Farm Bill, and 3) grazing WMAs following prescribed fire. Each serves to mimic natural processes under which native grasslands evolved, yet provide an economic incentive to farmers and ranchers.

Key Players:

- Minnesota DNR – The Minnesota DNR is currently exploring a working lands model on WMAs in southwest Minnesota that provides a test case for what might be achievable in the Middle Minnesota Valley on both WMAs and Aquatic Management Areas (AMAs).

- Conservation Organization Partners – Groups such as The Nature Conservancy TNC), Minnesota DNR and others are working to explore and test the feasibility of these conservation strategies in other geographies of the state. Their expertise and knowledge could be brought to bear in the Middle Minnesota Valley. In addition, key non-profit conservation organizations like TNC could lobby for modification of existing Farm Bill regulations to allow for mid-term CRP grazing.

Strategy 5. Recreation as a Conservation Strategy

The Minnesota River has significant potential for development of recreational assets that could serve to drive conservation along its corridor. Trail construction (biking, hiking, horse, canoe, birding, etc.) is a hot topic of discussion, with planning and trail development well underway. This strategy, relative to all others, has caught the eye of local units of government and has served to garner a broad base of participation from conventional and non-conventional partners alike.

Key Players:

- Local Organization Leader – A local leader is absolutely key to the development and implementation of diverse recreation plan that underpins both the conservation and economic interests of the Minnesota Valley. Tatanka Bluffs Corridor is currently playing that role, with broad participation by local, state and federal units of government, conservation organizations, recreational user groups and individuals.
- Trail Planner – Trails, in many ways, underpin the recreational aspects of the strategy. To that end, an experienced trail designer is needed to design trails that link both recreational and natural resources. The University of Minnesota's Center for Changing Landscapes is currently developing a master trail design for the project area.
- Implementation Leader(s) and Partners – Once designs/plans are put to paper, experienced implementation partners are needed to make them become a reality. Given the diversity of interests advocating for trails in the project area, a broad base of support is already available. Leadership and coordination of these interest groups to pull together funding proposals, gain political clout, and so forth, is a key requirement; Tatanka Bluffs Corridor is playing this key role, in collaboration with Renville and Redwood Counties, Green Corridor, Inc., Renville County Parks Commission, Minnesota Trail Riders Association, National Park Service Rivers & Trails Program, Friends of the Casey Jones Trail, Minnesota Valley Sno-Riders Snowmobile Club, Upper Minnesota Valley Trail Riders Association and the DNR Parks & Trails Division.

4.2.3 Over-Arching Strategies

Significant progress and success within both natural and cultural/historical components of the plan will require strong, broad collaboration among a diverse array of partners and stakeholders along with a continued funding stream necessary to achieve the conservation vision. To this end, we identify a final keystone strategy.

Strategy 1. Keystone Strategy for Landscape Reconciliation Success:

Development of and continued support by a strong collaboration of local, regional, state and national partners in funding and implementing a shared conservation and recreation vision is paramount to the success of this venture. This vision calls for a reconciliation of the fragmented landscape to conserve (over the long term) the unique ecological, cultural and historical resources of the Middle Minnesota Valley. As this collaborative partnership succeeds, the Valley will not only become a Minnesota conservation legacy, but also a national recreational and educational destination.

Key Players:

- Local Organization Leader – A local leader is central to the successful implementation of this conservation vision for the Middle Minnesota Valley. The Tatanka Bluffs Corridor and the Green Corridor are currently sharing that role, with broad participation by local, state and federal units of government, conservation organizations, recreational user groups and individuals.
- Supportive Community Stakeholders and Willing Landowners – Community stakeholders who understand the conservation vision and resulting economic vitality and, who are willing to lead in developing this legacy, and willing landowners that will offer their properties to be part of this land legacy are crucial to the success of this program.
- Local, Regional, State and National Partners – A broad coalition of partners who are willing to share the landscape to make the vision happen on the ground is required to make this vision a reality.
- Funders – Implementation of this vision cannot happen without continued support of funders at the individual, local, state, regional and national levels.

Acknowledgements

The authors of the Minnesota Valley Green Corridor Conservation and Action Plan wish to acknowledge the contributions of the following stakeholders and partners in the development of this plan:

- Green Corridor, Inc. - Board of Directors
- Great River Greening
- Southwest Initiative Foundation
- Redwood Area Communities Foundation
- Tatanka Bluffs Corridor, Inc. – Board of Directors
- Waukon RIM, Inc. – Board of Directors
- Lower Sioux Mdewakanton Community and Tribal Council
- Redwood County Commissioners
- Renville County Commissioners
- Redwood County SWCD
- Renville County SWCD
- Redwood Area Development Corporation
- Renville County Housing & Economic Development Authority
- City of Redwood Falls
- Minnesota Valley Regional Rail Authority
- Minnesota Historical Society
- Redwood County Historical Society
- Renville County Historical Society
- Wood Lake Battlefield Preservation Association
- Minnesota Valley History Learning Center – Board of Directors
- Redwood Area Chamber & Tourism
- Oliva Chamber of Commerce
- University of Minnesota - Center for Changing Landscapes
- University of Minnesota – Southwest Research & Outreach Center
- Minnesota River Valley National Scenic Byway Alliance
- Minnesota River Watershed Alliance
- National Park Service – Rivers Program
- Minnesota Trail Riders Association
- Upper Minnesota Trail Riders Association
- Redwood Valley Riders Saddle Club
- Renville County Amigo Riders Saddle Club
- Redwood Falls Sportsmen's Club
- Morgan Sportsmen's Club
- Minnesota Valley Snoriders Snowmobile Club
- Pheasants Forever, Inc.
- Redwood County Pheasants Forever Chapter
- Renville County Pheasants Forever Chapter
- Cottonwood County Pheasants Forever Chapter
- West Metro Pheasants Forever Chapter
- Minnesota Deer Hunters Association (MDHA)
- MDHA Sunrisers Chapter
- National Wild Turkey Federation (NWTF) Super Fund
- Redwood River Boss Toms NWTF Chapter

In addition, we extend our thanks to a multitude of friends from the Minnesota Department of Natural Resources from the local area offices, the Southern Region 4 office in New Ulm, and from senior staff in St. Paul, including:

- Fort Ridgely State Park
- Upper Sioux Agency State Park
- Parks & Trails Division
- Wildlife Division
- Fisheries Division
- Ecological Resources Division – Scientific & Natural Areas

A special acknowledgement is made to some special friends who stepped up and lifted this vision forward at critical points. These folks are the paradigm pioneers, who early on saw the potential for doing something very special on a shared landscape and kept the engine running:

- Blandin Foundation: for training us to think outside the box.
- Vicki Phillips: for her Minnesota River Valley trails vision
- Deborah Karasov: for her organizational skills
- Julie Rath: for her networking skills & can-do attitude
- Nancy Fasching: for helping make us fiscally viable
- John Kvasnicka: for his constant encouragement & mentoring
- Brad Cobb: for his ability to make it happen on the ground

Finally, we'd like to acknowledge the tireless commitment of the board members of Green Corridor, Inc.:

- Jim Doering
- Joel Harmoning
- Royce Heffelfinger
- Tom Hollatz
- Loran Kaardal
- Clint Knorr (Chair)
- Robin Nesburg
- Julie Rath (ex-officio)
- Nancy Fasching (ex-officio)
- Pat Dingels (ex-officio)
- Kurt Thompson (former)

References

Anderson, R.C. 1990. The historic role of fire in the North American grassland. In: Collins, S.L. and L.L Wallace, L.L., eds., Fire in North American tallgrass prairies. Norman: University of Oklahoma Press, p.8-18.

Axelrod, D.I. 1985. Rise of the grassland biome, central North America. Botanical Review 51(2): 163-201.

Biko Associates. 2007. Redwood County, Minnesota comprehensive plan. Available from: http://www.co.redwood.mn.us/Final%20Draft%20COMP%20Plan%2010-15-07-A.pdf (accessed October 2009).

Bright, R.C., Gatenby, C., Olson, D., and Plummer, E. 1990. A survey of the mussels of the Minnesota River, 1989. Minneapolis: Bell Museum of Natural History, University of Minnesota.

Busman, L. and Sands, G. 2002. Agricultural drainage publication series: Issues and answers. St. Paul, MN: University of Minnesota Extension Service, University of Minnesota. Available from: http://www.extension.umn.edu/distribution/cropsystems/components/07740.pdf (accessed December 2009).

Center for the Changing Landscape. 2009. Linking communities: The Minnesota River trail. Minneapolis, MN: Center for Changing Landscapes, University of Minnesota.

City of Bloomington Minnesota. 2010. Dakota missions on the Minnesota frontier. Available from: http://www.ci.bloomington.mn.us/main_top/2_facilities/rec_facility/pond/signs/missions/missions.htm (accessed December 2009).

Collins, S.L. and Gibson, D.J.1990. Effects of fire on community structure in tallgrass and mixed-grass prairie. In: Collins, S.L. and Wallace, L.L., eds., Fire in the North American tallgrass prairie. Norman: University of Oklahoma Press, p.81-98.

Collins, S.L., Knapp, A.K., Briggs, J.M., Blair, J.M., and Steinauer, E.M. 1998. Modulation of diversity by grazing and mowing in native tallgrass prairie. Science 280: 745–747.

Cross, F. B. and Moss, R.E. 1987. Historic changes in fish communities and aquatic habitats in plains streams of Kansas. In: Matthews, W.J., and Heins, D.C., eds., Community and evolutionary ecology of North American stream fishes. Norman: Univ. Oklahoma Press, p.155–165.

Dupouey, J.L., Dambrine, E., Laffite, J.D., and Moares, C. 2002. Irreversible impact of past land use on forest soils and biodiversity. Ecology 83:2978–2984.

Fisher, T.J. 2004. River Warren boulders, Minnesota, USA: catastrophic paleoflow indicators in the southern spillway of Glacial Lake Agassiz. Boreas 33: 349-358.

Foster, D., Swanson, F., Aber, J., Burke, I., Brokaw, N., Tilman, D., and Knapp, A. 2007. The importance of land-use legacies to ecology and conservation. BioScience 53 (1): 77-88.

Green, J.C. 1988. Birds: introduction. In: Coffin, B. and Pfannmuller, L., eds. Minnesota's endangered flora and fauna. Minneapolis: University of Minnesota Press, p.253-255.

Harding, J.S., Benfield, E.F., Bolstad, P.V., Helfman, G.S., and Jones, E.D.B. 1998. Stream biodiversity: the ghost of land use past. Proceedings of the National Academy of Sciences 95: 14843–14847.

Historical Marker Society of America. 2010. Yellow Medicine City. Available from: http://www.historicmarkers.com/component/content/article/3324-yellow-medicine/84109-yellow-medicine-city (accessed: April 2010).

Institute for Minnesota Archaeology. 2010. Stories: Upper Mississippi cultural timeline. Available from: http://www.fromsitetostory.org/stculture.asp (accessed: April 2010).

International Council on Monuments and Sites (ICMOS). Heritage at risk: Trends; threats and risk (2001-2002). Available from: http://www.international.icomos.org/risk/2001/synthesis.htm (accessed: April 2010).

Krenz, G. and Leitch, J. 1993. A river runs north: Managing an international river. Red River Water Resources Council.

Lant, C.L., Kraft, S.E. and Gillman, K.R. 1995. The 1990 farm bill and water quality in Corn Belt watersheds: Conserving remaining wetlands and restoring farmed wetlands. Journal of Soil and Water Conservation 50: 201-205.

Marschner, F.J. 1974. The original vegetation of Minnesota, a map compiled in 1930 by F.J. Marschner under the direction of M.L. Heinselman of the U.S. Forest Service [map]. 1:500,000. St. Paul, MN: Cartography Laboratory of the Department of Geography, University of Minnesota.

Meyer, R.W. 1993. History of the Santee Sioux: United States Indian policy on trial. Lincoln: University of Nebraska Press.

Minnesota Board of Soil and Water Resources. 2010. History of wetland regulation and conservation in Minnesota. Available from: http://www.bwsr.state.mn.us/wetlands/wca/history.html (accessed: April 2010).

Minnesota Department of Natural Resources. 2005. Field guide to native plant communities of Minnesota: The eastern broadleaf forest province. St. Paul, MN: Ecological Land Classification Program, Minnesota County Biological Survey, and Natural Heritage and Nongame Research Program.

_____. 2007a. Minnesota River State Trail Master Plan. Saint Paul, MN: Division of Trails Waterways, Minnesota Department of Natural Resources. Available from: http://www.dnr.state.mn.us/state_trails/master_plans.html (accessed October 2009).

_____. 2007b. Native plant communities and rare species of the Minnesota River Valley counties. St. Paul, MN: Minnesota County Biological Survey, Division of Ecological Resources, Minnesota Department of Natural Resources.

_____. 2009a. Wild and scenic rivers program. Available from: http://www.dnr.state.mn.us/waters/watermgmt_section/wild_scenic/index.html (accessed November 2009).

_____. 2010. Prairie parkland province. Available from: http://www.dnr.state.mn.us/ecs/251/index.html (accessed: April 2010).

_____. 2010a. Ecological system summaries. Available from: http://www.dnr.state.mn.us/npc/wetlandgrassland.html (accessed: April 2010).

Minnesota Historical Society. 2010. State historic sites, south: Harkin store. Available from: http.//www.mnhs.org/places/sites/hs/ (accessed: April 2010).

Minnesota Land Management Information Center (MLMS). n.d. Original public land survey plat maps of Minnesota [maps]. Available from: http://www.mngeo.state.mn.us/glo/Index.htm.

Multi-Resolution Land Characteristics Consortium (MRLC). 2010. National land cover data base. Available from: http://www.mrlc.gov/.

National Park Service. 2009. The Homestead Act of 1862. Available from: http://www.nps.gov/home/historyculture/upload/MW,pdf,Homestead%20Act,txt.pdf (accessed November 2009).

National Scenic Byway Minnesota River Valley. 2010a. Discovery sites. Available from: http://www.mnrivervalley.com/sites/sites.php (accessed March 2010).

_____. 2010b. Discovery sites: Granite Falls to Redwood Falls. Available from: http://www.mnrivervalley.com/sites/sites.new.php?itinid=4 (accessed March 2010).

_____. 2010c. Discovery sites: Redwood Falls to New Ulm. Available from: http://www.mnrivervalley.com/sites/sites.new.php?itinid=5 (accessed March 2010).

Neill, E.D. 1882. History of the Minnesota valley. Minneapolis, MN: North Star Publishing Co.

Nordquist, G.E. and Birney, E.C. 1988. Mammals. In: Coffin, B. and Pfannmuller, L., eds., Minnesota's endangered flora and fauna. Minneapolis: University of Minnesota Press, p. 296-301.

Noss, R., LaRoe, E., and Scott, J. 1995. Endangered ecosystems of the United States: A preliminary assessment of loss and degradation. Biological Report 28. Washington, D.C.: U.S. Department of Interior, National Biological Service.

Ostlie, W.R., Schneider, R.E., Aldrich, J.M., Faust, T.M., McKim, R.L.B. and Chaplin, S.J. 1996. The status of biodiversity in the Great Plains. Arlington, VA: The Nature Conservancy.

Redwood County, MN. 2009. Zoning ordinances. http://www.redwoodcounty-mn.us/ordinances.htm (accessed December 2009).

Redwood Soil and Water Conservation District. 1990. Redwood County comprehensive local water management plan. Available from: http://www.redwoodswcd.org/Water%20Management.htm (accessed December 2009).

Renville County, MN. 2009. Renville soil and water conservation district: 2009 annual plan. Available from: http://www.renvilleswcd.com/2009%20Annual%20Plan(2).doc (accessed December 2009).

_____. 2009. Zoning ordinances. Available from: http://www.co.renville.mn.us/index.asp?Type=B_BASIC&SEC={A7F1C8F1-32FC-4BE3-8F5F-A1A868E568D5}&DE={564003A1-515E-4AD1-8763-999F88554286} (accessed December 2009).

Rhemtulla, J.M., and Mladenoff, D.J. 2007. Why history matters in landscape ecology. Landscape Ecology 22 (Supplement 1): 1-3.

Risser, P.G. 1985. Grasslands. In: Chabot, B.F. and Mooney, H.A., eds. Physiological ecology of North American plant communities. New York: Chapman and Hall, p. 232-256.

_____. 1990. Landscape processes and the vegetation of the North American grassland. In: Collins, S.L. and Wallace, L.L., eds. Fire in North American tallgrass prairies. Norman, University of Oklahoma Press, p. 133-146.

Rootsweb. 2010. Yellow Medicine County. Available from: http://www.rootsweb.ancestry.com/~mnyellow/mngeo.htm (accessed March 2010).

_____. 2010a. A short history of Renville County. Available from: http://www.rootsweb.ancestry.com/~mnrenvil/hist-rc.htm (accessed April 2010).

Science Views. 2010. Little Crow. Available from: http://www.scienceviews.com/indian/littlecrow.html (accessed March 2010).

SRF Consulting Group. 2002. Renville County comprehensive plan. Available from: http://www.co.renville.mn.us/index.asp?Type=B_BASIC&SEC={341192EE-0B12-4090-8E32-A00E00216E2F} (accessed October 2009).

The Nature Conservancy. 1998. Ecoregional planning in the northern tallgrass prairie ecoregion. Minneapolis, MN: The Nature Conservancy, Midwest Regional Office.

_____. 2006. Conservation by design: A strategic framework for mission success. Arlington, VA: The Nature Conservancy.

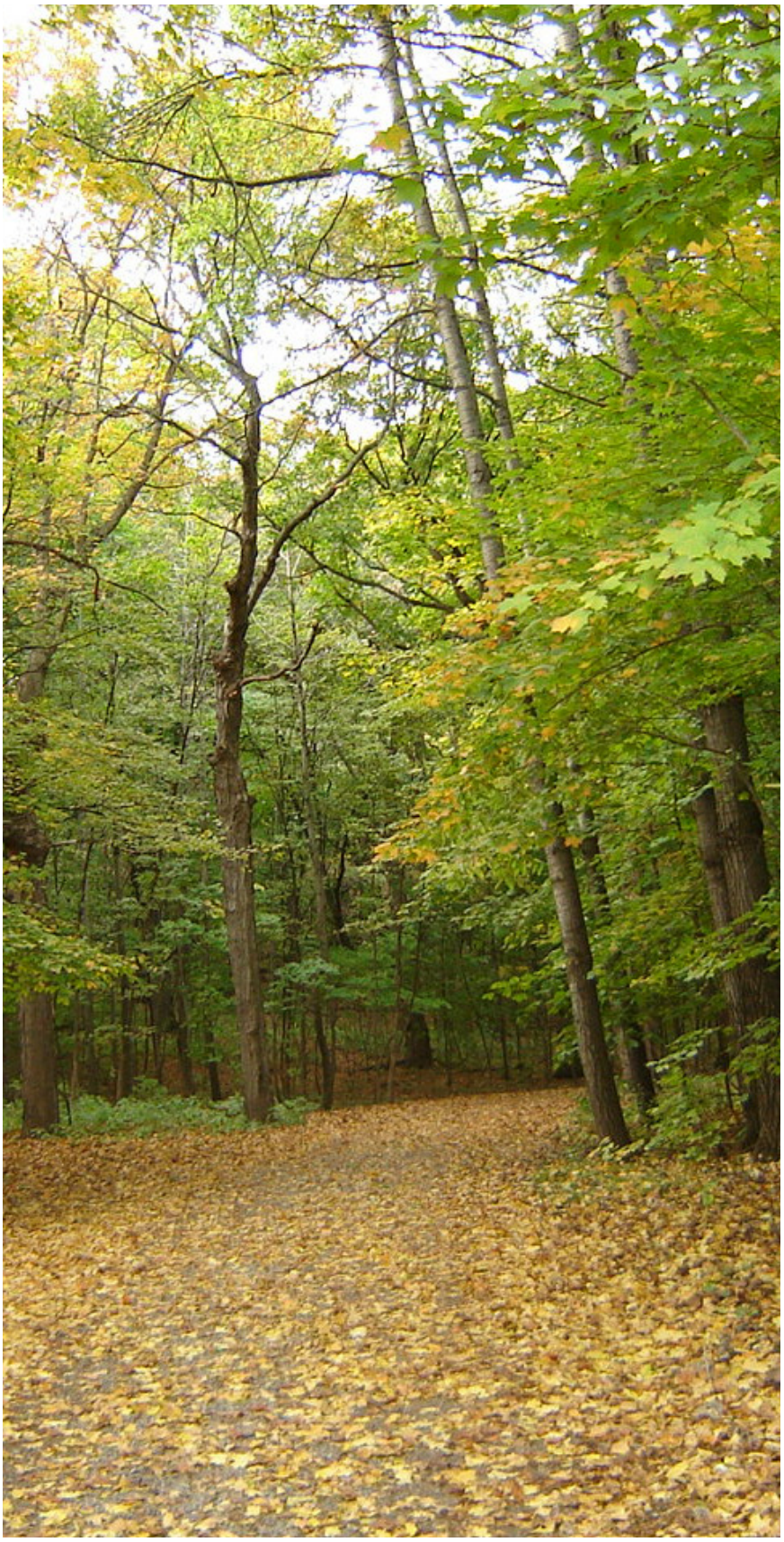
Weaver, J.E. and Albertson, F.W. 1956. Grasslands of the Great Plains: their nature and use. Lincoln, NE: Johnsen Publishing Co.

Weeks, John A. 2010. Minnesota Falls dam. Available from: http://www.johnweeks.com/river_minnesota/pages/mnC09.html (accessed March 2010).

Wikipedia. 2010. Redwood ferry. Available from: http://en.wikipedia.org/wiki/Battle_of_Redwood_Ferry (accessed March 2010).

Williams, J.D., Warren, M.L., Cummings, K.S., Harris, J.L. and Neves, R.J. 1993. Conservation status of freshwater mussels of the United States and Canada. Fisheries 18(9): 6-22.

World Wildlife Fund. 2004. From the vision to the ground: A guide for implementing ecoregion conservation in priority areas. Washington, D.C.: World Wildlife Fund.



Appendices

Appendix A: Building a foundation for Conservation Design

Appendix B: Documented Rare Flora & Fauna

Appendix C: Documented Natural Communities

Appendix D: Threats & Strategies

Appendix E: Historical/Cultural Sites

Figure A.1: Fall in the Minnesota River Valley
©Brad Cobb

Appendix A: Building a Foundation for Conservation Design

Prior to entering into conservation planning for the Middle Minnesota Valley, a group of individuals representing key stakeholders met to discuss the scope, direction, team structure, timeline and budget for the planning exercise. This meeting – held on August 28, 2008 at Fort Ridgely State Park – cemented a close working relationship between the newly established Steering Committee, Core Team, and Assessment and Design Team. A brief summary of the process developed for developing the conservation plan is provided below.

Planning Leads, Committees and Teams

As detailed in Figure A.1 (Team Structure Diagram), there are several key responsibilities related to both development of a conservation plan and its subsequent implementation. Individuals, teams, or committees assigned these roles are integral to the overall compilation and implementation of the conservation plan. These parties and their respective roles are as follows:

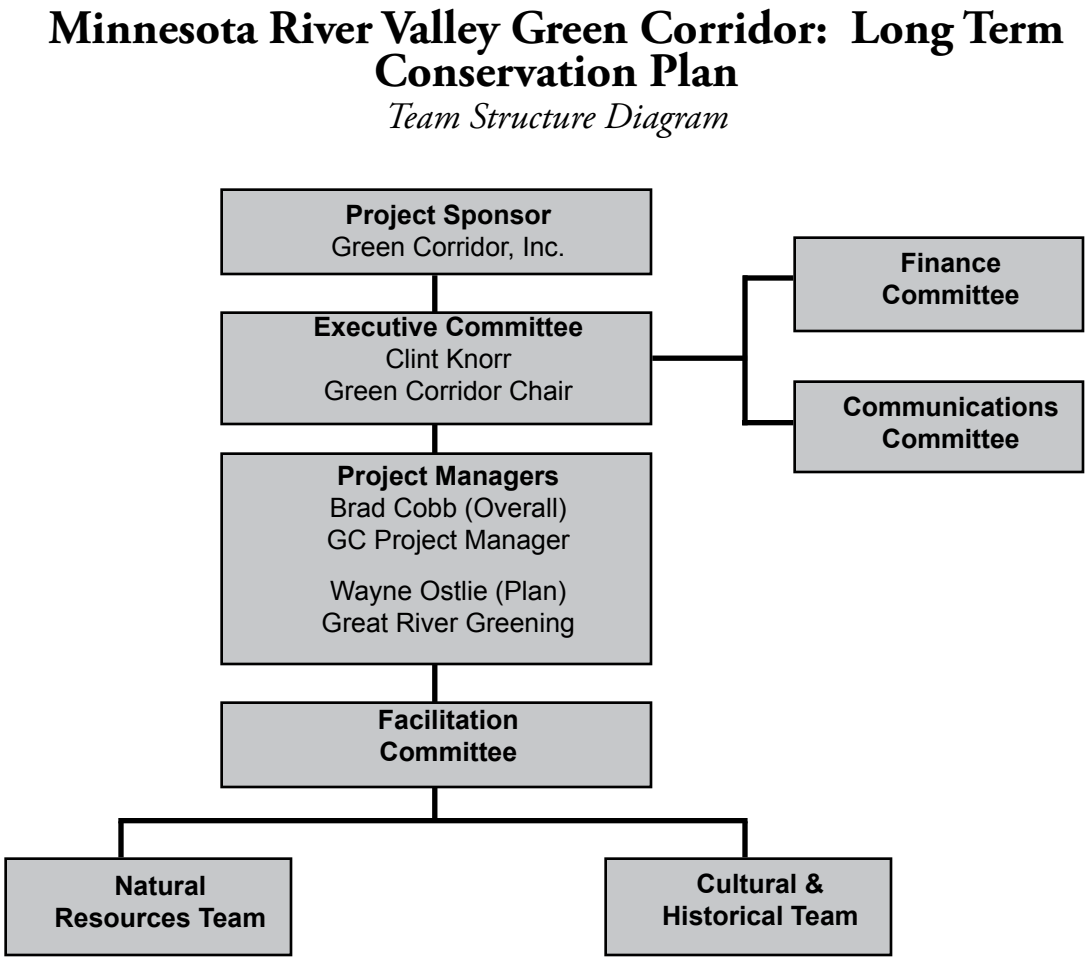


Figure A.1: Team Structure Diagram

1. Project Sponsor: Green Corridor, Inc., the Project Sponsor acts as a vocal and visible champion, legitimizes the project's goals and objectives, keeps abreast of major project activities, and is a decision-maker for the project. The Project Sponsor provides support for the Project Manager; assists with major issues, problems, and policy conflicts; removes obstacles; is active in planning the scope; approves scope changes; signs off on major deliverables; and signs off on approvals to proceed to each succeeding project phase. The Project Sponsor generally chairs the steering committee on large projects.

2. Project Manager: The Project Manager is responsible for ensuring that the project is completed on time, within scope and on budget. S/He develops the Project Plan with the team and manages the team's performance of project tasks. It is also his/her responsibility to secure acceptance and approval of deliverables from the Project Sponsor and Stakeholders. The project manager for the conservation plan is Wayne Ostlie, Great River Greening; the overall project manager is Brad Cobb, projects manager for the Green Corridor.

3. Executive Committee: Led by Clint Knorr and composed of the Green Corridor, Inc.'s Board of Directors, the Executive Committee approves the work plan, reviews and approves the conservation plan, and oversees the implementation of the conservation plan going forward.

4. Communications Committee: Represented by members of the Green Corridor Board of Directors and others, the committee develops and implements a communication strategy on behalf of the Green Corridor. This committee is integral to the development of the Middle Minnesota Conservation Plan, identifying target audiences and ensuring that information related to the planning effort meshes with the direction of the organization.

5. Finance Committee: Represented by members of the Green Corridor Board of Directors, the committee approves all financial requests (donations and grants) to cover all acquisition, administrative and other organizational costs.

4. Facilitation Committee: The Facilitation Committee is led by the Project Manager and develops/executes the project plan in hand with the designated work teams. The Committee staffs and provides direction to the work teams to facilitate the completion of the project plan.

5. Work Teams: The Work Teams are responsible for executing tasks and producing deliverables as outlined in the Project Plan and directed by the Project Manager and Facilitation Committee. Two work teams were formed: – a Natural Resources Team and a Cultural/Historical Team – to assist with the development of those components of the plan.

The Planning Process

The planning process adopted for use for the Middle Minnesota Valley was comparable to that followed by numerous other planning teams across the country and globe, and therefore will not be described in detail here. Figures A.2 and A.3 illustrate the major phases of the project, the approximate timeframe for each, and the relationship and responsibilities of the teams in developing the plan.

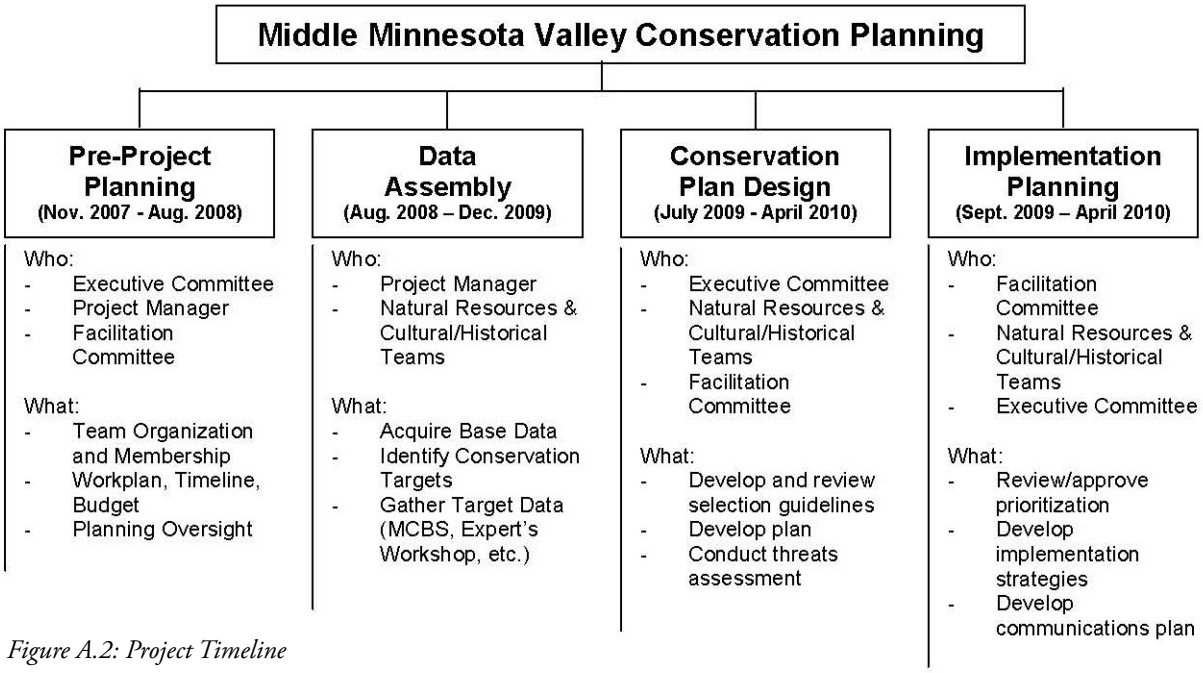


Figure A.2: Project Timeline

Minnesota River Valley Green Corridor: Long Term Conservation Plan

Detailed Planning Process

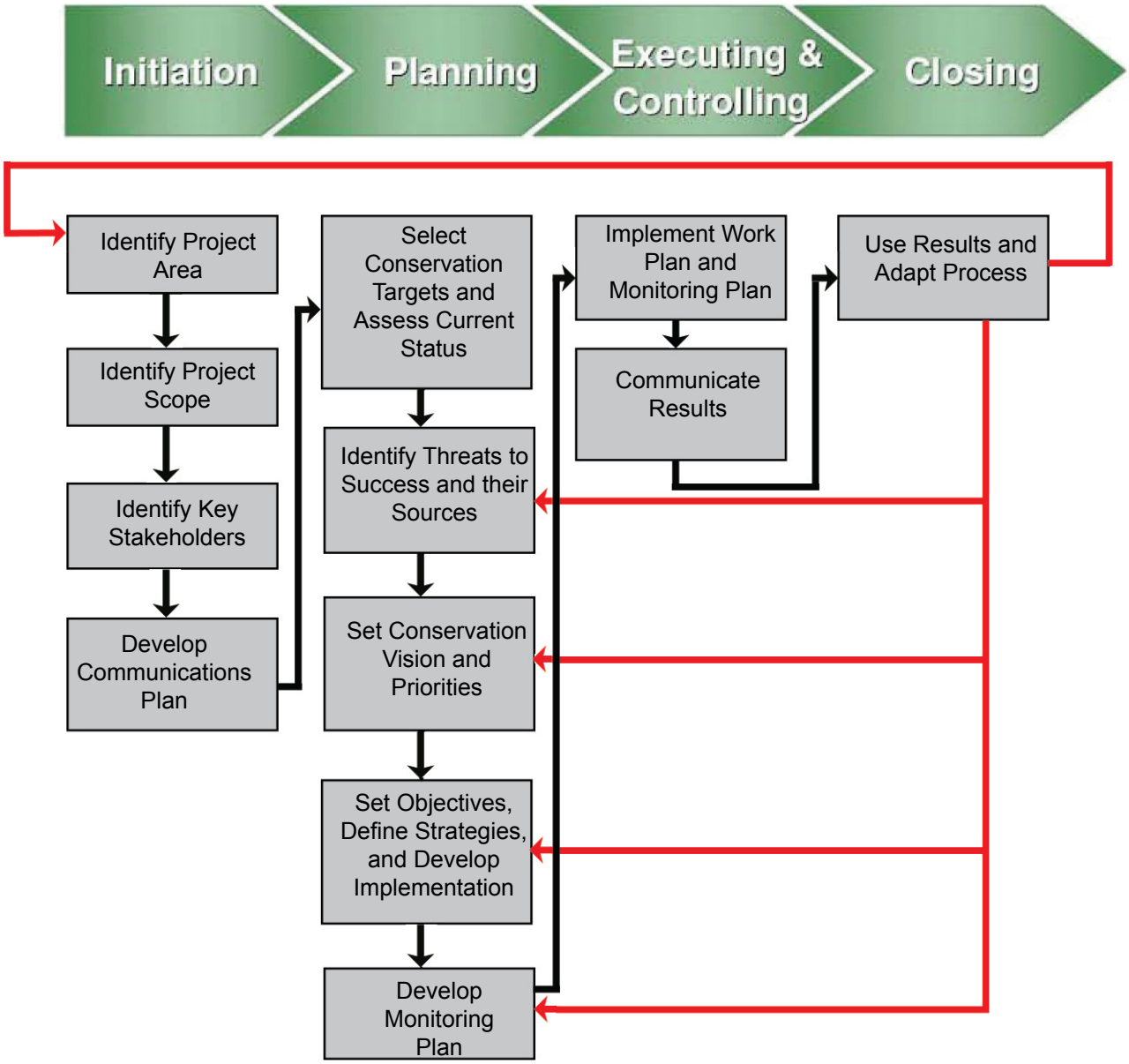


Figure A.3: Detailed Planning Process

Appendix B: Documented Rare Flora & Fauna (Minnesota Heritage Data Base)

Scientific Name	Common Name	Federal Status	State Status
Birds			
Bartramia longicauda	Upland Sandpiper		Tracked in heritage database
Botaurus lentiginosus	American Bittern		Tracked in heritage database
Buteo lineatus	Red-shouldered Hawk		Special Concern
Dendroica cerulea	Cerulean Warbler		Special Concern
Haliaeetus leucocephalus	Bald Eagle		Special Concern
Fish			
Cycleptus elongatus	Blue Sucker		Special Concern
Ictiobus niger	Black Buffalo		Special Concern
Polyodon spathula	Paddlefish		Threatened
Insects			
Atrytone arogos	Arogos Skipper		Special Concern
Hesperia ottoe	Ottoe Skipper		Threatened
Speyeria idalia	Regal Fritillary		Special Concern
Lichens			
Buellia nigra	A Species of Lichen		Endangered

Ictiobus niger, Black Buffalo
© K. Schmidt, MNDNR

Scientific Name	Common Name	Federal Status	State Status
Mammals			
Reithrodontomys megalotis	Western Harvest Mouse		Tracked in heritage database
Mussels			
Actinonaias ligamentina	Mucket		Threatened
Alasmidonta marginata	Elktoe		Threatened
Arcidens confragosus	Rock Pocketbook		Endangered
Elliptio dilatata	Spike		Special Concern
Lampsilis teres	Yellow Sandshell		Endangered
Lasmigona compressa	Creek Heelsplitter		Special Concern
Lasmigona costata	Fluted-shell		Special Concern
Ligumia recta	Black Sandshell		Special Concern
Obovaria olivaria	Hickorynut		Special Concern
Pleurobema coccineum	Round Pigtoe		Threatened
Quadrula metanevra	Monkeyface		Threatened
Quadrula nodulata	Wartyback		Endangered
Tritogonia verrucosa	Pistolgrip		Threatened
Venustaconcha ellipsiformis	Ellipse		Threatened
Reptiles			
Apalone mutica	Smooth Softshell		Special Concern
Elaphe vulpina	Eastern Fox Snake		Tracked in heritage database
Eumeces fasciatus	Five-lined Skink		Special Concern

Five-lined Skink
© T.Jessen, MNDNR

Scientific Name	Common Name	Federal Status	State Status
Reptiles (continued)			
Heterodon nasicus	Western Hognose Snake		Special Concern
Pituophis catenifer	Gopher Snake		Special Concern
Plants			
Alopecurus carolinianus	Carolina Foxtail		Tracked in heritage database
Aristida purpurea var. longiseta	Red Three-awn		Special Concern
Asclepias sullivantii	Sullivant's Milkweed		Special Concern
Astragalus lotiflorus	Low Milk-vetch		Tracked in heritage database
Astragalus missouriensis	Missouri Milk-vetch		Special Concern
Bacopa rotundifolia	Water-hyssop		Special Concern
Besseya bullii	Kitten-tails		Threatened
Carex annectens	Yellow-fruited Sedge		Special Concern
Cerastium brachypodum	Mouse-ear Chickweed		Tracked in heritage database
Cladium mariscoides	Twig-rush		Special Concern
Cyperus acuminatus	Short-pointed Umbrella-sedge		Threatened
Cypripedium candidum	Small White Lady's-slipper		Special Concern
Elatine triandra	Three Stamened Waterwort		Tracked in heritage database
Eleocharis quinqueflora	Few-flowered Spike-rush		Threatened
Eleocharis wolfii	Wolf's Spike-rush		Endangered
Fimbristylis puberula var. interior	Hairy Fimbristylis		Endangered
Gleditsia triacanthos	Honeylocust		Tracked in heritage database
Gymnocladus dioica	Kentucky Coffee-tree		Tracked in heritage database
Hordeum pusillum	Little Barley		Tracked in heritage database
Lespedeza leptostachya	Prairie Bush Clover	Threatened	Threatened
Monolepis nuttalliana	Povertyweed		Tracked in heritage database
Myosotis verna	Forget-me-not		Tracked in heritage database
Myosurus minimus	Mousetail		Tracked in heritage database
Opuntia macrorhiza	Plains Prickly Pear		Special Concern
Orobanche fasciculata	Clustered Broomrape		Special Concern
Panax quinquefolius	American Ginseng		Special Concern
Rhynchospora capillacea	Hair-like Beak-rush		Threatened
Schedonnardus paniculatus	Tumblegrass		Special Concern
Scleria verticillata	Whorled Nut-rush		Threatened
Triglochin palustris	Marsh Arrow-grass		Tracked in heritage database

Appendix C: Documented Native Ecological Systems

Prairie Types

Southern Dry Prairie (UPs13)

"Grass-dominated herbaceous communities on level to steeply sloping sites with droughty soils. Moderate growing-season moisture deficits occur most years, and severe moisture deficits are frequent, especially during periodic regional droughts. Historically, fires probably occurred every few years" (MNDNR 2005).

Documented subtypes: Dry Sand-Gravel Prairie (Southern), Dry Hill Prairie (Southern)

Southern Dry Savanna (UPs14)

"Sparsely treed communities with grass-dominated herbaceous ground layers on nearly level to steeply sloping sites with droughty soils. Moderate growing-season moisture deficits occur during most years, and severe moisture deficits are frequent, especially during periodic regional droughts. Trees are open grown, typically small and gnarled" (MNDNR 2005).

Documented subtypes: Dry Hill Oak Savanna (Southern)

Southern Mesic Prairie (UPs23)

"Grass-dominated but forb-rich herbaceous communities of somewhat poorly drained to well-drained loam soils mainly formed in unsorted glacial till, sometimes in a thin loess layer over till, and locally in lacustrine sediments and outwash deposits. Communities in this class occur primarily on level to gently rolling sites. Drought stress is irregular in occurrence and usually not severe"
(MNDNR 2005).

Documented subtype: Mesic Prairie (Southern)

Southern Wet Prairie (WPs54)

"Grass-dominated but forb-rich herbaceous communities on poorly drained to very poorly drained loam soils formed in lacustrine sediments, unsorted glacial till, or less frequently outwash deposits. Typically in slight depressions, sometimes on very gentle slopes. Flooded for brief periods at most; upper part of rooting zone is not saturated for most of growing season, but saturation usually persists in lower zone for much of season" (MNDNR 2005).

Documented subtype: Wet Prairie (Southern)

Forest Types

Southern Dry-Mesic Oak (Maple) Woodland (FDs37)

"Dry-mesic hardwood forests on undulating sand flats, hummocky moraines, and river bluffs. Present mostly on fine sand or sand-gravel soils. Often on south- or west-facing slopes but common also on flat to undulating sandy lake plains. Historically, fires were common in this community, and many stands are on sites occupied by brushlands 100 years ago." (MNDNR 2005)

Documented subtype: Pin Oak - Bur Oak Woodland

Southern Floodplain Forest (FFs68)

"Wet-mesic deciduous forests on silty or sandy alluvium on level, occasionally flooded sites along small streams to large rivers in the southern half of Minnesota" (MNDNR 2005).

Documented subtype: Silver Maple - (Virginia Creeper) Floodplain Forest

Southern Mesic Oak-Basswood Forest (MHs38)

"Mesic hardwood or, occasionally, hardwood-conifer forests. Present on wind-deposited silt on bedrock bluffs, on calcareous till on rolling till plains, and, rarely, on weakly calcareous till on stagnation moraines." (MNDNR 2005).

Documented subtypes: Basswood - Bur Oak (Green Ash) Forest, Red Oak - Sugar Maple - Basswood - (Bitternut Hickory) Forest

Southern Mesic Maple-Basswood Forest (MHs39)

"Rich Mesic hardwood forests on loamy soils derived from calcareous till or wind-deposited silt over bedrock. Present on sites that have been historically protected from fires on hummocky stagnation moraines, on till plains along the Minnesota River, and on middle or lower slopes of bedrock bluffs." (MNDNR 2005).

Documented subtype: Sugar Maple - Basswood - (Bitternut Hickory) Forest

Southern Wet-Mesic Hardwood Forest (MHs49)

"Rich, wet-mesic lowland hardwood forests on level silty alluvium in stream valleys and on level glacial till bordering lakes. Sites are protected from fire, and soils remain moist throughout the growing season." (MNDNR 2005).

Documented subtype: Elm - Basswood - Black Ash - (Hackberry) Forest

Rock Outcrop Types

Southern Bedrock Outcrop (ROs12)

"Dry, open lichen-dominated plant communities on areas of exposed bedrock. Woody vegetation is sparse, and vascular plants are restricted to crevices, shallow soil deposits, and rainwater pools." (MNDNR 2005).

Documented subtype: Crystalline Bedrock Outcrop (Prairie) MN River Subtype

Wetland Types

Prairie Bulrush-Arrowhead Marsh (MRp39)

"Emergent marsh communities typically dominated by bulrushes, bur reeds, arrowheads, or spikerushes. Present along lakeshores and stream borders." (MNDNR 2010a).

Documented subtypes: Bulrush Marsh (Prairie), Spikerush - Bur Reed Marsh (Prairie)

Prairie Extremely Rich Fen (OPp93)

"Open graminoid-dominated fens on permanently saturated peat sustained by mineral-rich groundwater discharge, with little influence from surface water inputs. Typically present on sloping sites; peat is sometimes mounded or domed. Small pools and sparsely vegetated marly peat areas are commonly present." (MNDNR 2010a).

Documented subtypes: Calcareous Fen (Southwestern)

Prairie Wet Meadow/Carr (WMp73)

" Open wetlands dominated by a dense cover of graminoids. Present in small, shallow depressions in the western and southern parts of the state." (MNDNR 2005)

Southern Seepage Meadow/Carr (WMs83)

"Open wetlands dominated by a dense cover of hummock-forming broadleaved sedges or tall shrubs. Present in areas of groundwater seepage along streams and drainage ways, on sloping terraces, and at bases of slopes." (MNDNR 2010a).

Appendix D: Threats & Strategies

Natural Resources: Terrestrial

Threats	Source of Threat:	Strategies to Abate Threat
1. Land Use & Land Use Legacies • Habitat Loss, Conversion & Fragmentation	Farm Bill; Economic Interests; Development Interests	1. Stronger Farm Bill Programs for Resource Protection 2. Farm Bill Giving Farmers Good Options 3. Economic Incentives for Conservation through State/Federal Programs 4. Stronger DNR Wild and Scenic River Program 5. Develop Strong Civic Engagement Programs 6. Restoration of Natural Habitats 7. Development of Local Ecotype Seed Sources for Restoration 8. Incentives for Permanent Vegetation; Increase Working Lands (Biofuels, Grazing WMAs behind fire)
2. Invasive Species	Agriculture; Federal/State Farm Programs; Nursery Trade; MN Department of Transportation	1. Curtailment of Invasive Species Plantings through State/Federal Agencies 2. Outreach to Nursery Retailers 3. Stronger Eradication Programs for Established Populations (Public and Private) 4. Develop Strong Civic Engagement Programs
3. Loss/Alteration of Natural Processes • Fire • Grazing	Agricultural Practices; Habitat Conversion; Farm Bill; Societal Norms and Expectations: Smokey the Bear	1. Education/Outreach 2. Demonstration Sites for Fire and Grazing with Livestock 3. CRP Program that Allows for Prescribed Fire followed by Grazing
4. Development & Urbanization	Population Growth; Economic Growth	1. Zoning 2. Easement Acquisition (Wild & Scenic River)
5. Incompatible or Unsustainable Recreational Activities	Conflicting Management Objectives (Public and Private Lands); Lack of Enforcement (Enabler on Public Lands)	1. Outreach and Education (Public and Private Lands) 2. Enforcement (Public Lands)

Threats	Source of Threat:	Strategies to Abate Threat
6. Incompatible Ecosystem Management	Conflicting Management Objectives (Public and Private Lands)	1. Multi-Agency Coordination
7. Mining	Quarry Operations	1. Easement Acquisition 2. Fee Title Acquisition 3. Partnership with Private Landowners
8. Climate Change	Industrial Emmissions; Vehicle Emissions (all carbon/nitrogen sources)	1. Alternative Fuel Sources (Cellulosic, Ethanol) 2. Education and Outreach
9. Aquifer Depletion	Irrigation; Municipal Water Supply; Climate Change; Wetland Drainage; Ethanol Production	1. Strengthen Existing Farm Bill Program 2. Wetland Restoration (via DNR, DU, FWS, etc.) 3. Tighter Ethanol Production Regulations
Natural Resources: Freshwater		
1. Invasive Species	Ship Ballast Water Dumping; Aquarium Trade; Recreational Vehicle Transport; Nursery Trade	1. Great Lakes Ballast Dumping Regulations 2. Outreach to Nursery Retailers 3. Stronger Eradication for Established Populations (Public and Private) 4. State Legislation - Noxious Species 5. Develop Strong Civic Engagement Programs
2. Hydrologic Alteration • Surface Drainage & Hydrologic Alteration • Dams & Culverts • Elevation of Magnitude/Duration of Peak Flows • Floodplain Alteration • In-Stream Channelization & Dredging	Minnesota Drainage Law; Agriculture Flood Control Actions; Electrical Generation	1. Change MN Drainage Law 2. Stream/River Channel and Habitat Restoration 3. Enhance Efforts to Keep Water on the Land 4. Lake Pepin TMDL Process 5. “Proof of Concept” Implementation through Small Watersheds 6. Wetland Restoration 7. Removal of Obsolete Dams 8. Incentives for Permanent Vegetation; Increase Working Lands (Biofuels, Grazing WMAs behind fire)

Threats	Source of Threat:	Strategies to Abate Threat
3. Non-Point Source Pollution & Runoff • Nutrient Flow – Land Use Practices • Erosion & Sedimentation – Land Use Practices	Minnesota Drainage Law; Agriculture Agriculture (Row Crop); Wetland Drainage; Tiling	1. Change MN Drainage Law 2. Low/No Till Agriculture 3. Lake Pepin TMDL Process 4. "Proof of Concept" Implementation through Small Watersheds 5. Wetland Restoration 6. Enforce State Laws (Buffer Strips, etc.) 7. Incentives for Permanent Vegetation; Increase Working Lands (Biofuels, Grazing WMAs behind fire)
4. Climate Change	Industrial Emmissions; Vehicle Emissions; All Carbon/Nitrogen Sources	1. Alternative Fuel Sources (Cellulosic, Ethanol) 2. Education and Outreach
5. Point Source Pollution • Mining • Feed Lot Contamination • Septic Systems	Agriculture (Feed Lots); Mining; Industry; Homeowners	1. Enforcement of State Laws - MPCA
6. Aquifer Depletion	Irrigation; Municipal Water Supply; Climate Change; Wetland Drainage: Ethanol Production	1. Strengthen Existing Farm Bill Programs 2. Wetland Restoration (via DNR, DU, FWS, etc.) 3. Tighter Ethanol Production Regulations

Historical/Cultural:

1. Benign Neglect	Lack of appreciation; Lack of awareness; Lack of resources	1. Complete comprehensive inventory and prioritize resource 2. Educate landowners 3. Develop cost-share programs or other funding streams for historical/cultural priorities
2. Development & Urbanization	Population Growth; Economic Growth	1. Conduct urban and land use planning at city and county levels 2. Build historical designations into county zoning 3. Develop incentive programs for preservation of historic/cultural sites

Threats	Source of Threat:	Strategies to Abate Threat
3. Loss of Knowledge/Passing of Time	Inadequate historical documentation	1. Conduct comprehensive inventory of historical/ cultural features 2. Conduct research, literature and oral.
4. Land Use and Land Use Legacies	Land conversion (Agriculture)	See Terrestrial Threats above.
5. Maintenance Deficiency	Lack of financial and human resources	1. Work with state/county governments to mechanisms for long-term maintenance funding. 2. Develop/cultivate local "friends" groups to support sites. 3. Pursue innovative funding strategies that marry continued use with long-term maintenance. 4. Complete comprehensive inventory and prioritize resources 5. Educate landowners 6. Develop cost-share programs or other funding streams for historical/cultural priorities
6. Economic and Social Changes	Changing State Responsibilities; Deterioration of public funding	1. Work with state/county governments to mechanisms for long-term maintenance funding. 2. Develop/cultivate local "friends" groups to support sites.
7. Insufficient and Inadequate Conservation Standards		1. Work with resource professionals, state/county historical societies and government agencies in establishing and maintaining standards.
8. Tourism-Related Degradation and Loss	Insufficient enforcement and education; Inadequate protective measures including capacity controls.	1. Develop and implement standards for tourism use and taylor them to specific sites. 2. Implement site management and maintenance standards at sites. 3. Increase funding for enforcement and education.
9. Lack, Loss or Insufficient Protective Heritage Legislation	Lack of appreciation or support at legislative levels; Lack of support among local constituencies	1. Educate local legislatures 2. Build statewide support for historical resources

Appendix E: Historic/Cultural Site Descriptions

Alexander Ramsey Park (Other - Early Recreation) - Redwood County
"Alexander Ramsey Park is the largest municipal park in Minnesota. The park spans 217 acres with vast features that have something for everyone!

The park was built as a state park in 1911 with much of the work being done by the CCC during the 1930's. The state of Minnesota gave the park back to the city of Redwood Falls in later years and now the city maintains and improves the park." (NSBMRV 2010b)

Ramsey Falls
© Kristi Fernholz

Andrew John Volstead House (Important People) - Yellow Medicine County
"Andrew John Volstead was institutional in the creation of the 18th Amendment. This amendment banned "the manufacture, sale, or distribution of intoxicating liquors." It went into effect July 1, 1920. The Volstead Act — also known as the National Prohibition Act — was enacted in October, 1919 to provide for enforcement mechanisms. It gave federal authorities the power to prosecute violations. Also, it defined intoxicating beverages as those containing more than .5 percent alcohol." (NSBMRV 2010a)

Birch Coulee Battlefield Site (Military) - Renville County
"*The location of one of the hardest fought battles of the U.S.-Dakota War, the Battle of Birch Coulee, was fought here. Visitors can walk a self-guided trail through recreated prairie and read about the battle from the perspectives of Joseph Anderson, a captain in the U.S. Army, and Wamditanka (Big Eagle), a Mdewakanton soldier.*" *(NSBMRV 2010b)*

Birch Coulee (Dakota Culture, Military) - Renville County
This encompasses a larger geography than the dedicated battlefield site. The area encompasses land surrounding the site as well as the coulee all the way to the Minnesota River.

Camp Cemetery (Religion) - Renville County
Cemetary - Church is no longer on site but there is an occasional burial. (Mark Tjosaas)

Camp Pope - Little Shakopee Village Site (Dakota Culture, Military) - Redwood County
Balance of Camp Pope - 3500 soldiers garrisoned there in 1863 (Loran Kaardal)

Cedar Rock Ranch (Dakota Culture) - Redwood County
60 acre Dakota Vision Quest Site. (Loran Kaardal)

Clam Shelling Site (Early Commerce) - Redwood County
Clam shell harvesting by an Iowa company for shirt buttons. (Loran Kaardal)

Fort Ridgely
© Ron Bouldan

Fort Ridgley Historic Site (Military) - Renville and Nicollet County
"In 1853, the U.S. military started construction on Fort Ridgely, near the southern border of the new reservation and northwest of the German settlement of New Ulm. The fort was designed as a police station to keep peace as settlers poured into the former Dakota lands.
Nine years later, unkept promises by the U.S. government, nefarious practices by fur traders and crop failure all helped create tensions that erupted into the U.S.-Dakota war in August 1862. Dakota forces attacked the fort twice-on Aug. 20 and Aug. 22. The fort that had been a training base and staging ground for Civil War volunteers suddenly became one of the few military forts west of the Mississippi to withstand a direct assault. Fort Ridgely's 280 military and civilian defenders held out until Army reinforcements ended the siege." (NSBMRV 2010c)

Fort Ridgely & Dale Church Cemetery (Religion, Military) - Renville County
Church no longer used except for special occasions. Cemetery contains graves from early settlement. Occasional burial still occurs. (Mark Tjosaas)

Fort Ridgley to Fort Abercrombie Road (Military, Transportation) - Renville County
Trail that connected Fort Ridgely to Fort Abercrombie in North Dakota. (Mark Tjosaas)

Fort Ridgely Cemetery (Religion, Military, Important People) - Nicollet County
Cemetery includes monuments to those killed at Redwood Ferry and a Chippewa chief who helped settlers (Chief Mouzoomaunee, Capt. John S. Marsh, Eliza Muller). Also contains graves that date to the period of the fort. (Mark Tjosaas)

Fort Ridgley State Monument (Military) - Nicollet County
A 52 ft. granite monument commemorating the heroism of the fort's defenders during its nine day siege in the Dakota - US Conflict of 1862. (Tom Ellig)

Old Fort Road (Military, Transportation) - Nicollet County
Connected Fort Ridgely to St. Peter, MN. (Mark Tjosaas)

Golden Gate Townsite (Ghost Town) - Brown County
Former townsite. Sign Identifying the townsite is located on MN Hwy 4. Townsite is located east of the highway on private property. (Mark Tjosaas)

Harkin's General Store (Early Commerce) - Nicollet County
"1870's general store managed by the Nicollet County Historical Society. When the railroad passed by the small town of West Newton, the store was forced to close with much of the unsold inventory still on the shelves, where it remains today." (MNHS 2010)

Harkin's General Store
© Kristi Fernholz

Hazlewood Republic (Dakota Culture, Religion) - Yellow Medicine County
"Founded by Stephen R. Riggs, this mission was located near the Upper Sioux Agency. The mission included a school and numerous Christian Dakota farming families who broke with the communal tribal structures and formed a self-governing organization called the Hazelwood Republic.
Upper Sioux Community." (Bloomington 2010)

Joseph R. Brown (Military, Important People) - Renville County
"*The Joseph R. Brown State Wayside Rest displays the granite ruins of Brown's home from 1862. Destroyed during the U.S./Dakota Conflict of 1862, the three story home was a mansion compared to normal pioneer homes. Brown's family was spared because of his wife's Native American heritage. Brown was a politician, inventor, publisher and Indian Agent.*" *(NSBMRV 2010b)*

Joseph R. Brown State Wayside
© Kristi Fernholz

Little Crow Village/Camp Site (Dakota Culture, Important People) - Redwood County
Location of Little Crow's village. Little Crow was an important chief among the Dakota during the US - Dakota conflict (Science View 2010).

Lower Sioux Agency
© Kristi Fernholz

Lower Sioux Agency Historic Site (Dakota Culture, Military) - Redwood County
"*In 1853 the U.S. Government established the Agency to administer treaty obligations with the Dakota people living on reservations along the Minnesota River. Explore the history and culture of the Dakota, learn how government employees and missionaries sought to change their traditional way of life at the agency, and discover the roots of the U.S.- Dakota Conflict of 1862 in the visitor center exhibit.*" *(NSBMRV 2010c)*

Lower Sioux Community (Dakota Culture) - Redwood County
"The People of the Lower Sioux Indian Community are known as Dakota , and come from the Mdewakanton ("Dwellers by Mystic Lake") band. The Lower Sioux Indian Community (LSIC) is located on approximately 1750 acres held in trust status in southwestern Minnesota, bounded by Redwood County, MN and the Minnesota River. Of the tribal population, 50% live on the reservation with an approximately equal number residing within the 10-mile tribal service zone. Historic sites include St. Cornelia's Church and the Bishop Whipple School Trading Post" (NSBMRV 2010c)

Minnesota Falls Dam (Early Commerce, Other - Early Infrastructure) Yellow Medicine County
Minnesota Falls Dam was constructed by the Montevideo Power Company in 1905 and was at that time the largest long-distance electrical generating plant in the world. Now owned by Xcel Energy.

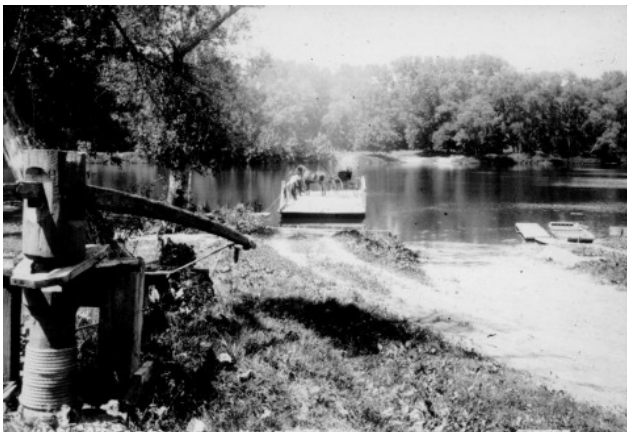
Morton Monuments (Dakota Culture, Military, Important People) - Renville County
"*On a hill overlooking the beautiful Minnesota River Valley and the city of Morton, stand two 52-foot tall granite monuments. These monuments are known as the Birch Coulee and Loyal Indian Monuments. The Birch Coulee Monument was erected in 1894 for the soldiers who fought at the Battle of Birch Coulee on September 2, 1862. The Loyal Indian Monument was erected in 1899 to honor 6 Dakota who saved lives of whites during the U.S.-Dakota Conflict of 1862." (NSBMRV 2010c)*

Morton Monuments early years
Redwood County Historical Society

Post Newton Cemetery (Religion) - Redwood County
1 acre pioneer cemetery on bluffs of MN River Valley. (Loran Kaardal)

Red Rock Trading Post (Early Commerce) - Nicollet County
Site is adjacent to the MN River a distance form the nearest township road. A historical Marker has been placed on the road. (Mark Tjosaas)

Redwood Ferry (Transportation, Military) - Redwood and Renville County
The Battle of Redwood Ferry was a battle in the Dakota War of 1862. On August 18, 1862 Captain John S Marsh and his men were ambushed at the ferry site upon returning from the Lower Sioux Agency (Wikipedia 2010).



Redwood Ferry
Redwood County Historical Society

Redwood Rendering (Early Commerce) - Redwood County
Original site of pioneer recycling - rendering business.

Rice Creek Village (Dakota Culture) - Redwood County
Rice Creek Falls, Village site of "Blanket Indians", Red Middle Voice was chief. (Loran Kaardal)

Riverside (Early Commerce, Transportation, Ghost Towns) - Redwood County
Riverside existed in the 1870's. Included a general store, hotel, and grain warehouse. Steam boats from New Ulm came with freight and carried grain back down river. (Loran Kaardal)

Schwandt Memorial (Military) - Renville County
"The Schwandt Memorial Monument was erected on August 18, 1915, near the spot where the Johan Schwandt family was murdered in the U.S.-Dakota Conflict of 1862. It was erected in memory of the 6 Schwandt family members and 2 of their friends that were killed on August 18, 1862. Two of the Schwandt children survived the attack. The daughter, Mary, was taken captive, but was protected by a Dakota woman, Snana. The son, August, managed to crawl away." *(NSBMRV 2010b)*

Springville Mine (Early commerce, Ghost Town, Other - Early Recreation) - Redwood County
13 acre site of Goldmine and Springville town site. Pioneer recreation site. (Loran Kaardal)

Town of Minnesota Falls (Ghost Town) - Yellow Medicine County
"Located on the west side of the Minnesota River near the Minnesota Falls Dam is the site of the abandoned town of Minnesota Falls. The town was essentially wiped out in a flood during the spring of 1881." (Weeks 2010)

Union (Doncaster) Cemetery (Dakota Culture, Religion) - Yellow Medicine County
Union Cemetery is also referred to as Doncaster. Chief Big Eagle and other Dakota are buried there.

Upper Sioux Agency
© Kristi Fernholz

Upper Sioux Agency (Dakota Culture, Military) - Yellow Medicine County
"The Upper Sioux Agency (or Yellow Medicine Agency) was established by the federal government in 1854 to be a center for instructing the Dakota People in farming methods. The park offers three campgrounds, 18 miles of trails, two picnic areas, river fishing, and two rental tipis. It is listed in the National Register of Historic Places."
(NSBMRV 2010b)

Woodlake Battlefield Monument (Military) - Yellow Medicine County
"*On September 19, 1862, Col. Henry Hastings Sibley set out from Fort Ridgely with 1,500 volunteers to put down the Santee uprising. As they neared Wood Lake on September 23, Sibley's men escaped an ambush by 700 warriors under Chief Little Crow and engaged them in a battle. Sibley's force won the day inflicting heavy casualties on the Sioux. For this action, Sibley received a promotion to brigadier general. Wood Lake was the first decisive defeat of the Sioux since the uprising began.*" *(NSBMRV 2010b)*

Woodlake Battlefield Site (Military) - Yellow Medicine County
This encompasses the proposed location of the larger battlefield.

Yellow Medicine City (Early Commerce, Ghost Town) - Yellow Medicine County
"The city was founded in 1866 and platted June 10, 1869, was on the south side of the river of this name, about a mile west of the site of the former Yellow Medicine or Upper Sioux Agency. This village was designated as the county seat early in 1872, but in accordance with the vote of the people in 1874 the county offices were removed in December of that year to Granite Falls, which has since been the county seat. During 1875-80 the area of the Yellow Medicine village site reverted to farming land." (Rootsweb 2010)

"The first village in Yellow Medicine County was located about ½ mile southwest of this marker. John Winter settled there in 1866. In 1868 Hoxie established a store and Gorham Powers a law office. In 1869 George Olds platted the village, a stage station and a brick hotel were built and Joseph Fortier opened another store.

A post office and mail route to Redwood Falls was established in 1870. In January 1872 Yellow Medicine City, with a population of 40, became the county seat. The county seat of government was moved to Granite Falls in 1874. Yellow Medicine City was abandoned in 1878." (HMSA 2010)

Zoar Mission/ Wabasha Village Site (Dakota Culture, Religion) - Redwood County
"*John P. Williamson, son of Dr. Thomas S. Williamson, founded this mission, which was located near the Lower Sioux Agency. Most of its members had been affiliated with the mission at Kaposia. The mission was temporarily closed at the outbreak of the U.S. Dakota War of 1862 and resumed operation in November 1862. Shortly thereafter, its members were marched under armed guards to the Fort Snelling Dakota Internment Camp.*" (Bloomington 2010)

Green Corridor, Inc.

The mission of Green Corridor, Inc. is to create a legacy of habitat connectivity, public access, and economic viability in the Mid-Minnesota River Valley Watershed.

Southwest Initiative Foundation

The mission of the Southwest Initiative Foundation is to be a catalyst, facilitating opportunities for economic and social growth by developing and challenging leaders to build on the region's assets.

Southwest Initiative Foundation
15 3rd Ave NW
Hutchinson, MN 55350-1643

(320) 587-4848
www.swifoundation.org

Great River Greening

The mission of Great River Greening is to lead community-based restoration of forests, prairies and waters, while inspiring volunteers to lifelong stewardship.

Great River Greening's team of experienced ecologists brings over 50 years of combined experience managing and restoring native habitats, designing and installing systems that improve the ecosystem services of a site, conducting natural resource inventories, fundraising for restoration projects on public lands, and engaging over 21,000 volunteers.

Great River Greening
35 West Water Street, Suite 201
St. Paul, MN 55107

(651) 665-9500
www.greatrivergreening.org

2008 Project Abstract
For the Period Ending June 30, 2010

PROJECT TITLE: **Scientific and Natural Area Acquisition (3f)**
PROJECT MANAGER: Margaret (Peggy) Booth
AFFILIATION: DNR Division of Ecological Resources
MAILING ADDRESS: 500 Lafayette Rd, Box 25
CITY/STATE/ZIP: St Paul, MN 55155-4025
PHONE: 651-259-5088
E-MAIL: peggy.booth@state.mn.us
WEBSITE: www.dnr.state.mn.us/snas
FUNDING SOURCE: Environment and Natural Resources Trust Fund
LEGAL CITATION: M.L. 2008, Chap. 367, Sec. 2, Subd. 3(f)
$1,000,000 is from the trust fund to the commissioner of natural resources for acquisition of scientific and natural areas in the southern two-thirds of Minnesota. A list of proposed acquisitions must be provided as part of the required work program.

APPROPRIATION AMOUNT: $1,000,000

Overall Project Outcome and Results
Environment and Natural Resources Trust Fund (ENRTF) dollars from this appropriation contributed toward the acquisition of six sites protecting a total of 673 acres (211.3 acres using ENRTF dollars; 461.7 acres using other funds) with rare features and native plant communities. These acquisitions resulted in three new Scientific and Natural Area (SNA) units within the State Outdoor Recreation System – Chimney Rock SNA (Dakota County), Clinton Falls Dwarf Trout Lily SNA (Steele County), and Lester Lake SNA (Hubbard County) – plus additions to three existing SNAs – Franconia Bluffs SNA (Chisago County), Lake Alexander Woods SNA (Morrison County), and St. Wendel Tamarack Bog SNA (Stearns County).

About the sites:

- The 77-acre new Chimney Rock SNA acquisition included a landowner donation and funding from Dakota County and the Department's rare species mitigation funds (pro-rated at 44.6 acres for this appropriation). Chimney Rock SNA is named for its unique geological feature of statewide significance and contains four rare plant species.
- The 21-acre Clinton Falls Dwarf Trout Lily SNA contains the world's largest population of the Minnesota endemic species of dwarf trout lily which straddles and is riparian to the Straight River.
- The new 440-acre Lester Lake site – jointly managed as an SNA and an Aquatic Management Area (320 acres designated as SNA and 120 acres designated as AMA) – was acquired through the Trust for Public Land with funding support from the Outdoor Heritage Fund, Kabekona Lake Association and Foundation, and Reinvest in Minnesota (pro-rated at 30.3 ENRTF acres for this appropriation). This site fully contains the undisturbed 70-acre Lester Lake, forested and sedge meadow native plant communities, and habitat for state special concern red-shouldered hawk and white adder's mouth orchid.
- Additions to existing SNAs include various native forest communities at the 35-acre Franconia Bluffs SNA, Parcel 2 (prorated at approximately 15.4 acres ENRTF), a 40-acre addition to Lake Alexander Woods SNA, and a 60-acre addition to the St. Wendel Tamarack Bog.

Trust Fund 2008 Work Program and Trust Fund 2009 Work Program

Date of Report: October 28, 2010
Date of Next Status Report: March 1, 2010

	M.L. 2008	M.L. 2009
Date of Work program Approval:	June 10, 2008	June 16, 2009
Project Completion Date:	June, 30 2010	June 30, 2011

I. PROJECT TITLE: **Scientific and Natural Area Acquisition (3f) [M.L. 2008]**
Statewide Scientific and Natural Area Acquisition and Restoration (4f) [M.L. 2009]

Project Manager: Margaret (Peggy) Booth
Affiliation: DNR Division of Ecological Resources
Mailing Address: 500 Lafayette Rd, Box 25
City / State / Zip : St Paul, MN 55155-4025
Telephone Number: 651-259-5088
E-mail Address: peggy.booth@dnr.state.mn.us
FAX Number: 651-296-1811
Web Page address: www.dnr.state.mn.us/snas

Location: 2008: southern two-thirds of statewide, primarily in DNR Regions 1, 3, and 4; 2009: statewide (See Figure 1)

Total Trust Fund Project Budget:	**M.L. 2008**	**M.L. 2009**	**Total**
Trust Fund Appropriation:	**$1,000,000**	**$590,000**	**$1,590,000**
Encumbrances:	**$51,865**	**$37,053**	**$88,918**
Minus Amount Spent:	**$948,135**	**$45,564**	**$993,699**
Equal Balance:	**$0**	**$507,383**	**$507,383**

Legal Citation:
M.L. 2008, Chap. 367, Sec. 2, Subd. 3(f).
Appropriation Language:
$1,000,000 is from the trust fund to the commissioner of natural resources for acquisition of scientific and natural areas in the southern two-thirds of Minnesota. A list of proposed acquisitions must be provided as part of the required work program.

M.L. 2009, Chap. 143, Sec. 2, Subd. 4(d)
Appropriation Language:
$590,000 is from the trust fund to the commissioner of natural resources to acquire high quality native plant communities and rare features and restore parts of scientific and natural areas as provided in Minnesota Statutes, section 86A.05, subdivision 5. A list of proposed acquisitions must be provided as part of the required work program.

II. PROJECT SUMMARY AND RESULTS:

M.L. 2008

About 180 acres of high quality native habitat will be acquired and designated as Scientific and Natural Area (SNA) in order to protect elements of natural diversity of state importance, such as rare and endangered plant and animal species, undisturbed plant communities, and geological features, and to provide for their use for scientific study, education, and nature observation.

M.L. 2009

This project would protect and perpetuate in an undisturbed natural state as state Scientific and Natural Area those nature features that possess exceptional scientific or education value. Specifically, about 100 acres of high quality native plant communities, rare plants and animals and other natural features of statewide importance would be acquired and designated as state Scientific and Natural Area. Also, about 600 acres of SNAs that are threatened or degraded by human impacts, invasives, and/or lack of natural disturbance regimes would be restored or enhanced, or development improvements made for safety or management purposes or to meet minimum standards.

III. PROGRESS SUMMARY AS OF APRIL 1, 2010:

M.L. 2008

Three acquisition projects have been completed using all or in part this funding – 35-acre Franconia Bluffs SNA, Parcel 2 (Chisago County), a 40-acre addition to Lake Alexander Woods SNA (Morrison County), and the recent acquisition of the 440-acre Lester Lake parcel (to be designated the new Lester Lake SNA with an Aquatic Management Area subunit). The DNR has committed funds (election-to-purchase) to two projects – a 60-acre addition to the St. Wendel Tamarack Bog (Stearns County) and acquisition of about 76 acres which will become the new Chimney Rock SNA (Dakota County). Also, the landowner has signed the option to sell 21 acres to the DNR to become the new Clinton Falls Dwarf Trout Lily SNA.

M.L. 2009

Two acquisition projects are is underway with this funding – a proposed 240-acre new SNA called Dinner Creek in Hubbard County and a 17-acre addition to Cold Spring Heron Colony SNA (Stearns County). Woody encroachment removal towards improving rock outcrop and native prairie habitat has been completed by MCC crews on 16 acres at three sites (Racine Prairie SNA, Iron Horse Prairie SNA and Swede's Forest SNA). Restoration and development projects have been initiated at several sites, including preparation for numerous prescribed burns (pending appropriate weather conditions).

PROGRESS SUMMARY AS OF OCTOBER 28, 2010:

M.L. 2008

Five acquisition projects protecting 652 acres (192.4 pro-rated LCCMR acres) have been completed using all or in part this funding – 35-acre Franconia Bluffs SNA, Parcel 2 (Chisago County), a 40-acre addition to Lake Alexander Woods SNA (Morrison County), 320 acres out of the 440-acre Lester Lake parcel as designated the new Lester Lake SNA with the other 120 acres of the parcel as the cooperative

Lester Lake Aquatic Management Area, a 60-acre addition to the St. Wendel Tamarack Bog (Stearns County), and 77 acres which became the new Chimney Rock SNA (Dakota County). Also, the landowner option to sell 21 acres to the DNR to become the new Clinton Falls Dwarf Trout Lily SNA will close by end of 2010.

M.L. 2009
Four acquisition projects are is underway with this funding – a 17-acre addition to Cold Spring Heron Colony SNA (Stearns County), a up to 160-acre addition to Blanket Flower SNA (Clay County), the proposed new 52-acre Rushford Bluffs SNA, with a 5th site (a 62-acre addition to Iron Springs Bog SNA in Clearwater Co) requested through a work program amendment. Fourteen more acres of woody and invasive species removal projects have been completed and various sign, fencing, and other site development projects done at 11 SNAs across the state. Other restoration, enhancement, and development projects have been initiated at many sites across the state.

IV. OUTLINE OF PROJECT RESULTS*:*

Result 1: SNA Acquisition

Description:

The SNA program will acquire and designate as SNA approximately 280 acres of high quality native habitat in order to protect elements of natural diversity of state importance such as rare and endangered plant and animal species, undisturbed plant communities, and geological features (180 acres using M.L. 2008 appropriation and 100 acres using M.L. 2009 appropriation). The SNA goal is to preserve and perpetuate the ecological diversity of Minnesota's heritage for scientific study, education, and nature observation. Furthermore, SNA acquisition is an important strategy of the State Wildlife Action Plan in protecting key habitats for Species of Greatest Conservation Need. Sites acquired are designated and managed as provided in MN Statute 86A.05 and MN Rules 6136. Presently, 147 SNAs encompassing over 182,000 acres have been designated in Minnesota.

Sites to be acquired under this appropriation have been identified as priorities for protection by the Minnesota County Biological Survey (MCBS) with Ecological Evaluations approved for SNA acquisition by the Commissioner's Advisory Committee. Land acquired with this appropriation will be sufficiently improved to meet at least minimum management standards as determined by the commissioner. All required Trust Fund acquisition reports will be submitted for each acquisition.

Through this funding (M.L. 2008 and M.L. 2009), all or part of about 4-10 sites would be protected at estimated costs of $2,000 to $12,000/acre depending on appraised land values in the locations being acquired. These funds would be targeted at sites that will not be protected through other currently available ENRTF and bonding funds. Specifically, to date the sites have been identified as conservation priorities for potential acquisition under this grant are listed in Table 1 and shown in Figure 1.

Summary Budget Information for Result 1:

	M.L. 2008	M.L. 2009	Total

Trust Fund Budget:	**$1,000,000**	**$430,000**	**$1,430,000**
Funds Encumbered:	**$51,865**	**$13,775**	**$65,640**
Amount Spent:	**$948,135**	**$5,451**	**$953,586**
Balance:	**$0**	**$420,774**	**$420,774**

Deliverable	**Completion Date**	**Budget**	**Status**
1. M.L. 2008: 180 acres acquired & designated SNA	June 30, 2010	$1,000,000	5 sites (~ 194.5 acres pro-rated) acquired; a 21-acre site near completion
2. M.L. 2009: 100 acres acquired & designated SNA	June 30, 2011	$ 430,000	4 sites in progress + 1 more pending amend.

Completion Date: M.L. 2008: June 30, 2010; M.L. 2009: June 30, 2011

Result Status as of December 1, 2008: NA

Result Status as of March 1, 2009: Five acquisition projects are underway with this funding. First, this funding will be used in combination with Metro Corridors Phase IV funding to acquire a 35-acre addition to the Franconia Bluffs SNA in Chisago County that is currently in the appraisal process and is expected to close in May 2009. Second, negotiations are underway to acquire a 21-acre parcel in Steele County that is proposed to become the new Clinton Falls Dwarf Trout Lily SNA – site of the world's largest population of the Minnesota endemic species of dwarf trout lily which straddles and is riparian to the Straight River. Third, through this funding, a set of three adjoining parcels will be added to the north side of the St. Wendel Tamarack Bog SNA – a 10 acre and 60 acre privately-owned parcels will be acquired in fee and, by previous county board resolution, when this happens the county will transfer an additional 60 acres of tax forfeit land to the state for SNA designation. These projects are expected to need about ½ of the appropriated funds, such that the SNA staff are determined the next highest priorities for use of these funds.

Result Status as of December 1, 2009: One acquisition project closed in Mary 2009 in cooperation with the Trust for Public Land. Specifically, the 35-acre **Franconia Bluffs SNA – Parcel 2** (Chisago County). This was acquired with a combination of this funding (pro-rated at approximately 19.6 acres – pending final transaction costs and cost info from TPL) and Metro Corridors Phase IV (prorated at approximately 15.4 acres).

Six other acquisition projects are underway with this funding. An election to purchase has been made and county board approval received on additions to Lake Alexander Woods and St. Wendell Tamarack Bog SNAs. The 40-acre addition to Lake Alexander Woods SNA is expected to close in early 2010; this site which adjoins the existing SNA is completely MCBS-mapped – hardwood forest, northern wet ash swamp, and poor fen providing habitat for red-shouldered hawk. The addition of 60-acre private parcel at St. Wendel Tamarack Bog SNA will also allow the state to receive a 60-acre tax forfeit parcel from the county.

An offer has been made on a 21-acre proposed new Clinton Falls Dwarf Trout Lily SNA. A 20-acre addition to the SNA which is named Cold Spring Heron Rookery SNA is underway. While this site hasn't been used by the birds as a rookery for more than a decade, it does possess a hillside of native prairie and floodplain forest adjoining the Sauk River. The proposed addition of adjoining floodplain forest straddles both sides of the Sauk River and would add 3,453 linear feet of natural shoreline to the SNA.

The proposed new Dinner Creek SNA acquisition is 240 acres of contiguous, high-quality native plant communities with high biodiversity significance, which includes old-growth pine forests. The site is part of a 3250-acre macrosite of outstanding and high biodiversity significance with undeveloped lakeshore, large patches of jack pine woodland and rich black spruce swamp, old growth red pine-white pine forest, and five rare plant species straddling Becker and Hubbard Counties.

APPROVED WORK PROGRAM AMENDMENT: Pending approval of a work program amendment 2 more acquisition projects will be added. First, is the proposed new Chimney Rock SNA. While this landmark in Dakota County is a recognized unique geological feature of statewide significance that also contains a population of the rare kittentail plant species, it lies outside the mapped Metropolitan Conservation Corridors focus areas - thus, use of this funding is requested towards this acquisition. A 76-acre acquisition of the primary Chimney Rock feature would be done in cooperation with the Dakota County Farmland and Natural Area which would do the appraisal (as a DNR 3rd party) and contribute partial funding to the project. Second, protection of the 440-acre Lester Lake site in Hubbard County has been reinitiated through the Trust for Public Land as a proposed joint AMA-SNA project. The SNA program made an offer which the landowner turned down in 2008 to acquire this MCBS-recommended site containing a whole 80-acre undeveloped lake, seepage cedar/black spruce swamps, and upland forest.

Result Status as of April 1, 2010: Two more acquisition projects have been completed using all or in part this funding . The 40-acre addition to **Lake Alexander Woods SNA** (Morrison County) closed in January 2010. Acquisition of the 440-acre Lester Lake parcel closed in March 2010 and will be designated the new **Lester Lake SNA** with an Aquatic Management Area subunit . This was acquired through the Trust for Public Land as a 3rd party with $100,000 of these funds contributing approximately 6.88% of the total funding (pro-rated at approximately 30.3 acres – pending final transaction costs).

The DNR has entered into an election to purchase and has county board approval for two projects which are now in final title review by the attorney general. A 60-acre addition will be added to the **St. Wendel Tamarack Bog SNA** (Stearns County). DNR in cooperation with Dakota County and with a partial landowner donation will acquire 76.6 acres which will become the new **Chimney Rock SNA**.

The landowner has signed the option to sell 21 acres to the DNR that is proposed to become the new **Clinton Falls Dwarf Trout Lily** SNA pending county board approval. Following site survey and county board approval, the DNR will elect to purchase this site.

M.L. 2009
Two acquisition projects are underway with this funding – a proposed 240-acre new SNA called **Dinner Creek** in Hubbard County and a 17-acre addition to **Cold Spring Heron Colony SNA** (Stearns County). Each project has run into acquisition issues (related to legal access and deed-legal description), thus the SNA program is considering starting a 3rd project with this funding – including the possibility of an additional site on the Table 1 list – see below.

APPROVED WORK PROGRAM AMENDMENT: Pending approval of a work program amendment, one more acquisition project site will be added. The state's newest SNA is the 72-acre Boltuck-Rice Forever Wild SNA (received largely through donation of these families) on Lake Siseebakwet (Sugar Lake) in Itasca County that was established in cooperation with Itasca County to protect a complex of native plant communities with unique geological shoreline features of unusually intact ice push ridges and swales that are within an area being mapped by MCBS as high or outstanding biodiversity significance. Acquisition of a 10-acre addition would allow the program to fully protect the remainder of a developable upland forest lake frontage tract that straddles the new SNA boundary.

M.L. 2008 Final Report Summary [This is pending completion of Clinton Falls project which was fully obligated by June 30, 2010 as per appropriation language provision and is expected to close in late 2010.]

Result Status as of October 28, 2010:
M.L. 2008
Acquisition of the 440-acre Lester Lake parcel closed in March 2010 in cooperation with the Trust for Public Land and the Fisheries Section of the Division of Fish and Wildlife and a number of other funding partners (LCCMR-Habitat Conservation Partnership, OHC Conservation Partners Legacy Grant, and the Kabekona Lake Foundation), but a management decision was subsequently made to split the designation into the new 320-acre **Lester Lake SNA** and the adjoining and cooperatively management 120-acre Lester Lake Aquatic Management Area. This was acquired through the Trust for Public Land as a 3rd party with $100,000 of these funds contributing approximately 6.88% of the landowner payment costs (pro-rated at approximately 30.3 LCCMR acres for this appropriation).

Acquisition of the 60-acre addition to the **St. Wendel Tamarack Bog SNA** (Stearns County) closed in April 2010. In cooperation with Dakota County Farmland and Natural Area Program and with a partial landowner donation acquisition of 76.6 acres closed in June 2010 which was designated the new **Chimney Rock SNA** with $320,000 of these funds contributing approximately 58.18% of the landowner payment costs (pro-rated at approximately 44.6 LCCMR acres).

The site survey was completed for the optioned 21-acres proposed new **Clinton Falls Dwarf Trout Lily.** County Board approval took longer than expected in order to resolve satisfactorily their concerns about an adjoining county ditch. Following final attorney general title opinion, the project is expected to close in late 2010.

M.L. 2009

The projects originally initiated under this appropriation all experienced significant delays. The 17-acre addition to **Cold Spring Heron Colony SNA** (Stearns County) is now back on track since the landowner produced the needed ownership documentation. Now that the 60-acre private land acquisition at **St. Wendell Tamarack Bog SNA** (Stearns Co) is completed with the 2008 appropriation, work can proceed on obtaining another 60 acres of tax forfeit land with this appropriation covering necessary DNR costs to add the land to the SNA. The previously proposed addition to the Boltuck-Rice Forever Wild SNA and the new Dinner Creek acquisition have been delayed and will be pursued with other funding.

Three other projects are proposed for work under this funding to assure that sufficient projects will be able to close by the end of FY11. Two of other acquisition projects underway that were already on Table 1 have been provisionally moved to this funding. One is an addition of up to 160 acres at **Blanket Flower Prairie SNA** (Clay County) featuring high quality dry sand-gravel prairie (providing habitat for regal fritillary and Nuttal's ground rose) as well as woodland and lakeshore plus adding significant acreage to the SNA which harbors 106 bird species including greater prairie chicken; this site is one of the few ownerships in this area with high quality prairie that has not sold a wind lease to a wind farm developer. The other site already on the list is in the Root River Valley and is proposed to become the new the **Rushford Bluffs SNA**; this 52-acre site contains very rare dry barrens oak savanna (southern) with the state endangered rough seeded flameflower and the special concern species clasping milkweed, as well as two types of oak woodland and Mn Threatened timber rattlesnakes. The site is currently for sale in Rushford and adjoins property acquired for a new high school thus providing unique, cooperative environmental education opportunities.

WORK PROGRAM AMENDMENT REQUEST: Pending approval of a work program amendment, one more acquisition project site will be added for potential funding through this appropriation. Specifically, the proposed addition to **Iron Springs Bog SNA** (Clearwater County) provides additional MCBS-mapped bog and forest habitat to this SNA, buffers the existing SNA, and will resolve the issue of lack of appropriate public access to the SNA. The existing 215-acre SNA is a conifer swamp with several rare species and a history of active use by researchers since the 1930's. The SNA program has unsuccessfully been trying to secure a safe road

access and parking area for this site. When the adjoining land was put up for sale this summer, an MCBS ecologist evaluated it and recommended it as an addition to the SNA which will also solve the public access issue.

Result Status as of March 1, 2011:

M.L. 2009 Final Report Summary:

Result 2: Restoration and Development of SNAs
Description:
Restoration, enhancement, and development activities on about 600 acres at approximately 25 Scientific and Natural Areas (SNAs) statewide will improve the health and sustainability of native biodiversity of native prairie, savanna, old growth forest, and other native plant communities. This work will directly contribute towards achievement of restoration of degraded and rare land features (particularly native prairie, savanna, and forest) needed to support Species of Greatest Conservation Need (SGCN) and thereby helps achieve Habitat Recommendation 5 of the SCPP.

Activities for restoration, development, and native habitat enhancement purposes and to bring sites acquired up to minimum standards will be carried out by SNA program or other Department crews, Minnesota Conservation Corps (MCC), Sentence to Service personnel, volunteers, and/or contractors on SNAs across the state (outside of the Metro Conservation Corridors partnership mapped corridors). This includes activities, such as seed collection, site preparation, planting, establishment period maintenance, removal and treatment of exotics, control of woody encroachment, site clean-up, signing, deer exclosures and other fencing, prescribed burns, and updating of management plans or completion of new adaptive management plans for targeted sites. Results will be reported for all non-duplicated acres with activities accomplished through these funds (e.g. acres of exotics removed or treated, miles of burn breaks installed or acres of prescribed burns, acres of seed harvest, acres planted, etc). All restoration will use seeds or plants of a local ecotype, collected whenever possible from onsite or within 25 miles.

All SNAs are candidates for restoration, enhancement, and development work, with the highest priority sites (not including sites with prairie work targeted through other funding) are listed in Table 2 and highlighted in Figure 1.

Summary Budget Information for Result 2:

	M.L. 2008	M.L. 2009	Total
Trust Fund Budget:	**$0**	**$160,000**	**$160,000**
Funds Encumbered:	**$0**	**$23,278**	**$23,278**
Amount Spent:	**$0**	**$40,113**	**$40,113**
Balance:	**$0**	**$96,609**	**$98,609**

Deliverable	Completion Date	Budget	Status
1. ~30 acres restoration/reconstruction	June 30, 2011	$25,000	initiated
2. ~140 acres invasive species control &	June 30, 2011	$48,000	initiated;

woody encroachment removal			32 acres complete
3. ~430 acres prescribed burning	June 30, 2011	$50,000	planned for spring
4. site development at ~ 10 SNAs	June 30, 2011	$13,000	projects completed at 11 sites
5. ~ 5 management plan (updates or new)	March 1, 2011	$24,000	initiated

Completion Date: M.L. 2009: June 30, 2011

Result Status as of December 1, 2009: Restoration and development projects have been initiated at several sites. Woody encroachment removal on 19 acres at three sites (Racine Prairie SNA and 2 additional sites to the project list –Iron Horse Prairie SNA and Swede's Forest SNA.) has been targeted as higher priorities because of threats of woody invasives on the native prairie and rock outcrop communities and time sensitive opportunities to use MCC crews to complete the work. See Table 2.

Result Status as of April 1, 2010: Woody encroachment removal towards improving rock outcrop and native prairie habitat has been completed by MCC crews on 16 acres at three sites (Racine Prairie SNA, Iron Horse Prairie SNA and Swede's Forest SNA). Restoration and development projects have been initiated at several sites, including preparation for numerous prescribed burns (pending appropriate weather conditions). A 16-acre savanna-dune restoration project focusing at this time on woody encroachment removal at Uncas Dunes is requested to be added to this fund's list (to supplement other primary funding for the project – with final acres pro-rated). Other sites requested to be added to this funding involve opportunities (weather dependent) for prescribed burns at Cannon River Turtle Preserve, Uncas Dunes, Hythecker Prairie, Kasota Prairie, and Yellow Bank Hills. See Table 2.

Result Status as of September 1, 2010: Fourteen more acres of woody and invasive species removal projects have been completed (including another CCM project treating herbaceous invasives across 2 acres at Sugarloaf Point SNA on Lake Superior) and various sign, fencing, and other site development projects done at 11 SNAs across the state. The specific sites being worked on with this fund are listed in Table 2.

Result Status as of March 1, 2011:

Final Report Summary:

V. TOTAL TRUST FUND PROJECT BUDGET:

M.L. 2008

Staff or Contract Services: $3,500 (for classified and unclassified SNA staff paid almost exclusively with special project funds: ~ 0.4 FTE acquisition specialist

Equipment: $500 (truck & equipment fleet charges & incidental parts as needed for acquisition site visits, landowner negotiations and up to bring sites to minimum standards)

Development: $0 Note: any of this work will be done through the 2009 appropriation under this work program.

Acquisition: $995,800 (towards fee acquisition of about 180 acres; including about ~~$50,000~~ $65,800 of related real estate transaction costs) Note: real estate costs have been increased due to increased number of projects and associated costs include for survey.

Other: $200 (instate travel as needed by land acquisition specialist evaluating site & negotiating with landowners

TOTAL 2008 TRUST FUND PROJECT BUDGET: $1,000,000

M.L. 2009

Personnel: $143,000 (for classified and unclassified SNA program & other DNR staff paid almost exclusively with special project funds: ~ 0.1 FTE acquisition specialist; up to ~0.1 FTE management plan writer & contract coordinator – new position; up to ~ 0.5 FTE specialists and technicians; and ~ 0.6 FTE laborers and seasonal crews).

Contracts: $15,000 (MCC and contractors selected through bid process as needed to complete restoration and development projects).

Equipment/Tools/Supplies: $13,000 (truck & equipment fleet charges & incidental parts; materials and supplies, such as fencing, signs, gloves, PPE, chemical, etc.)

Acquisition, including easements: $415,000 (towards fee acquisition of about 100 acres to be owned by DNR & designated SNA; including related real estate transaction costs)

Travel: $4,000 (instate travel as needed by land acquisition specialists evaluating site & negotiating with landowners & as needed by project staff for restoration & development work.)

Other:

TOTAL 2009 TRUST FUND PROJECT BUDGET: $590,000

Explanation of Capital Expenditures Greater Than $3,500: NA

VI. OTHER FUNDS & PARTNERS / PROJECT STRATEGY:

A. Project Partners:

M.L. 2008 & M.L. 2009

SNA will develop and implement its projects in cooperation with The Nature Conservancy, The Trust for Public Land, and/or local partners.

B. Other Funds Proposed to be Spent during the Project Period:

M.L. 2008 & M.L. 2009

These Environmental Trust fund appropriations will be supplemented by other state funding (e.g. bonding and potentially other LCCMR recommended funding) and non-

state funds (e.g. federal SWG, private funds, and partial landowner donations) as needed to complete priority acquisitions and restoration and development projects. Funding sources used for acquisition projects done through these appropriations and pro-rated acreages will be reported in work program updates.

C. Spending History:
SNA acquisition, restoration and development project appropriations received in CY 2005-2008 (not counting those targeted exclusively to Metro Corridors, HCP, or private prairie stewardship): 2005 SNA Statewide $134K; 2008 SNA Statewide $1M; Accelerated Prairie (Results 4 & 6 only) $775K. FY06-08 Bonding appropriations: 2006 SNA $2M; 2008 SNA $1M; 2008 Native Prairie $4M. Federal funds spent as of 4/1/09 in FY06-09: State Wildlife Grants $94K,. Other funds spent: partner contributions & landowner donations. The SNA program general fund includes approximately $400,000 annually for statewide operations and crew.

D. Time: M.L. 2008: July 1, 2008 – June 30, 2010; M.L. 2009: July 1, 2009 – June 30, 2010.

E. Project Impact and Long-term Strategy:
This project will help protect and perpetuate rare species, SGCNs, and natural features of state significance at approximately 25-35 SNA sites across the state selected because of their importance and strategic value in protecting these rare resources. As a part of the State Outdoor Recreation system, all of these sites are managed as state SNAs that provide public access and opportunities to the public for nature observation and study.

The SNA Long Range Plan has a goal of protection through SNA designation within each ecological subsection of five occurrences of each native plant community (NPC) and three occurrences of each natural heritage element found in that subsection. The Division of Ecological Resources is in the process of using the recently revised Native Plant Community Classification system to assess the extent of protection for each NPC per subsection – looking at both numbers of occurrences (NPC polygons) and acreage protected. This demonstrates a substantial need for more SNA land acquisition and native habitat restoration/development for at least the next 2 decades. Towards this end, the Division could readily utilize support from the Environment and Natural Resources Trust fund and/or the Lessard Outdoor Heritage Council of $2M to $8M per biennium over this timeframe.

VII. DISSEMINATION: SNA in cooperation with its partners will issue a press release and/or publicize a dedication event for each acquisition completed through this project.

VIII. REPORTING REQUIREMENTS:
Periodic work program progress reports will be submitted not later than March 1st and September 1st of each year. A final work program report and associated products for the 2008 appropriation will be submitted no later than August 1, 2010 as

requested by the LCCMR and a final work program report and associated products for the 2009 appropriation will be submitted no later than August 1, 2011.

IX. RESEARCH PROJECTS: NA

Attachment A: Budget Detail for 2008 Projects updated 10/28/10

Project Title: Scientific & Natural Area Acquisition (3f)

Project Manager Name: Margaret (Peggy) Booth

Trust Fund Appropriation: $ 1,000,000

2008 Trust Fund Budget	REVISED BUDGET April 2010 Result 1 Budget:	Amount Spent (4/14/10)	Balance (4/14/10)	REVISED BUDGET October 2010 Result 1 Budget:	Amount Spent (6/30/10)	Encumbrance (6/30/10)	Balance (6/30/10)	TOTAL BUDGET	TOTAL BALANCE
	SNA Acquisition			**SNA Acquisition**					
BUDGET ITEM									
PERSONNEL: wages and benefits: classified and unclassified SNA staff paid almost exclusively with special project funds: ~ 0.1 FTE acquisition specialist and ~ 0.1 FTE project crew as needed to bring sites up to minimum standards . Fringe varies from 14 -20%	~~3,500~~	~~3,220~~	~~280~~	3,843	3,843		0	3,843	0
Equipment: truck, tractor, trailer & equipment fleet charges & incidental parts for tractor, vehicles, etc. as need for acquisition site visits, landowner negotiations & to bring sites up to minimum standards	~~500~~	~~418~~	~~82~~	419	419		0	419	0
Land acquisition	~~930,000~~	~~403,493~~	~~526,507~~	926,946	875,081	51,865	0	926,946	51,865
Real Estate Transaction Costs (e.g. professional services, survey, AG, title, recording, etc)	~~65,800~~	~~46,244~~	~~19,556~~	68,713	68,713		0	68,713	0
Other Supplies: e.g. fencing, signs, etc as needed to bring sites up to minimum standards	0	0	0	0	0		0	0	0
Travel expenses in Minnesota	~~200~~	79	~~121~~	79	79		0	79	0
Other land improvement: direct expenses not included above for purposes of meeting minimum standards	0	0	0	0	0		0	0	0
COLUMN TOTAL	**$1,000,000**	**$453,455**	**$546,546**	**$1,000,000**	**$948,135**	**$51,865**	**$51,865**	**$1,000,000**	**$51,865**

Table 1. Proposed 2008-09 Scientific and Natural Area Acquisition - STATEWIDE REVISED10/28/10

Note: all locations in 2008 work program list are also included in 2009 list.

Appr. Year	Location Name	County	Proposed SNA Addition	Proposed New SNA	Estimated Acres	Ecological Features (primary)	Status
2008	Avon Hills Forest	Stearns	x		300+	mesic oak forest	one project initiated; may utilize 2008 bonding
2008	Big Stone ~~Moraine~~ prairie complex	Big Stone		x	<300	rock outcrop, prairie	no current projects; NPB (Native Prairie Bank conservation easement) acquisition being pursued
2008	Big Woods of Cottonwood R forest-prairie complex	Lyon		x	>1200	snow trillium, mesic forest, sedge meadow, prairie	no current projects
2008	Boiling Springs Prairie	Redwood		x	<100	mesic prairie	no current projects; proposed for 2011 Green Corridor work
2008	Cedar Mountain	Redwood	x		<320	rock outcrop, prairie, oak woodland; igneous rock intrusion	no current projects; proposed for 2011 Green Corridor work
2008	Chanarambie Creek	Murray		x	250	dry prairie	no current projects; most top priority sites now NPB
2008	**Clinton Falls**	**Steele**		**x**	**21**	**Dwarf Trout Lily**	**landowner signed option; being approved by county board, remainder of 2008 appropriation encumbered for this landowner payment**
2008	Cooks Lake Forest	Ottertail & Becker		x	<1800	mesic hardwood forest, undeveveloped lakeshore	no current projects
2008	Des Moines R prairie-forest complex	Jackson	x		<1500	oak woodland, mesic prairie	landowner rejected offer on addition of up to 80 acres to Holthe Prairie SNA under 2008 LCCMR Accelerated Prairie project
2008	Felton Prairie	Clay	x		<8000	prairie complex, including sand-gravel prairie on beach ridge	addition to Felton Prairie SNA initiated; on hold - with next step by county
2008	**Franconia Bluffs**	**Chisago**	**x**		**<1500**	**forested bluff-floodplain complex along St. Croix R.**	**32-ac acquisition closed in May 2008 through 2008 appropraition with partial funding also from 2007 LCCMR MeCC**
2008	Kasota Prairie	Le Sueur	x		780	mesic prairie, loggerhead shrike	no current projects
2008	Lower Antelope Valley prairie complex	Yellow Medicine		x	<250	saline prairie, wet prairie	NPB acquisition being pursued with potential as future SNA
2008	Mikkelson Prairie	Swift		x	<300	prairie	no current projects
2008	Morton Outcrops	Renville		x	65	bedrock knob, mesic prairie	acquisition project initiated; proposed for 2008 prairie or as potential Green Corridor project
2008	Yellow Medicine Coteau (was previously called No. Prairie Coteau prairie macrosite - Sioux Nation area)	Yellow Medicine	x	(x)	<1070	dry hill prairie, prairie meadow, wet prairie, various rare species	acquisition project initiated; being pursued under 2008 prairie bonding
2008	**St Wendel Tamarack Bog**	**Stearns**	**x**		**<1000**	**tamarack bog**	**60-acre acquisition closed April 2010 with 2008 appropriation; expenses for acquiring donation of adjoining 60-acre tax forfeit parcel through 2009 appropriation**
2008	Ten Mile Creek Prairie	Lac Qui Parle		x	50	dry prairie	project initiated as SNA or NPB under 2008 prairie bonding
2008	Wykoff Balsam Fir	Fillmore	x		320	mesic hardwood forest, algific talus slope, trout stream	project on hold
2009	**Blanket Flower**	**Clay**	**x**		**400**	**dry prairie**	**up to 160 acres to be acquired through this funding is in appraisal; 2 projects underway through 2008 prairie bonding;**
2009	Chester Hills	Polk		x	<1000	wetland, prairie	contact initiated
2008	**Chimney Rock**	**Dakota**		**x**	**250**	**prairie & rock formation**	**77-acre closed in June 2010 with 2008 appropriation**
2009	**Cold Spring Heron Rookery**	**Stearns**	**x**		**40**	**river terrace forest, red-shouldered hawk, Sauk River frontage**	**17-acre private parcel in progress through 2009 appropriation + adjoining 23-acre tax forfeit parcel to be received from county**
2009	Dexter Prairie	Mower		x	<80	mesic tall grass prairie	contact initiated
2009	Dinner Creek	Becker & Hubbard		x	<3200	forest-wetland complex, including jack pine woodland, white cedar swamp	240-acre acquisition project stalled due to lack of legal access; moved to potential project through 2010 appropriation
2009	Englund Ecotone	Benton	x		<680	oak forest, savanna, sedge meadow	discussion with landowners underway; potential project through 2010 appropriation
2009	Forever Wild	Itasca	x		10	northern rich mesic hardwood forest & beaver wetland complex	proposed 10-acre addition to newest SNA on Lake Siseebakwet (Sugar Lake) to fully protect developable upland area on SNA boundary; project deferred for future funding
2009	Hovland Woods	Cook	x		<2600	upland white cedar, northern hardwood forest	project under discussion
2009	**Iron Springs Bog**	**Clearwater**	**x**		**62**	**Mississippi R frontage, bog & forest**	**Work Program Amendment Request to add site: Property adjoining SNA currently for sale which includes mapped NPC, would buffer existing SNA & solve problem of lack of public access to site**
2009	Little Kandiyohi-Wakanda Lakes Peninsula Forest	Kandiyohi		x	<300	wet mesic hardwood forest; rock elm, kentucky coffeetree	project initiated by 3rd party
2008	**Lester Lake**	**Hubbard**		**x**	**440**	contains whole 80-acre undeveloped lake, as well as seepage cedar/black spruce swamps	**440-acre acquisition (with combination of funds) closed in March 2010; 320 acres designated as new SNA & 120 acres as AMA**
2008	**Lake Alexander Woods SNA**	**Morrison**	**x**		**<500**	**hardwood forest, lake shore**	**40-acre acquisition closed in January 2010 & designated as part of Lake Alexander Woods SNA**
2009	Marshall-Pennington Beach Ridge	Marshall & Pennington		x	500	fen, wet prairie	no current projects
2009	Mission Creek/Magney-Snivley	St. Louis		x	<1800	northern hardwood forest	protection options under discussion
2009	Mound Prairie	Houston	x		30	bluff prairie	1 project underway with 2008 prairie bonding
2009	Nopeming Unconformity	St. Louis		x	300	geological feature, northern hardwood forest	project proposed
2009	Pipestone Quartzite Outcrops	Pipestone		x	315	bedrock outcrop with rare plants	no current projects
2009	**~~Root River Valley~~ Rushford Bluffs**	**Fillmore**		**x**	**150**	**dry barrens oak savanna, oakd woodland, oak-shagbark hickory woodland, bluff prairie**	**52-acre private parcel in progress proposed through 2009 appropriation**
2009	Renwood Fen	Redwood		x	150	calcareous fen, prairie	proposed for 2011 Green Corridor work
2009	Swedes Forest	Redwood	x		<550	bedrock knobs with rare plants, five-lined skinks	proposed for 2011 Green Corridor work

Table 2. Potential SNA -STATEWIDE - Restoration & Development Activities - FY10-11
PROJECT STATUS AS OF OCTOBER 2010 - additional sites

SNA Name all SNAs statewide are candidate sites for work under this grant - ** denotes site proposed for acquisition	County	Updated or New Management Plan	Acres Completed (bold X if other					Comments & Accomplishments Not Measured in Acres
			Native Plant Community Reconstruction	Woody Encroachment-Invasives Removal	Prescribed Burning	Non-Woody or Seedling Invasives Control	Development	
DNR REGION 1 (NORTHWEST)								
Felton Prairie-Bicentennial	Clay	X					X	
Greenwater Lake	Becker						X	
Iron Springs Bog	Clearwater	X					X	
Lake Bronson Parkland	Kittson				X			
Otter Tail Prairie	Otter Tail						X	
Pembina Trail-Crookston Unit	Polk	X						
Pembina Trail-Foxboro Unit	Polk						X	culverts and repair approach/gates
Prairie Smoke Dunes	Norman						**X**	culvert and gate installed
Santee Prairie	Mahnomen						**X**	gate installed
Two Rivers Aspen Parkland	Roseau				X		X	
DNR REGION 2 (NORTHEAST)								
Chisholm Point Island	Itasca					**2**		
Hemlock Ravine	Carlton						X	1000' of exclosure reinforcement
Moose Mountain	St. Louis							boundary brushing
Myhr Creek Ridge	Cook						X	
Sugarloaf Point	Cook					**2**		
DNR REGION 3 (CENTRAL)								
Avon Hills Forest	Stearns							
Boot Lake	Anoka						**X**	412 ft boundary fencing completed
Cannon River Turtle Preserve	Goodhue							
Cherry Grove Blind Valley	Fillmore	X	X		X			proposed Rx burn spring 2011
Falls Creek	Washington							site cleanup - 1 dump completed
Franconia	Washington						**X**	2975 ft of boundary signing completed & site cleanup initiated
Kellogg-Weaver Dunes	Wabasha				X			proposed Rx burn spring 2011
N. Fork Zumbro Woods	Goodhue						**X**	signing completed
Oronoco Prairie	Olmsted				X			proposed Rx burn spring 2011
Quarry Park	Stearns				X			proposed Rx burn spring 2011
Seminary Fen	Carver						**X**	site cleanup completed
St. Croix Savanna	Washington						**X**	site cleanup completed
St. Wendel Tamarack Bog	Stearns							
Wolsfeld Woods	Hennepin						**X**	trail repair completed
Wood-Rill	Hennepin						**X**	3378 ft trail repair completed
Uncas Dunes	Sherburne			X	X			
Zumbro Falls Woods	Wabasha		X	**X**	X			biomass project completed; proposed fall 2010 & spring 2011 Rx burn 10 acres & reconstruction 10 acres
DNR REGION 4 (SOUTH)								
Blue Devil Valley	Yellow Medicine							
Butternut Valley Prairie	Blue Earth			**12**			**X**	all scattered buckthorn removed; signs installed
Cedar Mountain	Redwood							
**Clinton Falls Dwarf Trout Lily (proposed SNA)	Steele							
Clinton Prairie								2010 Rx burn done with other funding
Compass	Nobles							proposed spring 2011 rx burn
Cottonwood River Prairie	Brown							proposed spring 2011 rx burn
Des Moines River Prairie	Jackson				**X**			burn break completed; proposed spring 2011 rx burn
Gneiss Outcrops	Chippewa							proposed spring 2011 rx burn
Holthe	Jackson							proposed spring 2011 rx burn
Hythecker Prairie	Dodge							2010 Rx burn done with other funding
Iron Horse Prairie		X		**8**				proposed spring 10 rx burn
Kasota Prairie	LeSueur							2010 Rx burn done with other funding
Lundblad Prairie	Murray							proposed spring 2011 rx burn
** Morton Outcrop (proposed SNA)	Renville							
Mound Springs	Yellow Medicine							proposed spring 2011 rx burn
Osmundson	Faribault							proposed spring 2011 rx burn
Prairie Coteau	Pipestone							proposed spring 2011 rx burn
Racine Prairie	Mower	X		**4**				proposed spring 2011 rx burn
Rock Ridge	Cottonwood							proposed spring 2011 rx burn
Swede's Forest	Yellow Medicine-Redwood	X		**4**				
Wild Indigo Prairie	Mower			X				proposed spring 2011 rx burn
Yellow Bank Hills	Lac Qui Parle							2010 Rx burn done with other funding
TOTAL acres		**0**	**0**	**28**	**0**	**4**	**0**	

2008 Project Abstract

For the Period Ending June 30, 2012

PROJECT TITLE: State Land Acquisition Consolidation
PROJECT MANAGER: Craig L. Engwall
AFFILIATION: Northeast Regional Director, Minnesota Dept. of Natural Resources
MAILING ADDRESS: 1201 East Highway 2
CITY/STATE/ZIP: Grand Rapids MN 55744
PHONE: 218-999-7913
E-MAIL: craig.engwall@state.mn.us
WEBSITE: [If applicable] www.mndnr.gov

FUNDING SOURCE: **Environment and Natural Resources Trust Fund**
LEGAL CITATION: **M.S. 2008, Chap 367, Sec 2, Subd 3(g)**

APPROPRIATION AMOUNT: $500,000

Overall Project Outcome and Results

The goal of a land consolidation revolving fund was, and is, to enable Department of Natural Resources (DNR) to purchase lands of significant natural resource value adjacent to, or imbedded within, lands that are already managed by public agencies. Many of these purchases are likely to be private, industrial forest lands that would otherwise be subdivided and sold for development. At the same time, the DNR would sell parcels of state-owned land that are isolated and difficult to manage from a resource or public benefit standpoint. The proceeds from the sale of these parcels would go back into the land consolidation revolving fund. By strategically purchasing and selling parcels through this fund, the state could achieve a net gain from both a natural resource and economic perspective.

The appropriation for this project enabled DNR to purchase five parcels in Koochiching County and two parcels in Itasca County, totaling 800 acres. These were key acquisitions as each one was selected because it either was a sole private parcel imbedded in tens of thousands of acres of public ownership, or it was adjacent to DNR managed lands and would enhance that management and provide natural resource benefits. Development or subdivision of these parcels would create fragmentation and potentially hinder forest management activities on adjacent lands.

On the sale side, results were not as successful. DNR identified six parcels in the project area for potential sale, but did not succeed in selling any of them. We learned from this project that the geographic scope of this project was too small. The vast majority of the land in the project area (well over 90%) is state trust fund land and the proceeds of sales from these lands must go to the corpus of the school trust fund and not the revolving account. Had the project been broadened to include some northwestern Minnesota counties, where there are significantly more acquired lands, the project would have had more success. On a positive note, DNR has statutory authority to continue the purpose of this project statewide and will do so. We will continue to provide LCCMR updates on our work in this area.

Project Results Use and Dissemination

The State Land Acquisition Consolidation project information has been disseminated to DNR staff who manage lands in the project area, as well as county land departments and county commissioners in Koochiching and Itasca counties.

As stated above, we were in regular contact with the counties. We also have communicated with third party non-profits such as The Nature Conservancy, The Trust for Public Lands, and The Conservation Fund.

Environmental and Natural Resources Trust Fund 2008 Work Program
Final Report

Date of Report: October 2, 2012
Date of Next Status Report: Final Report
Date of Work program Approval:
Project Completion Date: June 30, 2012

I. PROJECT TITLE: State Land Acquisition Consolidation

Project Manager:	Craig L. Engwall
Affiliation:	Northeast Regional Director, Minnesota Dept. of Natural Resources
Mailing Address:	1201 E. Hwy. 2
City / State / Zip :	Grand Rapids, MN 55744
Telephone Number:	218-999-7913
E-mail Address:	craig.engwall@state.mn.us
FAX Number:	218-327-4263
Web Page address:	www.mndnr.gov

Location: Forest and riparian lands in northern Minnesota

Total Trust Fund Project Budget:	**Trust Fund Appropriation:**	**$ 500,000.00**
	Minus Amount Spent:	**$ 476,763.58**
	Equal Balance:	**$ 23,036.42**

Legal Citation: M.L. 2008, Chap. 367, Sec. 2, Subd. 3(g).

Appropriation Language:
$500,000 is from the trust fund to the commissioner of natural resources to consolidate state land ownership through acquisition and sale to reduce forest fragmentation and enhance management efficiency. A list of proposed fee title and easement acquisitions must be provided as part of the required work program. All funding for conservation easements must include a long-term stewardship plan and funding for monitoring and enforcing the agreement. Minnesota Statutes, sections 94.16 and 94.165, apply to the proceeds from the sale of land. For this appropriation, the Department of Natural Resources must establish a separate revolving account under Minnesota Statutes, section 94.165, for the use and accounting of trust fund money. This appropriation is available until June 30, 2011, at which time the project must be completed and final products delivered, unless an earlier date is specified in the work program.

II. and III. FINAL PROJECT SUMMARY:

The goal of a land consolidation revolving fund was, and is, to enable Department of Natural Resources (DNR) to purchase lands of significant natural resource value adjacent to, or imbedded within, lands that are already managed by public agencies. Many of these purchases are likely to be private, industrial forest lands that would

otherwise be subdivided and sold for development. At the same time, the DNR would sell parcels of state-owned land that are isolated and difficult to manage from a resource or public benefit standpoint. The proceeds from the sale of these parcels would go back into the land consolidation revolving fund. By strategically purchasing and selling parcels through this fund, the state could achieve a net gain from both a natural resource and economic perspective.

The appropriation for this project enabled DNR to purchase five parcels in Koochiching County and two parcels in Itasca County, totaling 800 acres. These were key acquisitions as each one was selected because it either was a sole private parcel imbedded in tens of thousands of acres of public ownership, or it was adjacent to DNR managed lands and would enhance that management and provide natural resource benefits. Development or subdivision of these parcels would create fragmentation and potentially hinder forest management activities on adjacent lands.

On the sale side, results were not as successful. DNR identified six parcels in the project area for potential sale, but did not succeed in selling any of them. We learned from this project that the geographic scope of this project was too small. The vast majority of the land in the project area (well over 90%) is state trust fund land and the proceeds of sales from these lands must go to the corpus of the school trust fund and not the revolving account. Had the project been broadened to include some northwestern Minnesota counties, where there are significantly more acquired lands, the project would have had more success. On a positive note, DNR has statutory authority to continue the purpose of this project statewide and will do so. We will continue to provide LCCMR updates on our work in this area.

IV. OUTLINE OF PROJECT RESULTS*:*

Result 1: Compliment the Forest Legacy Program by acquiring fee simple to forest lands that are beyond the reach of Forest Legacy.

Description: Forest Legacy conservation easements are a tremendous tool in attempting to mitigate forest fragmentation in Minnesota. Yet certain of the large industrial forest land owners in Minnesota have indicated that a conservation easement program does not mesh well with their business model as a real estate investment trust or timber investment management organization. Consequently, some large landowners have a much greater interest in selling forest lands to the State than in conveying conservation easements. A land consolidation revolving fund would provide the State with the opportunity to acquire important natural resource parcels that would otherwise be lost to development.

As described above, the $500,000 trust fund appropriation would be deposited in a sub-account under Minn. Stat. § 94.195, thus creating the land consolidation revolving fund. DNR would augment and eventually replace the appropriated funds (once they are spent) by using Minn. Stat. § 94.16, which states that “the proceeds from the sale of lands that were under the control and supervision of the

commissioner of natural resources shall be credited to the land acquisition account in the natural resources fund [94.165]." Thus, DNR could keep the land consolidation revolving fund operating even after the LCCMR project is completed.

Acquisition prioritization under this project will be based on proximity to state forest lands, public recreational opportunities, timber resources and ecological and related values.

Summary Budget Information for Result 1:	**Trust Fund Budget:**	**$500,000.00**
	Amount Spent:	**$476,763.58**
	Balance:	**$ 23,036.42**

Deliverable	**Completion Date**	**Budget**	**Status**
1.Outline of Selection Priorities	February, 2008	$0	
2.Establishment of Revolving Fund	Upon Leg. Approval	$0	
3.Acquisition of Parcel(s)	June, 2011	$500,000	Complete
4.Generate Add'l Acq. Funds	Ongoing		

Completion Date: June, 2012

Final Report Summary:
The final Project Summary (above) covers in large part the Final Report Summary. While the objective of selling state acquired land parcels was not obtained during the duration of the project, the approach set forth in the project is very viable in a much broader application. With respect to the remaining balance in the account, that balance is due to the fact that a potential seller rejected an offer on a parcel that had been appraised pursuant to statute. The project was a success in that the state obtained a number of parcels that are either of significant natural resource value, management value, or both.

V. TOTAL TRUST FUND PROJECT BUDGET:

Staff or Contract Services: $0
Equipment: $0
Development: $ $0
Restoration: $ 0
Acquisition, including easements: $ 500,000
Other: $ 0

TOTAL TRUST FUND PROJECT BUDGET: $500,000

Explanation of Capital Expenditures Greater Than $3,500: *N/A*

VI. OTHER FUNDS & PARTNERS:

A. Project Partners: No specific nonstate funding has been identified yet, but the state will continue to work with its non-governmental partners, as it has with the Forest Legacy Program, to strategically leverage public and private dollars.

B. Other Funds Proposed to be Spent during the Project Period: Staff time to be funded through existing programs.

C. Past Spending: No money has been spent to date.

D. Time: This will be a multi-year project ending in June, 2012.

VII. DISSEMINATION: The DNR project manager will regularly discuss program goals, progress and accomplishments with governmental and non-governmental partners who are working to minimize forest fragmentation.

VIII. REPORTING REQUIREMENTS:

Periodic work program progress reports will be submitted not later than December 2008; June 2009; December 2009; June 2010; December 2010; and June 2011. A final work program report and associated products will be submitted between June 30 and August 1, 2009 or 2011 as requested by the LCCMR.

IX. RESEARCH PROJECTS:

Attachment A: Budget Detail for 2008 Projects - Summary and a Budget page for each partner (if applicable)

Project Title: State of Minnesota Land Consolidation Revolving Fund

Project Manager Name: Craig L. Engwall

Trust Fund Appropriation: $500,000

1) See list of non-eligible expenses, do not include any of these items in your budget sheet

2) Remove any budget item lines not applicable

2008 Trust Fund Budget	**Result 1 Budget:**	**Amount Spent** *(date)*	**Balance** *(date)*	**Other Contributions:**	**Amount Spent** *(date)*	**Balance** *(date)*	**Other Contributions:**	**Amount Spent** *(date)*	**Balance** *(date)*	**TOTAL LCCMR BALANCE**	**TOTAL REVOLVING FUND BALANCE**
	Acquisition of Parcel(s)			*Donation or Gift*			*DNR Land Sales*				
Land acquisition with LCCMR Funds	500,000	476,764	23,236			0			0	23,236	0
New contributions to revolving fund						0			0		
COLUMN TOTAL	**$500,000**	**$476,764**	**$23,236**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**23,236**	**0**

Parcel List for Pine Island SFT acquisition #143040 (Koochiching and Itasca)

Koochiching County

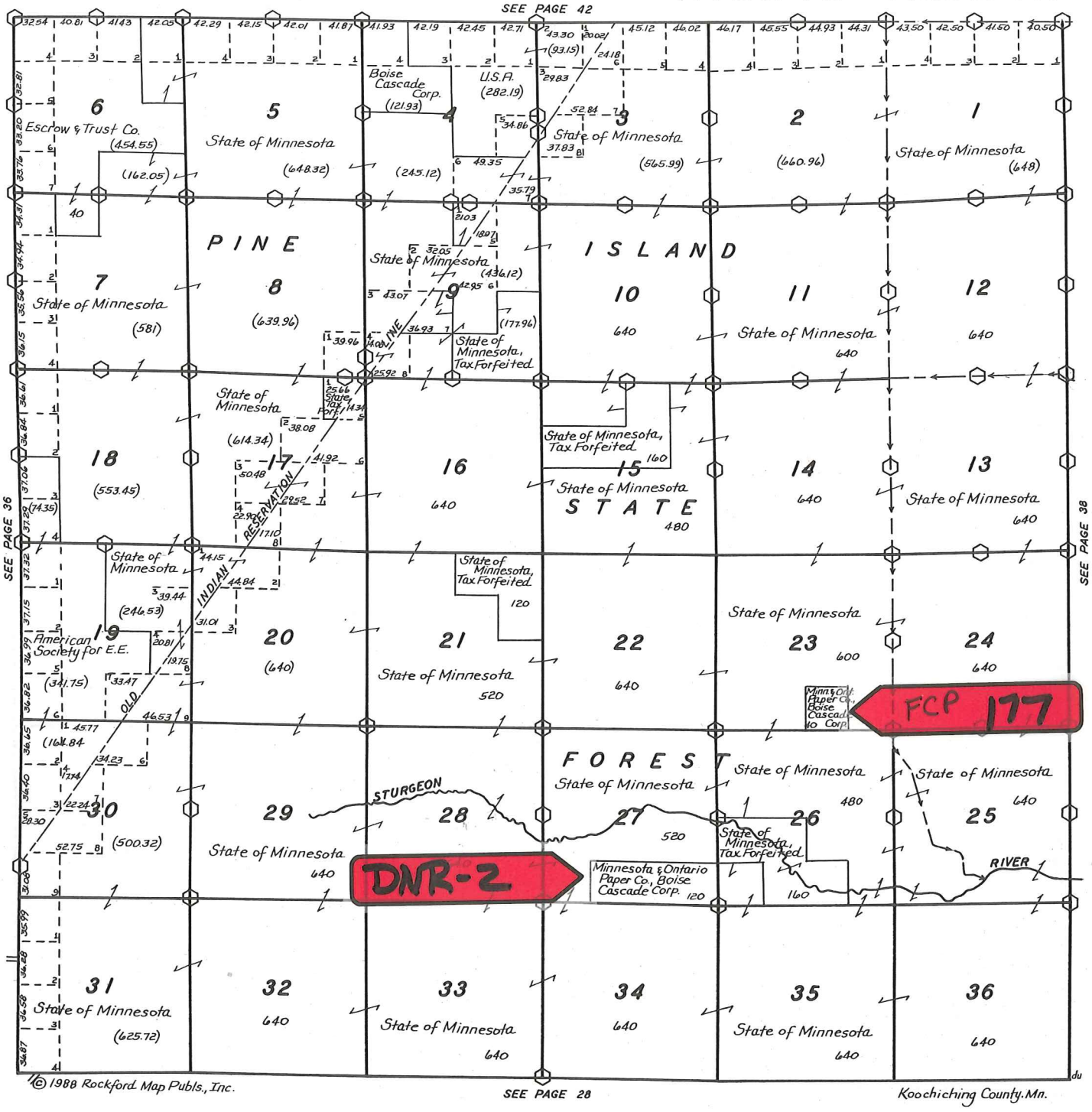
Tract ID	Ownership	State Forest	County	Twn	Rng	Sec	Legal	Acres
74	LaMinora	Pine Island	Koochiching	158	28	16	NWNE	40.00
177	LaMinora	Pine Island	Koochiching	155	28	23	SWSE	40.00
108	LaMinora	Koochching	Koochiching	66	24	27	SENE, SWNE	80.00
256	LaMinora	Koochching	Koochiching	65	26	9	NESE	40.00
DNR-1	Meriwether	Koochching	Koochiching	67	26	26	NESW, SENW, SESW, SWNE, SWNW	200.00
								400.00

Itasca county

Tract ID	Ownership	State Forest	County	Twn	Rng	Sec	Legal	Acres
247	Meriwether	Bigfork	Itasca	62	27	25	SENE, NESE	80.00
356*	Meriwether	Bigfork	Itasca	150	25	15	**N1/2 of Sec. 15**	320.00
								400.00

Potential DNR Fee Sale 2009

T. 155 N. – R. 28 W.



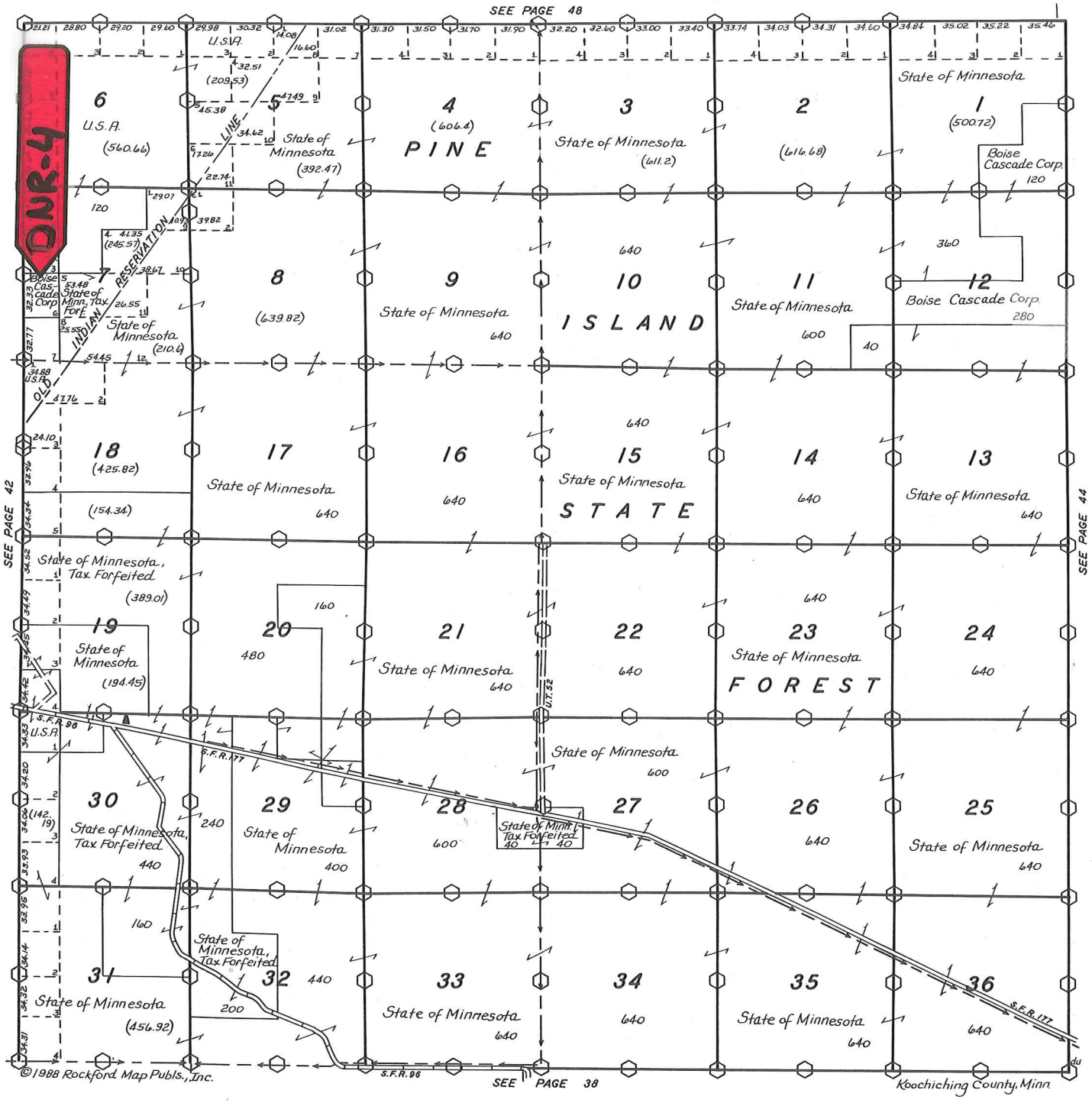
Bergstrom Wood Products

MANUFACTURERS OF QUALITY PALLETS & CUT STOCK
BUYERS OF QUALITY ASPEN BOLTS

RODNEY BERGSTROM, President
516 SECOND AVENUE
INTERNATIONAL FALLS, MINNESOTA 56649

PHONE:
(218) 283-4477

T. 156 N – R. 27 W.



TEXACO
LUBRICANTS

BORDER OIL CO. INC.

DISTRIBUTOR OF PETROLEUM PRODUCTS

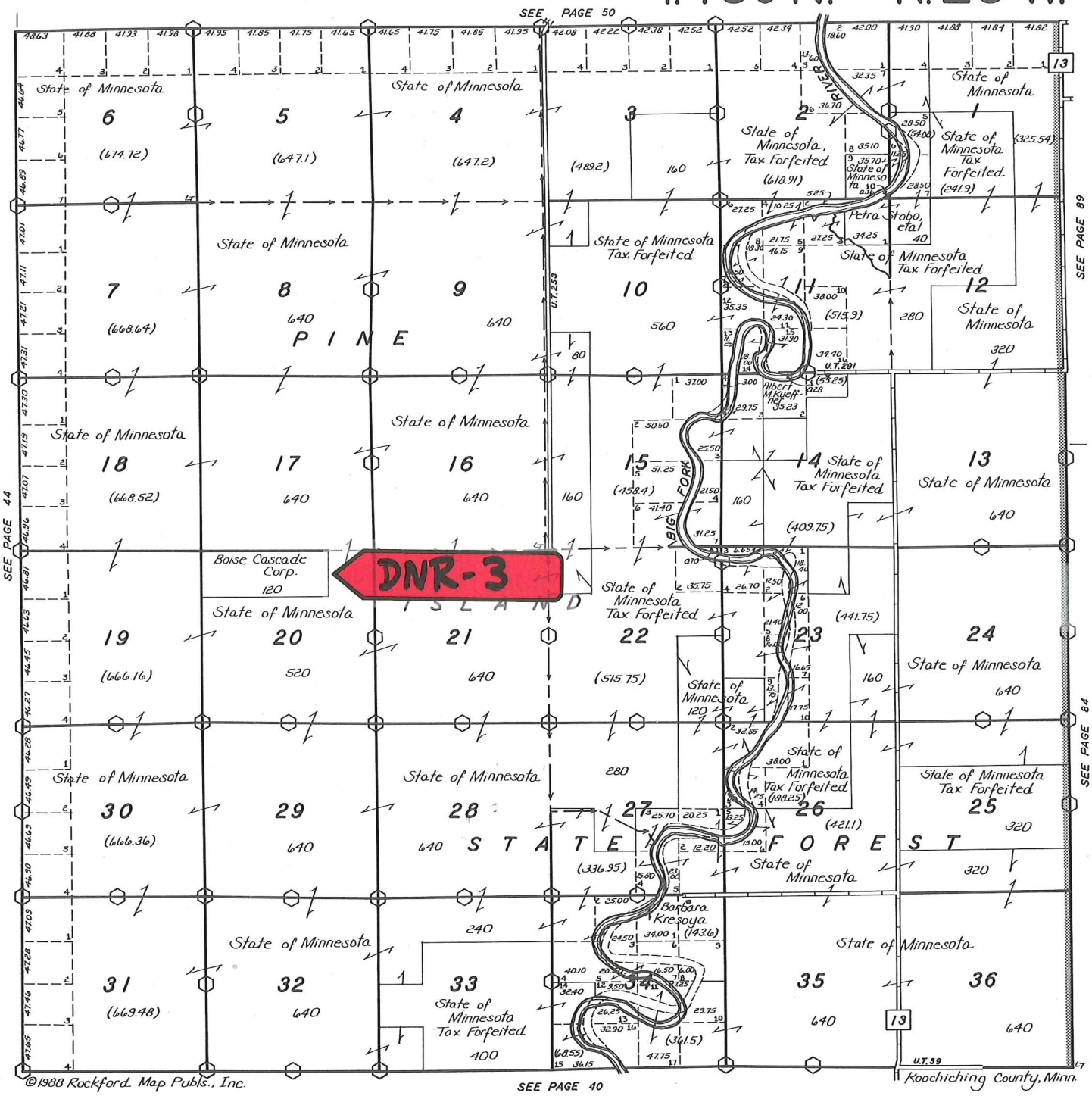
SPUR
FUELS

BARB LEINUM ARVID LEINUM

1100 THIRD AVENUE ■ INTERNATIONAL FALLS, MINNESOTA 56649

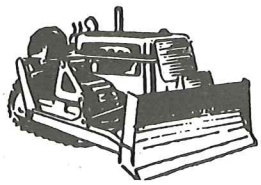
Phone: **283-3631**

T. 156 N. – R. 25 W.

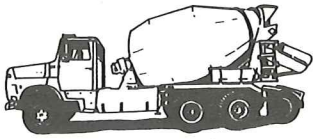


Bowman Construction

INTERNATIONAL FALLS, MINNESOTA 56649

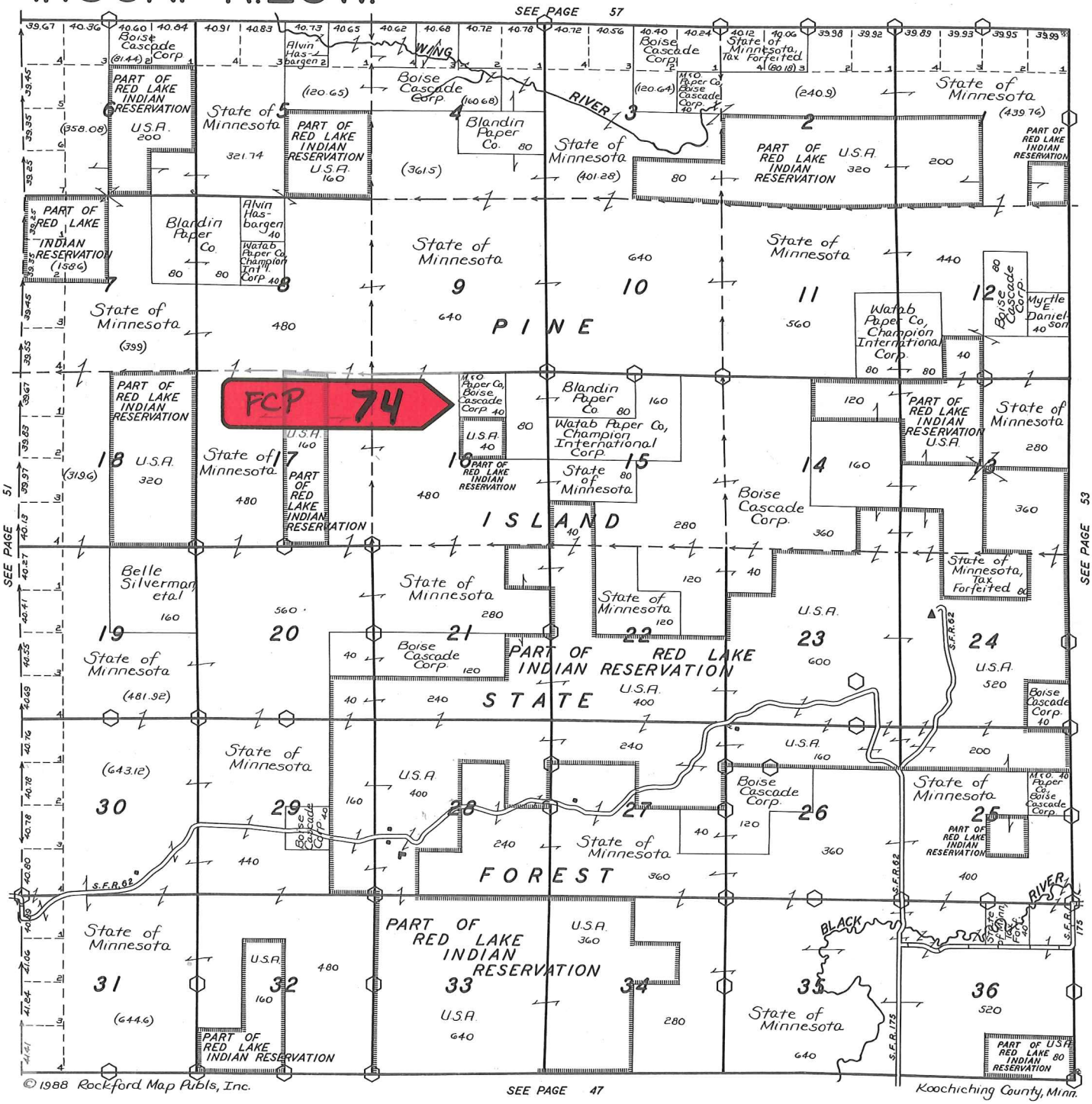


Ready-Mix Concrete
Crushed Rock - All Sizes
Road Building



PHONE: 283-4305

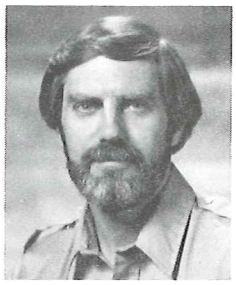
T.158N.–R.28W.



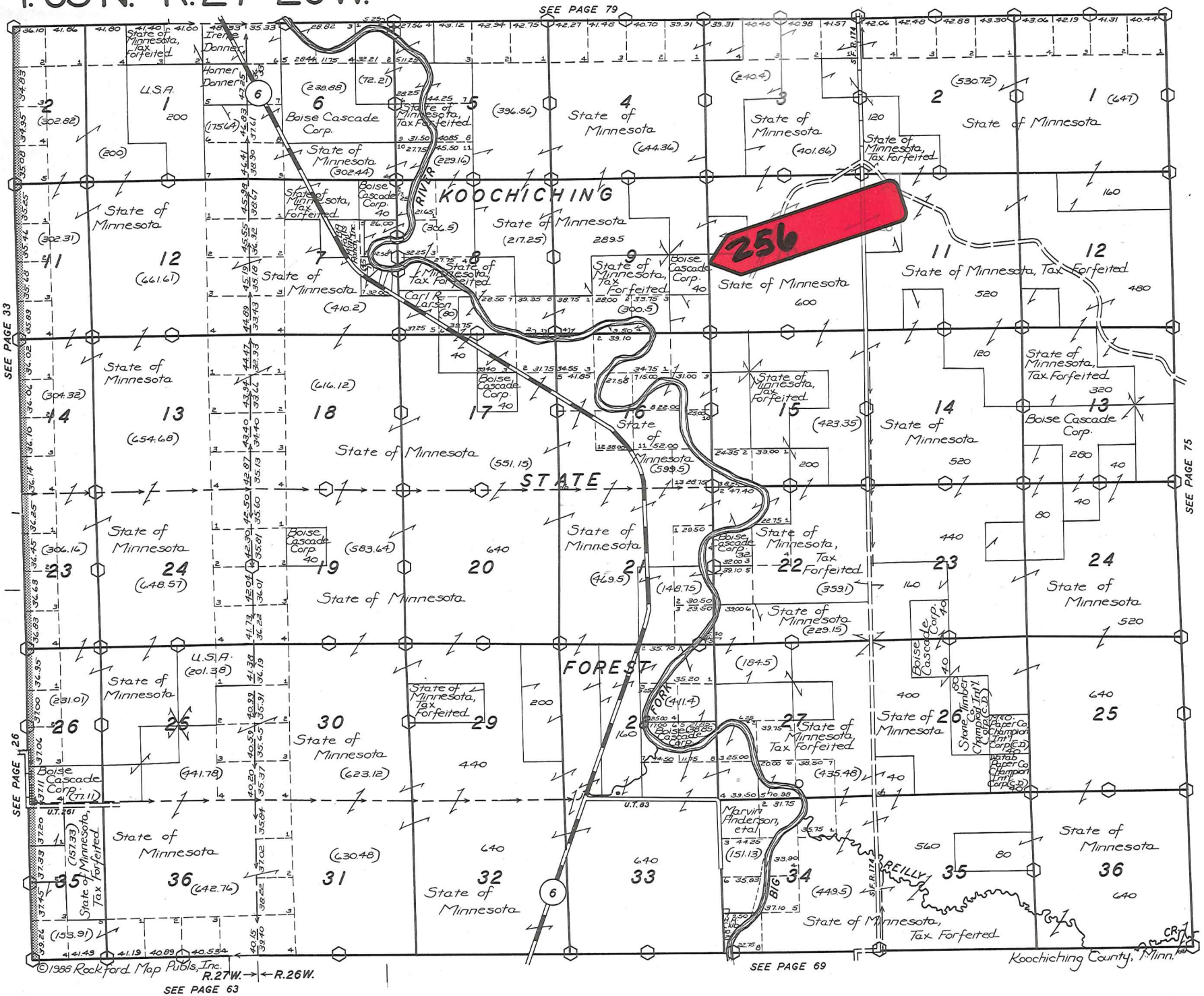
Bob Lessard

Working Together
For Koochiching County

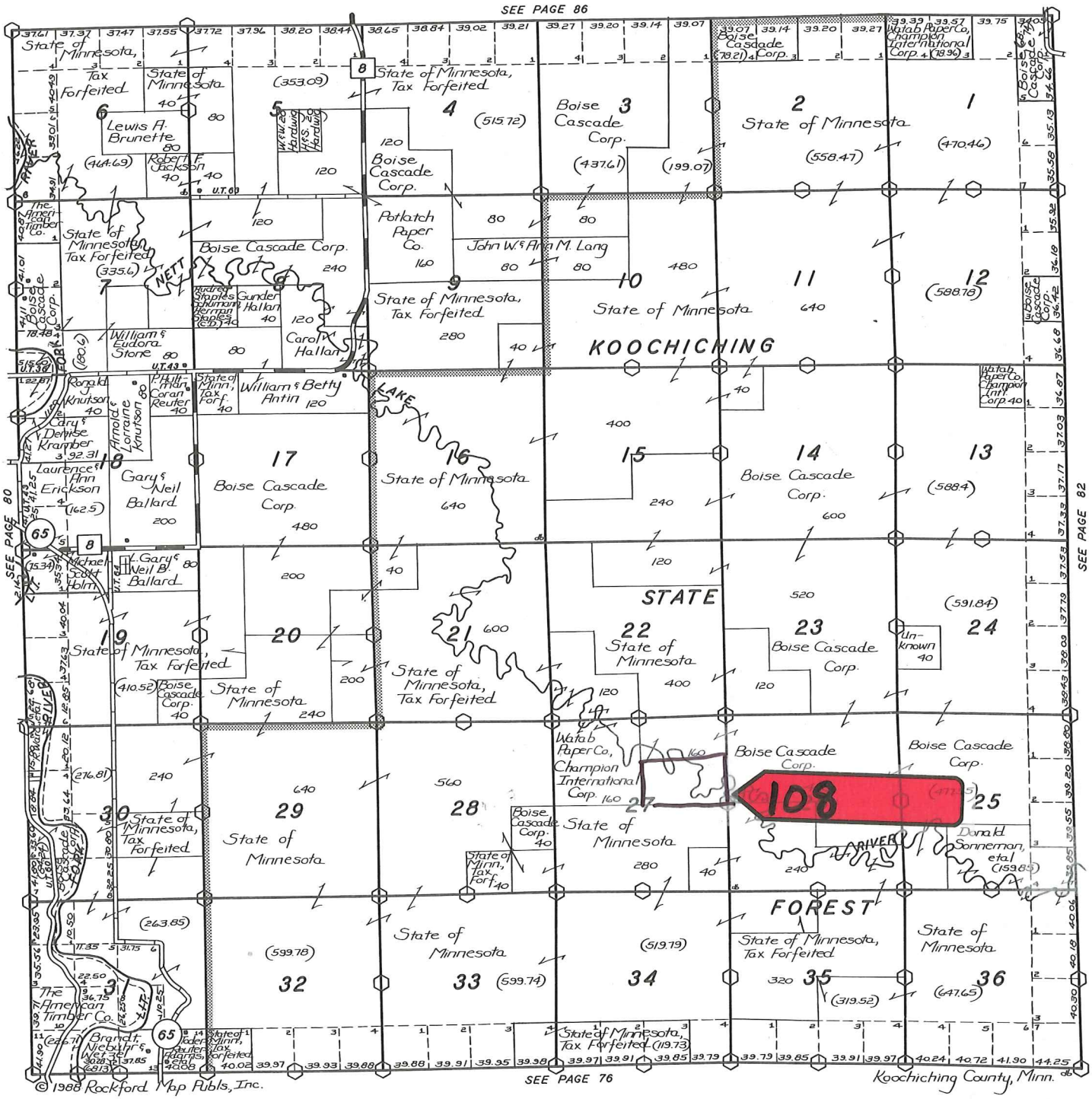
Senator BOB LESSARD
and
Representative BOB NEUENSCHWANDER


Bob Neuenschwander

T. 65 N.–R. 27-26 W.


SEE PAGE 79
SEE PAGE 33
SEE PAGE 75
SEE PAGE 26
SEE PAGE 69
SEE PAGE 63
KOOCHICHING
STATE
FOREST
RIVER
FORK
BIG
REILLY
CR.
256
State of Minnesota
State of Minnesota, Tax Forfeited
Boise Cascade Corp.
U.S.A.
Irene Donner
Homer Donner
Carl R. Larson
Marvin Anderson, et al
Stone Timber Co. Champion Int'l Corp. (C.D.)
Watab Paper Co. Champion Int'l Corp. (C.D.)
U.T. 261
U.T. 83
S.F.R. 174
R.27W. → ← R.26W.
Koochiching County, Minn.
©1988 Rockford Map Publs, Inc.

T.66N.–R.24W.



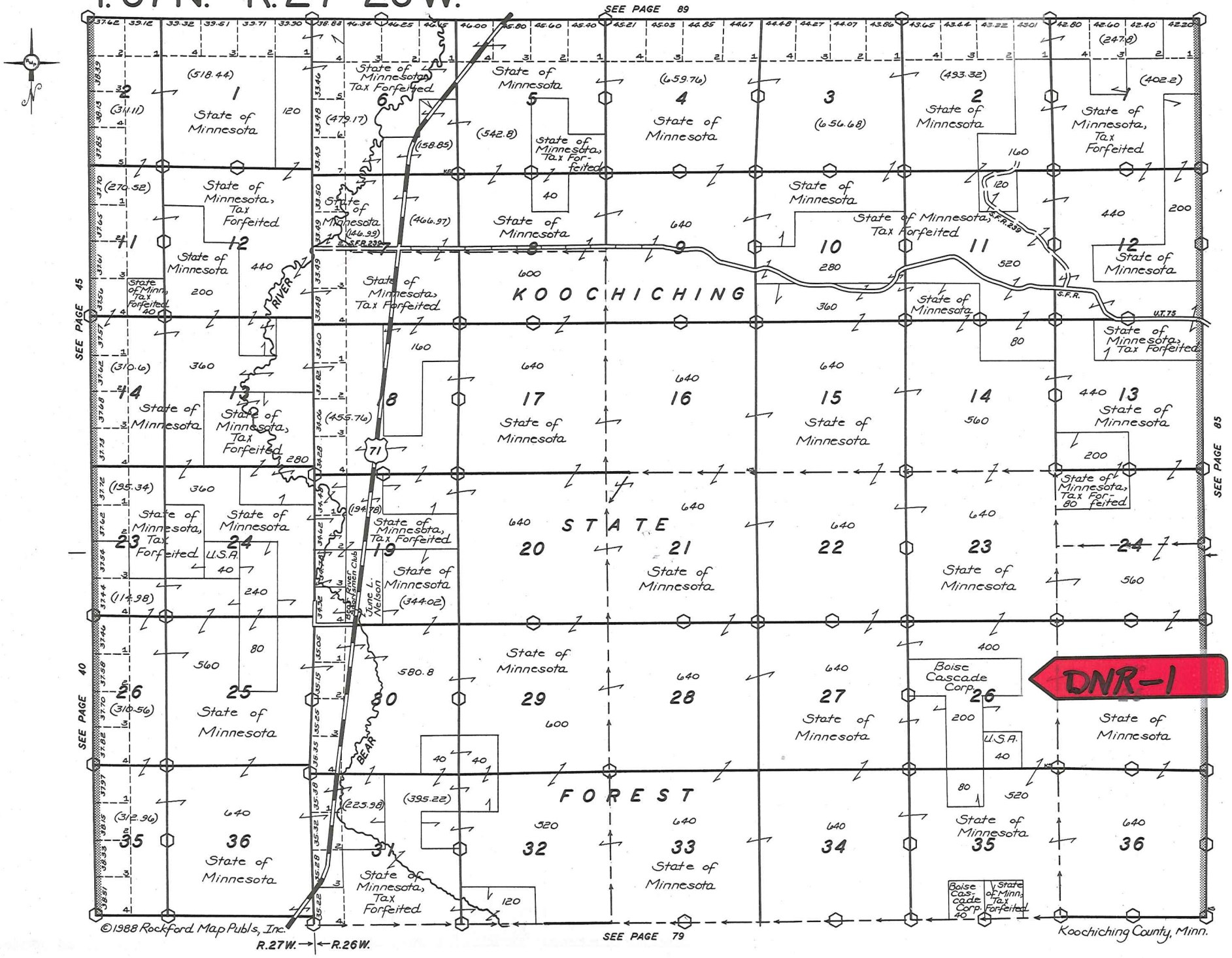
Riley's Sporting Goods Company

P.O. BOX 352
INTERNATIONAL FALLS, MINNESOTA 56649

TOM RILEY, OWNER

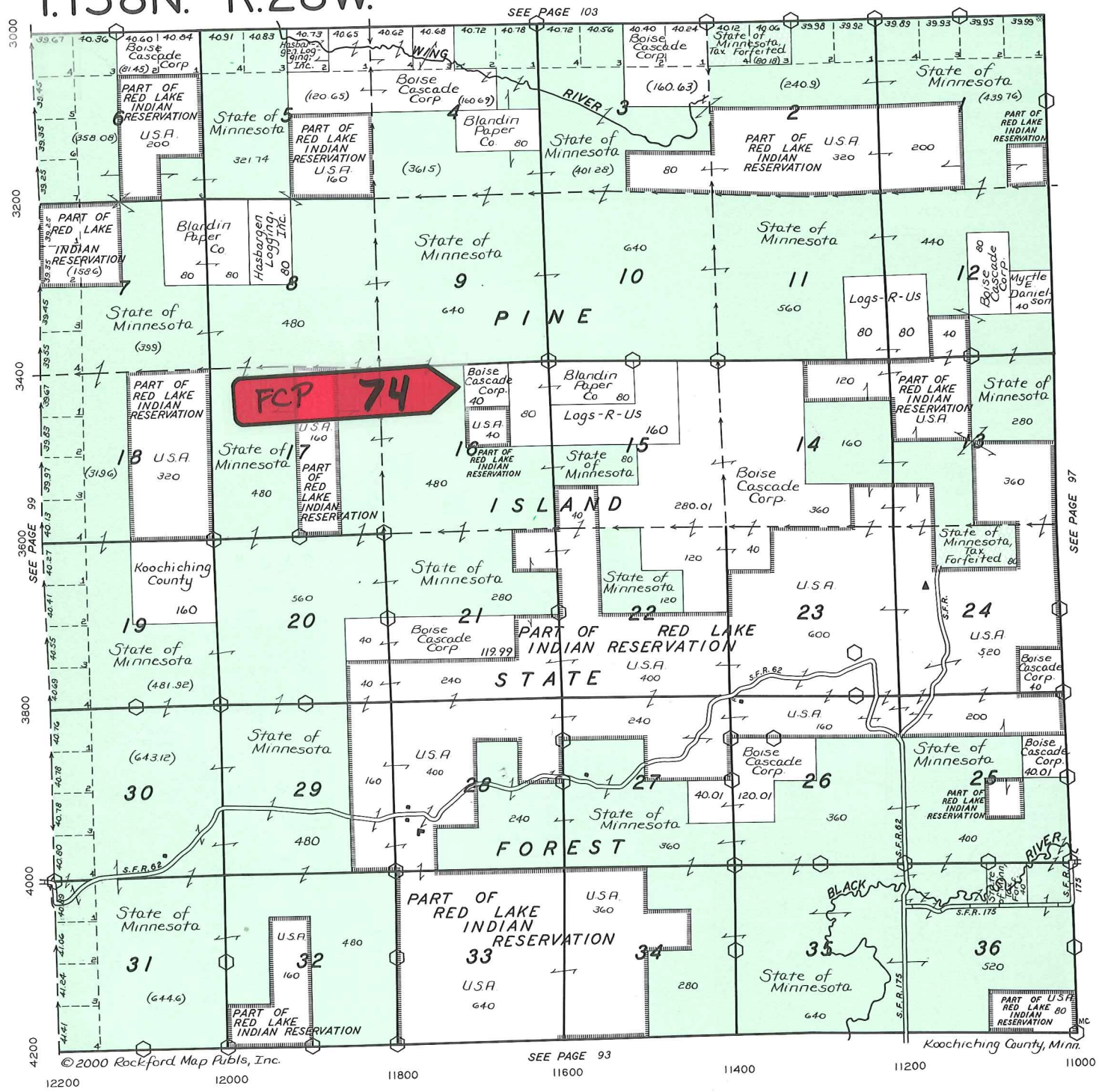
PHONE: 283-8479

T. 67 N. – R. 27-26 W.

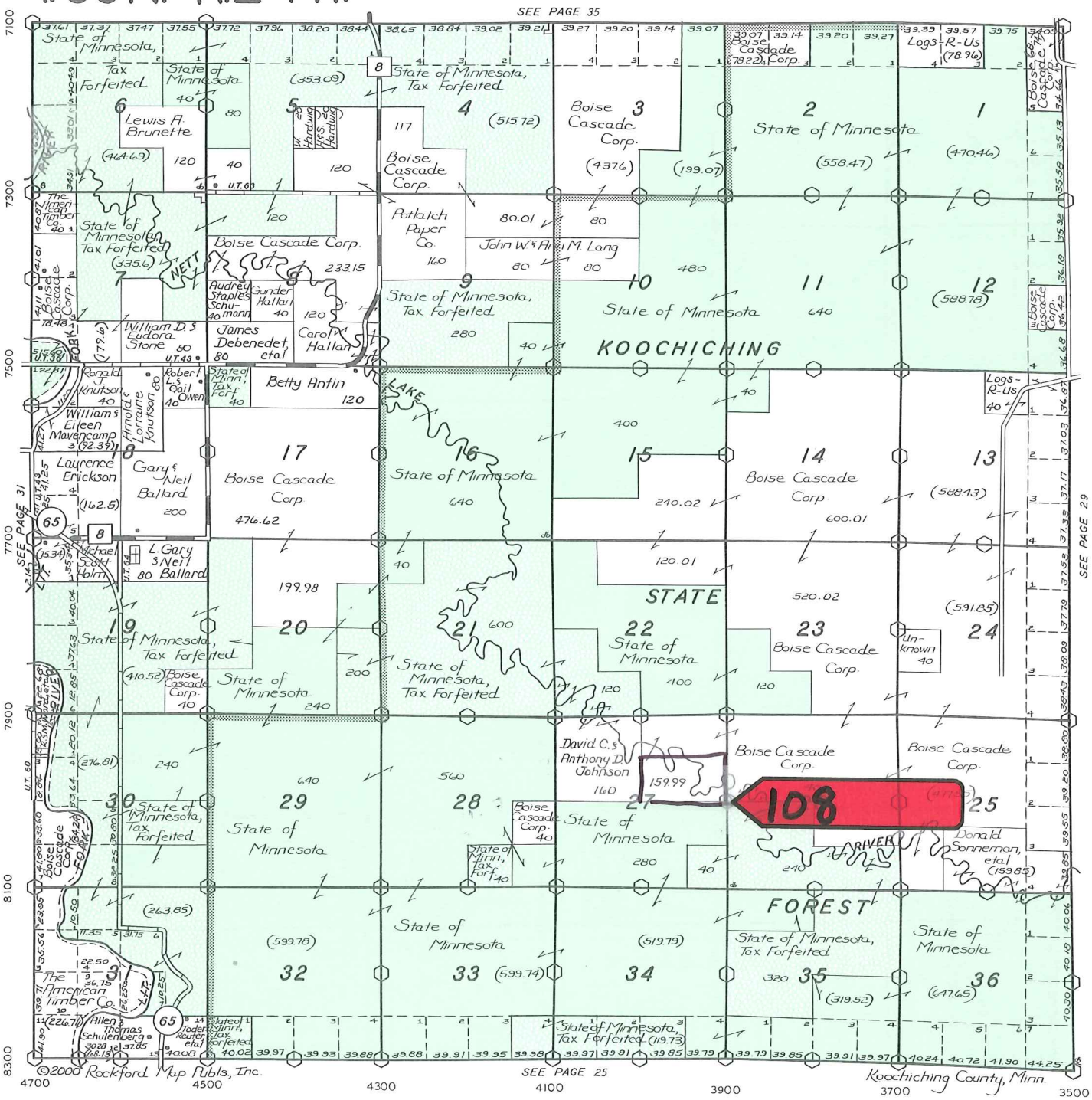


©1988 Rockford Map Publs, Inc.

T.158N.–R.28W.


SEE PAGE 103
SEE PAGE 99
SEE PAGE 97
SEE PAGE 93
WING RIVER
BLACK RIVER
PINE ISLAND STATE FOREST
PART OF RED LAKE INDIAN RESERVATION
State of Minnesota
Boise Cascade Corp
Blandin Paper Co
Hasbargen Logging Inc.
Logs-R-Us
Myrtle E Danielson
Koochiching County
State of Minnesota, Tax Forfeited
U.S.A.
S.F.R. 62
S.F.R. 175
FCP 74
Koochiching County, Minn.
© 2000 Rockford Map Publs, Inc.

T.66N.–R.24W.



When we enter this world, we're surrounded by love, comfort and care.
Don't we deserve the same when we leave?

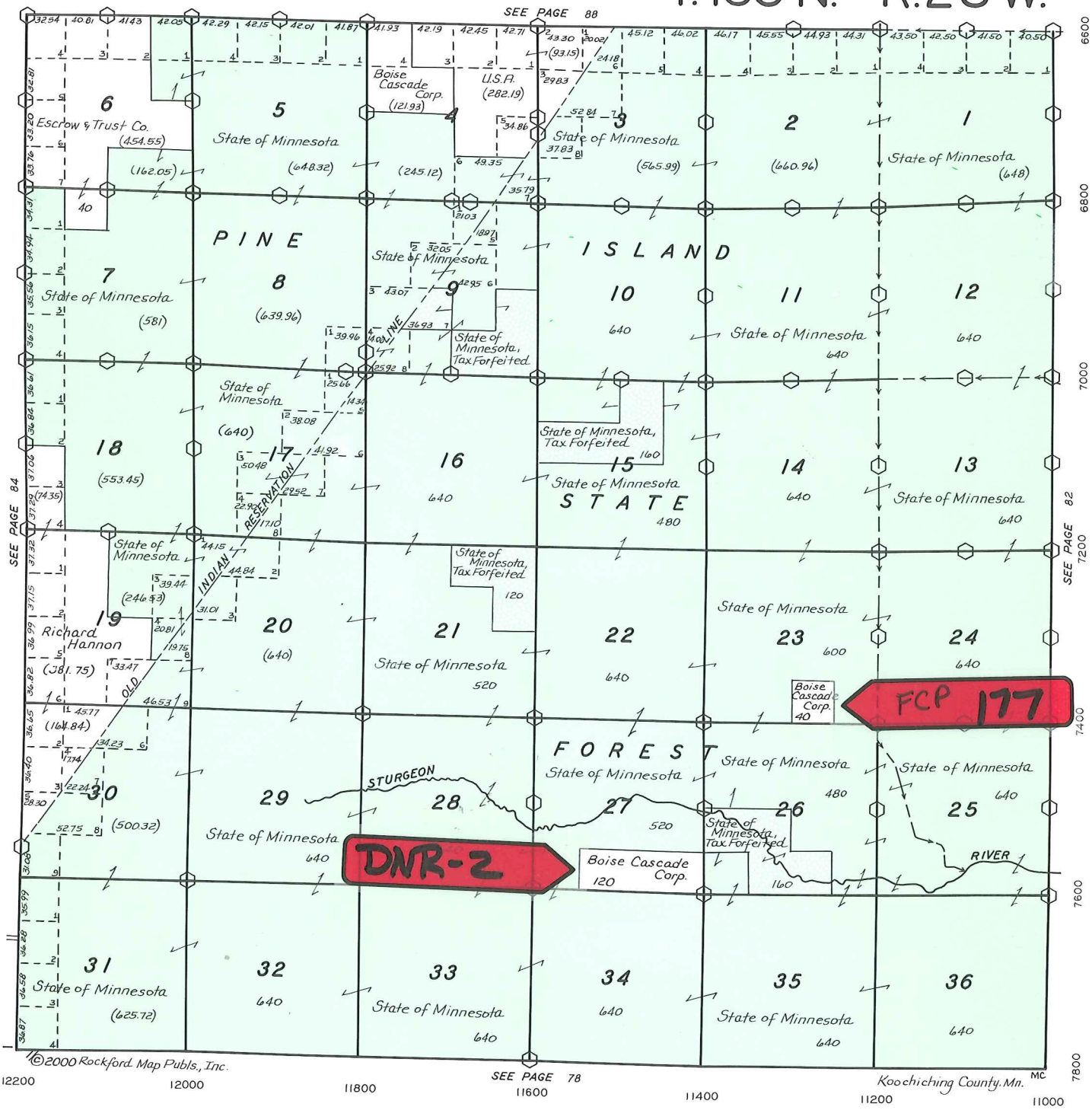
For help coping with a terminal illness call

KOOCHICHING HOSPICE, INC.

283-7058

A special kind of caring, a loving way of dying.

T. 155 N. – R. 28 W.



BERGSTROM WOOD PRODUCTS

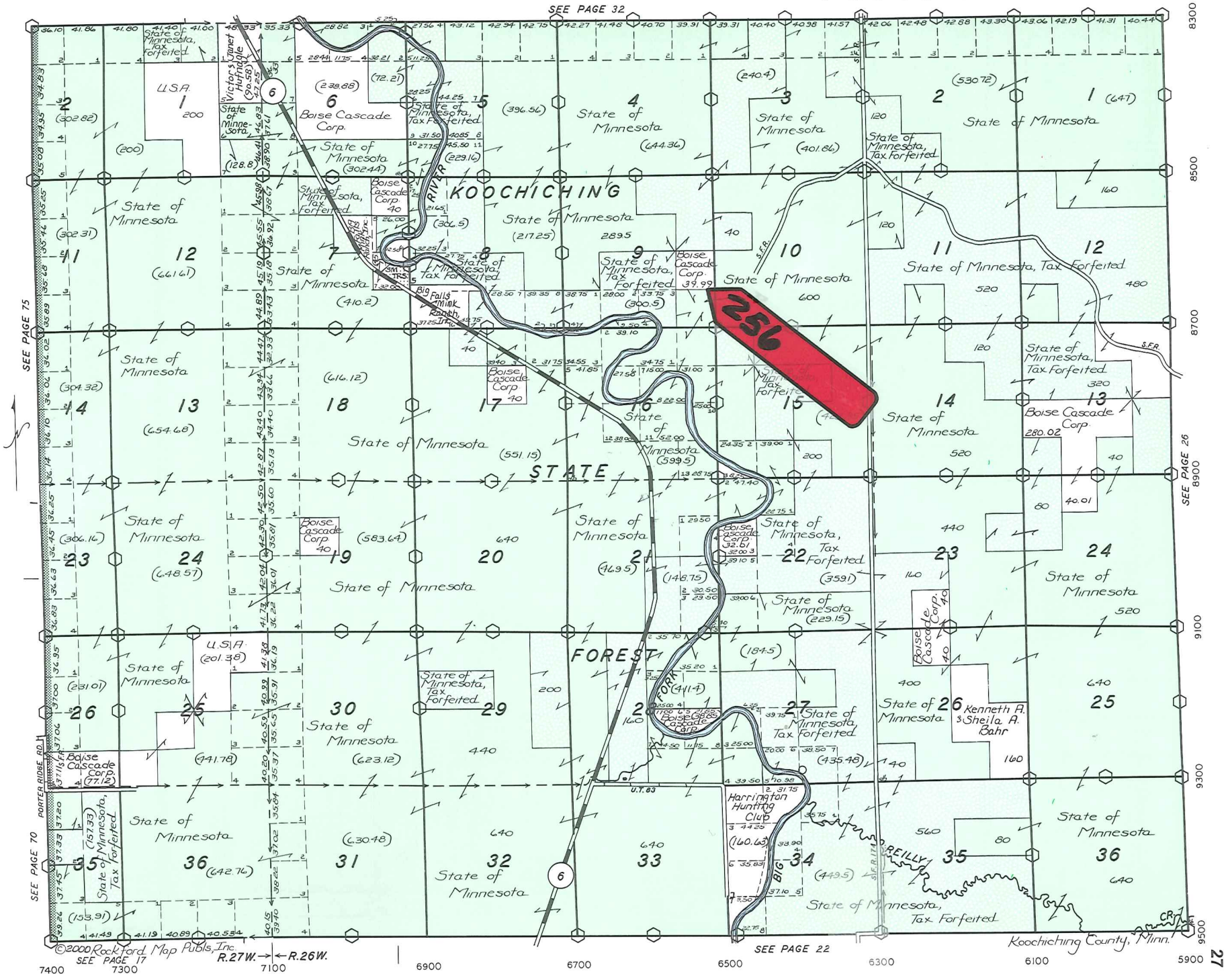
Manufacturers of Quality Pallets & Cut Stock

Buyers of Quality Aspen Tree Length

Plant Office: (218) 283-4557

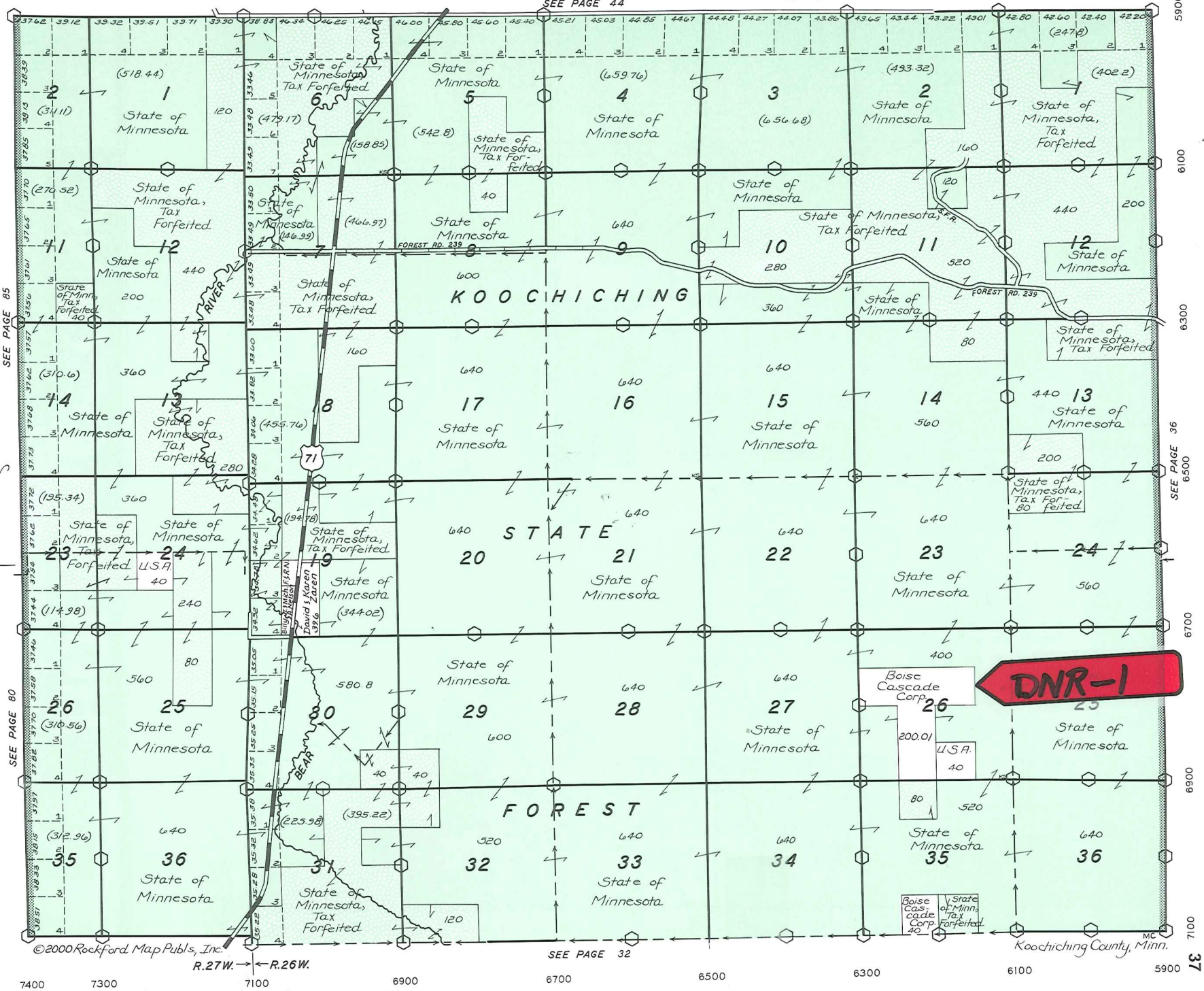
Main Office: (218) 283-4477 **Fax: (218) 283-8318**

T. 65 N.—R. 27-26 W.



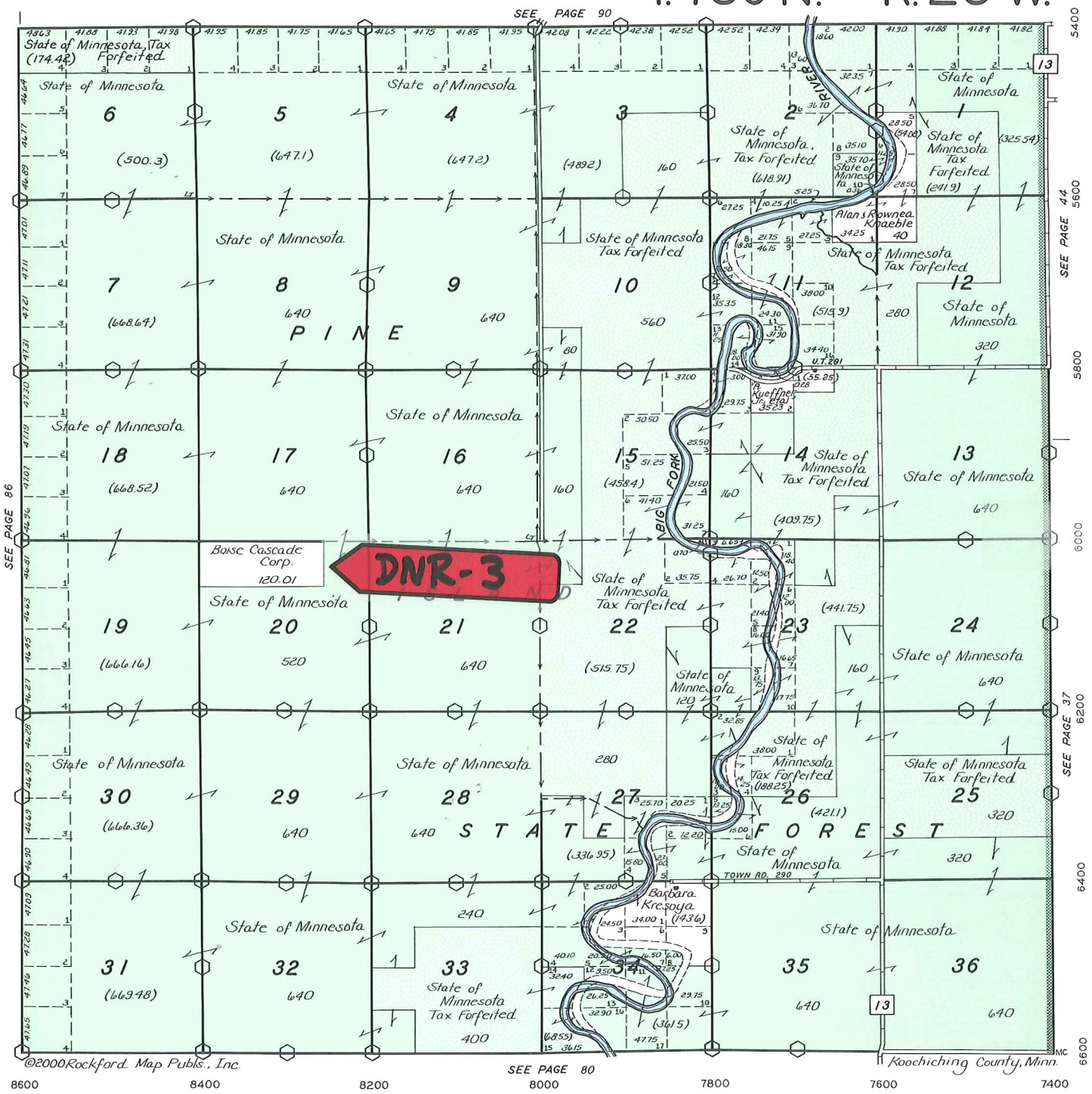
SEE PAGE 32
SEE PAGE 75
SEE PAGE 26
SEE PAGE 70
SEE PAGE 17
SEE PAGE 22
KOOCHICHING
STATE
FOREST
RIVER
FORK
BIG
REILLY
CR.
256
U.S.A.
State of Minnesota
State of Minnesota, Tax Forfeited
Boise Cascade Corp.
Victor & Janet Hufnagle
Big Falls Mink Ranch, Inc.
Harrington Hunting Club
Kenneth A. & Sheila A. Bahr
PORTER RIDGE RD.
U.T. 83
S.F.R.
Koochiching County, Minn.
R.27W. → ← R.26W.
©2000 Rockford Map Publs, Inc.
7400
7300
7100
6900
6700
6500
6300
6100
5900
8300
8500
8700
8900
9100
9300
9500

T. 67 N. – R. 27 – 26 W.

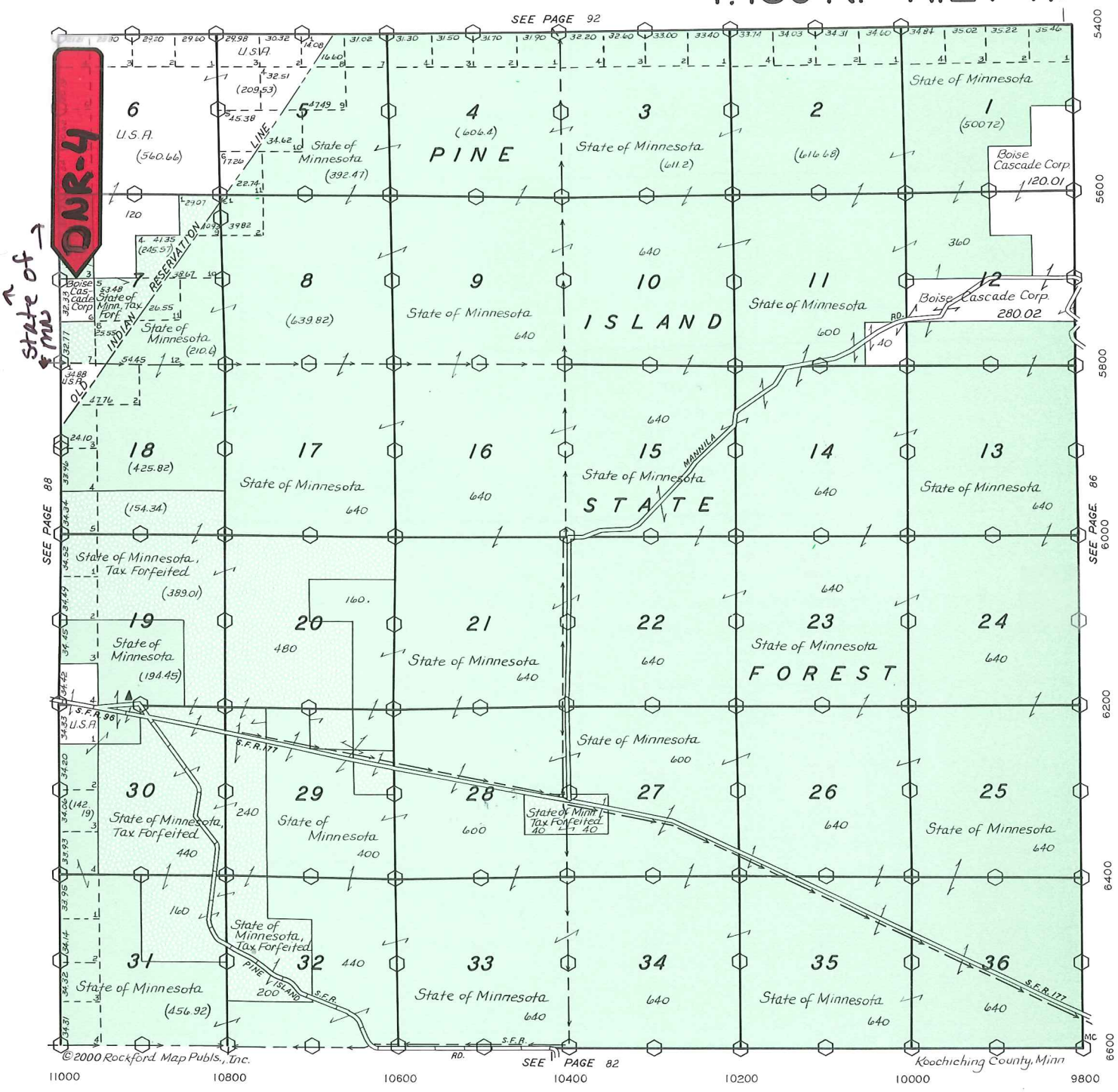


SEE PAGE 44
SEE PAGE 85
SEE PAGE 36
SEE PAGE 80
SEE PAGE 32
KOOCHICHING
STATE
FOREST
State of Minnesota
State of Minnesota, Tax Forfeited
Boise Cascade Corp.
U.S.A.
FOREST RD. 239
BEAR RIVER
71
David & Karen Zaren
Billy Jr. & Mich. F.S.R.N. Nelson
DNR-1
©2000 Rockford Map Publs, Inc.
R.27W. → ← R.26W.
Koochiching County, Minn.
MC
7400
7300
7100
6900
6700
6500
6300
6100
5900

T. 156 N. – R. 25 W.


SEE PAGE 90
SEE PAGE 86
SEE PAGE 44
SEE PAGE 37
SEE PAGE 80
State of Minnesota, Tax Forfeited (174.42)
State of Minnesota
State of Minnesota, Tax Forfeited (618.91)
State of Minnesota Tax Forfeited (241.9)
State of Minnesota Tax Forfeited
Alan & Rownea Knaeble
Kueffner Jr. etal
Boise Cascade Corp. 120.01
DNR-3
PINE
STATE FOREST
BIG FORK RIVER
Barbara Kresoya
TOWN RD. 290
U.T. 291
13
©2000 Rockford Map Publs., Inc.
Koochiching County, Minn.
8600
8400
8200
8000
7800
7600
7400
5400
5600
5800
6000
6200
6400
6600

T. 156 N. – R. 27 W.


SEE PAGE 92
SEE PAGE 88
SEE PAGE 86
SEE PAGE 82
DNR-4
State of Minn
PINE ISLAND STATE FOREST
INDIAN RESERVATION LINE
OLD
MANILA
PINE ISLAND
S.F.R. 177
S.F.R. 96
S.F.R.
RD.
State of Minnesota
State of Minnesota, Tax Forfeited
U.S.A.
Boise Cascade Corp.
Koochiching County, Minn.
© 2000 Rockford Map Publs., Inc.
11000
10800
10600
10400
10200
10000
9800
5400
5600
5800
6000
6200
6400
6600

2008 Project Abstract
For the Period Ending June 30, 2010

PROJECT TITLE: State Park and Trail Land Acquisition
PROJECT MANAGER: Larry Peterson (Parks) and Stan Linnell (Trails)
AFFILIATION: Department of Natural Resources, Division of Parks and Trails
MAILING ADDRESS: 500 Lafayette Road
CITY/STATE/ZIP: St. Paul, MN 55155
PHONE: Larry Peterson: 651-259-5593, Stan Linnell: 651-259-5626
E-MAIL: Larry.Peterson@state.mn.us and Stan.Linnell@state.mn.us
WEBSITE: www.dnr.state.mn.us
FUNDING SOURCE: Environment and Natural Resources Trust Fund
LEGAL CITATION: ML 2008, [Chap. 367], Sec.[2], Subd. 3h.

APPROPRIATION AMOUNT: $ 1,500,000

Overall Project Outcome and Results
The Trust Fund funding allowed for the following State Parks and State Trails land acquisition projects:

- Ownership of approximately 158 acres currently for sale adjacent to Monson Lake State Park. Adding this parcel will provide additional access to a high quality lake and is adjacent to state park ownership.
- Ownership of approximately 360 acres at George Crosby Manitou State Park. Acquisition of this parcel will provide protection to one of the largest and highest quality old-growth northern hardwood forest complexes in the Lake Superior Highlands.
- The DNR Parks and Trails Division made offers to acquire four parcels of land for the Mill Towns State Trail that were rejected by the landowners at the end of June 2010. An Amendment request to transfer the remaining funds to Result 5-acquisition of approximately 1.25 miles of Paul Bunyan State Trail was approved on August 17, 2010.
- The DNR Parks and Trails Division made offers to acquire one parcel in Maplewood State Park that was rejected by the landowner at the end of June 2010.
- Ownership of approximately 1.25 miles of the Paul Bunyan State Trail. The property acquired is comprised entirely of former industrial property and is located adjacent to the shoreline of Lake Bemidji. This acquisition is partially funded through LCCMR and provides for State ownership of a significant segment of the remaining authorized Paul Bunyan State Trail. The acquired trail segment is to be constructed during 2011. Additional funding through Capital Bonding (2005 and 2006) and 2009 LCCMR was also used for this project.

See attached map for locations.

All acquisitions are from willing sellers, within the statutory boundaries of state parks and for statutory authorized state trails as determined by the Commissioner.

Trust Fund 2008 Work Program Final Report

Date of Report: October 22, 2010
Date of Work program Approval: May 23, 2008
Date of Work program Amendment Approvals: July 6, 2009 and August 17, 2010

I. PROJECT TITLE: State Parks and Trails Land Acquisition

Project Managers: Larry Peterson (Parks) and Stan Linnell (Trails)
Affiliation: Department of Natural Resources, Division of Parks and Trails
Mailing Address: 500 Lafayette Road
City / State / Zip: St. Paul, MN 55155
Telephone Number: Larry Peterson: 651-259-5593, Stan Linnell: 651-259-5626
E-mail Address: larry.Peterson@state.mn.us and stan.linnell@state.mn.us
FAX Number: 651-296-6532
Web Page address: www.dnr.state.mn.us

Location: Acquisitions include, but not limited to 1) Monson Lake State Park in Swift County, 2) George Crosby Manitou State Park in Lake County, 3) Mill Towns State Trail in Goodhue County**,** 4) Maplewood State Park in Ottertail County, 5) Paul Bunyan State Trail in Beltrami County

Total Trust Fund Project Budget:	**Trust Fund Appropriation:**	**$ 1,500,000**
	Minus Amount Spent:	**$ 1,500,000**
	Equal Balance:	**$ -0-**

Legal Citation: ML 2008, [Chap. 367], Sec.[2], Subd. 3h.

Appropriation Language: State Park and Trail Land Acquisition
$1,500,000 is from the trust fund to the commissioner of natural resources to acquire land for designated state trail alignments and in-holdings for state parks. Land acquired with this appropriation must be sufficiently improved to meet at least minimum management standards as determined by the commissioner of natural resources. A list of proposed acquisitions must be provided as part of the required work program.

II. FINAL PROJECT SUMMARY AND RESULTS: Trust Fund funding allowed for the following:

- Ownership of approximately 158 acres in Monson Lake State Park. The addition of this parcel provides 44 acres of upland and 114 acres of water with 10,200 feet of shoreline along West Sundberg Lake. The lake has high quality with good fishing and high number of migratory waterfowl.

- Ownership of approximately 360 acres at George Crosby Manitou State Park. Acquisition of this parcel provides protection to one of the largest and highest quality old-growth northern hardwood forest complexes in the Lake Superior Highlands.

- The DNR Parks and Trails Division made offers to acquire four parcels of land for the Mill Towns State Trail. The offers were rejected by the landowners at the end of June 2010. The amendment request to transfer the remaining funds to Result 5-acquisition of approximately 1.25 miles of Paul Bunyan State Trail was approved on August 17, 2010.

- The DNR Parks and Trails Division made an offer to acquire one parcel in Maplewood State Park. The offer was rejected by the landowner at the end of June 2010. The amendment request to transfer the remaining funds to Result 5-acquisition of approximately 1.25 miles of Paul Bunyan State Trail was approved on August 17, 2010.

- Ownership of approximately 1.25 miles of the Paul Bunyan State Trail. The property acquired is comprised entirely of former industrial property, located adjacent to the shoreline of Lake Bemidji. This acquisition is a necessary connection to the Paul Bunyan State Trailhead on the southeastern corner of Lake Bemidji. This acquisition was a partially funded acquisition. Additional funding sources included Capital Bonding (2005 and 2006) and 2009 LCCMR were also used for this project. See Result 5 for a detailed description.

  See attached map for locations.

All acquisitions are from willing sellers, and located within the statutory boundaries of state parks and for statutory authorized state trails. Other critical parcels may be pursued as determined by the Commissioner.

III. FINAL REPORT SUMMARY:

In September 2008, an appraisal for Monson Lake SPK project was anticipated to be completed with an offer in November. The appraisal for George Crosby Manitou State Park was also completed in September. A Coastal Zone Management Grant to contribute to the acquisition cost of George Crosby Manitou State Park was applied for this project. The Mill Towns State Trail acquisition was initiated at this time.

By June 2009, the acquisitions at Monson Lake State Park and George Crosby Manitou State Park were completed. The Coastal Zone Management Grant proposal for this project was not approved, but RIM match funds were utilized since this transaction was a partial donation. The four property owners for the Mill Towns State Trail project were contacted. All parties agreed to the proposed trail alignment and appraisals were initiated.

Since the George Crosby Manitou State Park acquisition project was completed under budget and within the first year of funding appropriation, an Amendment request to transfer funds to acquire another property was submitted to LCCMR for approval. The proposal requested to transfer available funds towards acquiring a key parcel within Maplewood State Park. This island property is surrounded by undeveloped State Park lakeshore on Beers Lake. The Amendment was approved on July 6, 2009.

In December 2009, the four Mill Towns State Trail parcels were still in the acquisition process with the Division of Lands and Minerals. The Maplewood State Park parcel was also in the acquisition process with the Division of Lands and Minerals. The appraisals were anticipated to be completed by March 2010.

At the end of June 21010, the DNR Parks and Trails Division's offers to acquire four parcels of land for the Mill Towns State Trail and one parcel in Maplewood State Park were rejected by the landowners at the end of the month.

In August 2010, the DNR Parks and Trails Division requested a work plan amendment to transfer available funds from the not acquired parcels for the Mill Towns State Trail and Maplewood State Park to the Paul Bunyan State Trail along the South Shore of Lake Bemidji.

The amendment request to transfer the remaining funds from Result 3-Mill Towns State Trail and Result 4-Maplewood State Park to Result 5-acquisition of approximately 1.25 miles of Paul Bunyan State Trail was approved on August 17, 2010.

IV. OUTLINE OF PROJECT RESULTS*:*

Result 1: Ownership of approximately 158 acres within the statutory boundary of Monson Lake State Park.

Description: The Department of Natural Resources, Division of Parks and Recreation will appraise, negotiate and acquire this parcel. This 158-acre parcel contains 44 acres upland & 114 acres water with 10,200 ff along West Sundberg Lake. The lake is high quality with good fishing and high number of migratory waterfowl. The parcel is adjacent to existing state park ownership. This parcel was added to the statutory boundary in 2008. An additional $100,000 was needed to complete this transaction. Transfer of $100,000 was made from Result 2.

Summary Budget Information for Result 1:

Trust Fund Budget:	$400,000
Amount Spent:	$400,000
Balance:	$ -0-

Deliverable	Completion Date	Budget	Status
1. 158 Acres Acquired	June 30, 2010	$400,000	Acquired

Final Report Summary:
This acquisition was completed on June 17, 2009.

The appraisal for this acquisition was due in due October 2008. The appraised value came in higher than expected. in June 2009, $100,000 was transferred to this project from Result 2-George Crosby Manitou State Park**.** This property was acquired on June 17, 2009 and all funds have been spent.

Result 2: Ownership of approximately 360 acres within the statutory boundary of George Crosby Manitou State Park

Description: Acquisition of this parcel will provide protection to one of the largest and highest quality old-growth northern hardwood forest complexes in the Lake Superior Highlands.

Summary Budget Information for Result 2:

Trust Fund Budget:	$ 303,000
Amount Spent:	$ 303,000
Balance:	$ -0-

Deliverable	Completion Date	Budget	Status
1. 360 acres acquired	June 4, 2009	$303,000	Acquired

Final Report Summary:
This acquisition was completed on June 4, 2009.

In September 2008, a Coastal Zone Management (CZM) Grant request was submitted to for consideration to contribute towards the funding of this parcel. The appraisal was completed in early June 2009. The CZM Grant was denied. However, the DNR was able to utilized $50,000 in RIM match funds due to $50,000 donation given by the landowners. Funds in the amount of $100,000 were allocated from this project was transferred to the Result 1-Monson Lake State Park acquisition. In addition, since this acquisition project was completed under budget and within the first year of funding appropriation, an Amendment request to transfer $47,000 to Result 4- Maplewood State Park island acquisition was approved by LCCMR on July 6, 2009.

This property was acquired on June 4, 2009 and all funds have been spent.

Result 3: Ownership of approximately 0.75 miles along the authorized Mill Towns State Trail corridor.

Description: The trail corridor traverses four separate, privately owned parcels, ranging from undeveloped floodplain to steep, wooded bluffs. All current property owners were previously contacted and willing to consider purchase offers for the proposed trail corridor. These acquisitions would form the western terminus of the Mill Towns State Trail and would provide an immediate link upon development of the existing local Cannon Falls City Trail system and the Cannon Valley Trail to Lake Byllesby County Park.

Summary Budget Information for Result 3:

Trust Fund Budget:	$ 15,720
Amount Spent:	$ 15,720
Balance:	$ -0-

Deliverable	**Completion Date**	**Budget**	**Status**
1. 0.75 Miles Acquired	June 30, 2010	$15,750	Not Acquired

Final Report Summary:
This acquisition was not completed.

In September 2008, landowners were contacted and discussions occurred about proposed trail corridor alignments. In June 2009, DNR and landowners agreed upon trail alignment and appraisals to be initiated**.** In December 2009, DNR processed the acquisition with the appraisals anticipated in March 2010. In June 2010, DNR made offers to the four landowners. Each landowner declined the offer.

The DNR Parks and Trails Division offers to acquire four parcels of land for the Mill Towns State Trail were rejected by the landowners at the end of June 2010. An Amendment request was submitted to transfer the remaining funds from this acquisition to Result 5-acquisition of approximately 1.25 miles of Paul Bunyan State Trail. The amendment request was approved on August 17, 2010.

Result 4: Ownership of a 2 acres island within Maplewood State Park.

Description: This island property is surrounded by undeveloped State Park lakeshore on Beers Lake. The island could be used as a remote campsite or restored to a natural state. The island is also in view from the new camper cabin cluster development. Acquisition would protect this site from future development. Partial funding for this acquisition is being proposed from Result 2. The remaining funds (approximately $100,000) will come from RIM and/or Capital Bonding funds.

Summary Budget Information for Result 4:

Trust Fund Budget:	$ 1,166
Amount Spent:	$ 1,166
Balance:	$ -0-

Deliverable	**Completion Date**	**Budget**	**Status**
1.Two acres acquired	June 30, 2010	$ 1,166	Not Acquired

Final Report Summary:
This acquisition was not completed.

This acquisition began in July 2009 after the Amendment was approved to transfer available from Results 2-George Crosby Manitou State Park. In December 2009, an appraisal assignment was anticipated within the next couple of months. In June 2010, the DNR made an offer to the landowner. The landowner declined the offer. In August 2010, since the DNR Parks and Trails Division's offer was rejected by the landowner, and an Amendment request was made to transfer the remaining funds to Result 5-acquisition of approximately 1.25 miles of Paul Bunyan State Trail was approved by LCCMR on August 17, 2010.

Result 5: Acquire approximately 1.25 miles of the Paul Bunyan State Trail.

Description: The DNR proposes to acquire a single narrow linear parcel located along the southeastern shoreline of Lake Bemidji, and which containing 13.5 acres extending over approximately 1.25 miles. The property to be acquired is comprised entirely of former industrial property, located adjacent to the shoreline of Lake Bemidji. This proposed acquisition will partially fund the trail segment necessary to connect the existing Paul Bunyan Trailhead. The total acquisition cost was $2,300,000. Additional funding through Capital Bonding (2005 and 2006), and 2009 LCCMR has also been used for this acquisition project.

Summary Budget Information for Result 5:	Trust Fund Budget:	$780,114
	Amount Spent:	$780,114
	Balance:	$ -0-

Deliverable	**Completion Date**	**Budget**	**Status**
1. A portion of approx. 1.25 Miles	June 30, 2010	$780,114	Acquired

Final Report Summary:
This acquisition was completed on January 7, 2010.

During the week of August 9, 2010, the DNR Parks and Trails Division staff discussed available options with LCCMR staff regarding the balance of funds from rejected acquisition offers in Results 3-Mill Towns State Trail and Result 4-Maplewood State Park. As a result of the discussions, the DNR Parks and Trails Division requested a retroactive amendment to transfer the funds from Result 3 and 4 to Result 5-acquisition of 1.25 miles of Paul Bunyan State Trail. The approximately 1.25 miles of the Paul Bunyan State Trail acquisition transaction closed on January 7, 2010. The total acquisition cost was $2,300,000. Additional funding through Capital Bonding (2005 and 2006), and 2009 LCCMR was used for this acquisition project.

LCCMR approved a retroactive amendment to the DNR 2008 work program dated August 13, 2010 for the appropriation ending June 30, 2010. LCCMR was able to approve this change because Paul Bunyan State Trail acquisition has been funded in the past by the Trust Fund and is on the approved work program list for the 2009 Trust Fund appropriation. The 2008 Trust Fund appropriation language did not state specific parks or trails for expenditure but is governed by the DNR priorities and the list of proposed acquisitions in the work program. There were no other new state park or trail acquisitions for which there was a binding contract completed before June 30, 2010 – the deadline for expenditure of the Trust Fund appropriation. Bonding dollars replaced by the Trust Fund will be used for continued development of the Paul Bunyan State Trail ensuring that the Trust Fund is accelerating the funding for the completion of this trail.

In the future, LCCMR staff requested that the acquisition processing take place in a timely manner. LCCMR staff acknowledged that the landowners rejected DNR's offers; however, because declined offers did not take place until the end of June 2010 there were very few options for consideration of alternatives for strategic expenditure. LCCMR staff expressed interest to work with DNR staff on the current appropriations to be more fully informed of the timeline for processing the proposed acquisitions and any need for amendments to the work program. The work program change was approved retroactively as an exception to the process to ensure that the $780,000 appropriated for state park and trail acquisition from the Trust Fund is expended as intended by the legislature.

V. TOTAL TRUST FUND PROJECT BUDGET:

Staff or Contract Services: Appraisal Services and Professional Services from DNR, Division of Lands and Minerals and the Attorney General's Office
Equipment: None
Development: $ -0-
Restoration: $ -0-
Acquisition, including easements: 558 Acres & 1.25 Miles

TOTAL TRUST FUND PROJECT BUDGET: $1,500,000

Explanation of Capital Expenditures Greater Than $3,500:

VI. OTHER FUNDS & PARTNERS:

A. **Project Partners**: Local state park support groups and the Parks and Trails Council of Minnesota. Project partners will only receive market value of project sites in their ownership. Project partner may receive up to $1,500 reimbursement for appraisal costs.
B. Other Funds Proposed to be Spent during the Project Period: Bonding 2006 and 2008 funds; RIM Match funds when appropriate.

C. Past Spending:

Land Acquisition for the Division of Parks and Trails

M.L. 2007 $ 750,000
M.L. 2005 $2,100,000
M.L. 2003 $1,500,000
M.L. 2001 $1,726,000

Land Acquisition for the Division of Trails and Waterways (State Trails)
State Trail property acquisition efforts have been supported by legislative appropriations through Capital Bonding, Dedicated User Accounts, the General Fund, the Legislative Commission of Minnesota Resources and Federal appropriations through the Federal Highway Administration.

D. Time: To Acquire by June 2010

VII. DISSEMINATION: No projected news releases at this time

VIII. REPORTING REQUIREMENTS:
Periodic work program progress reports will be submitted not later than September 30, 2008, June 30, 2009, December 31, 2009 and June 30, 2010. A final work program report and associated products will be submitted between June 30 and August 30, 2010 as requested by the LCCMR.

IX. RESEARCH PROJECTS: NA

SEE ATTACHMENT A - LCMR 2008 Budget Detail

Attachment A: Budget Detail for 2008 Projects - Summary and a Budget page for each partner (if applicable)

Project Title: State Park and Trail Land Acquisition

Project Manager Name: Larry Peterson and Stan Linnell

Trust Fund Appropriation: $1,500,000
10/22/2010

2008 Trust Fund Budget	**Result 1 Budget:**	**Amount Spent** *(date)*	**Balance** *(date)*	**Result 2 Budget:**	**Amount Spent** *(date)*	**Balance** *(date)*	**Result 3 Budget:**	**Amount Spent** *(date)*	**Balance** *(date)*	**Result 4 Budget:**	**Amount Spent** *(date)*	**Balance** *(date)*	**Result 5 Budget:**	**Amount Spent** *(date)*	**Balance** *(date)*	**TOTAL BUDGET**	**TOTAL BALANCE**
	Ownership of 158 acres adjacent to Monson Lake State			Ownerhsip of 360 acres within George Crosby Manitou State Park		*8/26/2010*	Professional Services Costs for Mill Towns State Trail		*8/26/2010*	Professional Services Costs for Maplewood State Park		*8/26/2010*	Ownership of 1.25 miles of Paul Bunyan State Trail		*8/26/2010*		
BUDGET ITEM	400,000.00			303,000.00			15,720.00			1,166.00			780,114.00				
Land acquisition	395,000.00	395,000.00	0	296,000.00	296,000.00	0	0.00	0.00	0.00	0.00	0.00	0.00	780,114.00	780,114.00	0.00	1,471,114.00	0.00
Professional Services for Acq. such as Appraisal, Survey, Title Work and Professional Services	5,000.00	5,000.00	0	7,000.00	7,000.00	0	15,720.00	15,720.00	0.00	1,166.00	1,166.00	0.00	0.00	0.00	0.00	28,886.00	0.00
COLUMN TOTAL	**$400,000**	**$400,000**	**$0**	**$303,000**	**$303,000**	**$0**	**$15,720**	**$15,720**	**$0**	**$1,166**	**$1,166**	**$0**	**$780,114**	**$780,114**	**$0**	**1,500,000.00**	**0.00**

Trust Fund 2008 Work Program Final Report Addendum

As part of the Minnesota Department of Natural Resources Strategic Conservation Agenda, the Parks and Trails Division plans to continue to protect unique natural and cultural features (often identified by the Minnesota County Biological Survey or archeological survey) within the state park system, acquire key parcels that will buffer the park from development, and continue to assess the needs of each park through the Division's long term management plans. These plans identify the resource, recreation or management needs that may require changing the statutory boundary of our state parks and recreation areas.

The State Trail land acquisition efforts will help ensure that the resource objectives of the DNR's *Strategic Conservation Agenda 2003-2007: Measuring Progress Toward Mission / 2007 Update* are met. The 2007 Strategic Conservation Agenda Update identifies a target for state trails to: "Acquire 130 new state trail miles by the end of FY 2009".

STATE PARKS

Background:
The State Parks acquisition goals, as established by the 2000 MN State Park System Land Study, is to provide for a state park system which will preserve appropriate representations of Minnesota's landscape regions and meet future demands for state park resources, environmental education and recreational opportunities.

Decisions on which lands should be part of our state park system are based on our statutory obligations and Division's "vision to create unforgettable park, trail and water recreation experiences that inspire people to pass along the love for the outdoors to current and future generations."

Minnesota Statutes Chapter 86A.05, Subd.2(a) states "a state park shall be established to protect and perpetuate extensive areas of the state possessing those resources which illustrate and exemplify Minnesota's natural phenomena and to provide for the use, enjoyment, and understanding of such resource without impairment for the enjoyment and recreation of future generations".

The statute continues in setting out three criteria that a site must "substantially satisfy" to be authorized as a state park:

1. Exemplifies the natural characteristics of the major landscape regions of the state, as shown by accepted classifications, in an essentially unspoiled or restored condition or in a condition that will permit restoration in the foreseeable futures; or contains essentially unspoiled natural resources of sufficient extent and importance to meaningfully contributes to the broad illustration of the state's natural phenomena; and
2. Contains natural resources, sufficiently diverse and interesting to attract people from throughout the state; and
3. Is sufficiently large to permit protection of the plant and animal life and other natural resources which give the park its qualities and provide for a broad range of opportunities for human enjoyment of these qualities (Chap. 86A.05, Subd. 2(b)).

The statute also sets out three criteria for State Recreation Areas (SRA), but with greater emphasis on recreation opportunities:

1. Contains natural or artificial resources which provide outstanding outdoor recreational opportunities that will attract visitors from beyond the local area; and

2. Contains resources which permit intensive recreational use by large numbers of people;
   and
3. May be located in areas which have serious deficiencies in public outdoor recreation facilities, provided that state recreation areas should not be provided in lieu of municipal, county, or regional facilities.

There are several tools we use in helping us identify and prioritize lands to become part of our state park system. One tool is utilizing the *MN State Park System Land Study* which was completed in 2000. This study evaluated our existing system and identified gaps in our resource protection and recreation provision roles. The information in this study offers direction for our acquisition efforts.

Another tool is the state park and state recreation management plan. These plans are required under MN Statute 86A.09. Land acquisition priority areas are identified within the long-term management plans under the discussion of proposed boundary expansions. The plans look strategically at park boundary issues and what other parcels would contribute for resource protection and recreation. Through the planning process, we consult with various resources such as the Minnesota County Biological Survey, land cover and exotics mapping information, as well as discussions with other DNR professionals in helping us identify lands for inclusion in the state park or SRA. We also present our boundary change proposals to members of the local community, city, township and county government through the appropriate board meetings.

The proposed boundary changes are brought forward through the management plan or other processes for Division and Department consideration. Boundary adjustments supported by the Department are taken to the Minnesota State Legislature for approval. These boundary changes help guide our long-term acquisition goals.

Prioritization Process:

State Parks maintains a priority list for future acquisitions. The list evolves as new parcels are added to the statutory boundary of a park or the status of a parcel changes when more information is evaluated. A two- filter evaluation process helps us prioritize parcels on this list.

Each state park manager assigns a priority ranking for the private parcels within the statutory boundary of that park. The regional park managers review these rankings before submitting the priority report to the Development and Real Estate Section of the Division of Parks and Recreation. This first filter priority ranking helps us decide if a greater assessment is needed.

The ranking is divided into four levels of priority, A through D. An A-ranking includes lands considered highest importance to mission and management of the state park (such as high resource or recreational potential). A B-ranking includes lands that have less impact on the park, if not acquired (for example: less immediate threat of development). A C-ranking includes lands with no immediate impact on the park (for example: lower existing resource quality). A D-ranking includes lands proposed for deletion from the statutory boundary (for example: significant development has since occurred on the site).

The park managers usually develop and maintain contact with the landowners within the statutory boundary (the manager lives in the same community with most of these landowners). We work with the park manager to find out if a landowner is ready to hear an offer. In other cases, the landowner contacts the park manager stating they are interested in selling their property.

When developing funding proposals, we look at the priority rankings noted above. We discuss which parcels would be likely candidates for proposals and request the Park Managers submit Acquisition Proposal Forms.

This second filter evaluation looks in greater detail at a wide range of factors that determine the importance for acquiring the parcel. These factors include, but are not limited to the following: rare geological feature, quality or quantity of natural or cultural resource present, historic buildings or cultural sites, riparian protection, high restoration potential, view shed preservation, threat due to development or timber harvesting, buffer potential, provide link to other recreation opportunities (trail connection), develop new recreational facility (improved trail system), expand a facility, better access to park or facilities, eliminating fragmented parcels for better management, urgency to acquire due to landowner's needs, resolve visitor safety concerns, funding leverage with potential partnerships and bargain sale opportunity.

The Division's Regional Manager will advise the Regional Management Team and Regional Director of the Division's proposal. The Division Director and Real Estate Manager are also involved in the discussing all acquisition funding proposals. During a funding cycle, the funding proposal list may be revised due to failed negotiations or another priority parcel may be identified.

When another parcel is identified for acquisition, the Park Manager discusses the priority ranking with the Regional Manager and/or the Real Estate Program Coordinator. If they determine the site requires greater evaluation, the park manager is asked to fill out the Acquisition Proposal Form.

The Regional Park Manager, Manager of Development and Real Estate Manager, and Real Estate Program Coordinator evaluate these factors and descriptions on the acquisition proposal form. They discuss what other priority acquisitions are available, and the current funding status, and then decide whether to present the new parcel to the Division Director.

The Division Director determines if we proceed with the acquisition. Depending on the funding availability and/or urgency of the acquisition, we pursue the acquisition with current funds or the parcel is place on our priority list for future acquisitions as funding is available.

If the site is very critical to our state park system and our current funds are committed to other projects, if it is urgent to acquire a site immediately, or the acquisition has specific challenges, we may work with outside organizations such as the Parks and Trails Council of Minnesota. The Parks and Trails Council of Minnesota assist us by acquiring these critical parcels and hold them until we are able to pursue the acquisition. If we need assistance from an outside organization or if there are other unusual circumstances surrounding a particular acquisition proposal, the Division Director reviews the proposal with the Commissioner.

STATE TRAILS

Background:

State Trails are established to provide recreational travel routes connecting units of the outdoor recreation system or the national trail system, provide access to or passage through areas which have significant scenic, historic, scientific, or recreational qualities, reestablish or permit travel along an historical prominent travel route, or provide commuter transportation (Minnesota Statutes Chapter 86A.05, Subd. 4).

Currently the Minnesota State Trail system is comprised of 26 legislatively authorized state trails, with a total of 1,249 miles along these designated routes presently developed and managed for public use. Of the 1,249 miles of existing state trail, 475 miles are currently paved. These State trails and trail corridors provide a broad range of recreation opportunities for a variety of trail users including

bicyclists, in-line skaters, hikers, horseback riders, snowmobilers, cross-country skiers, and dogsledders. The trail corridors, which are subject to active vegetation and habitat management, are open to public hunting. The State Trail system is a key element to in the efforts to improve the lives and health of Minnesotans, by providing a convenient and managed system of multiuse and multi-seasonal trails which traverse the diverse environmental zones present throughout the State. The presence of the State Trail system and the number of trail users present throughout all seasons provides a significant economic benefit to adjacent communities. The acquisition of state trail lands is focused on the parcels required to complete authorized state trail corridors or parcels that represent solutions to operational issues.

Applicable Statutes Governing Acquisition and Use of State Trails:

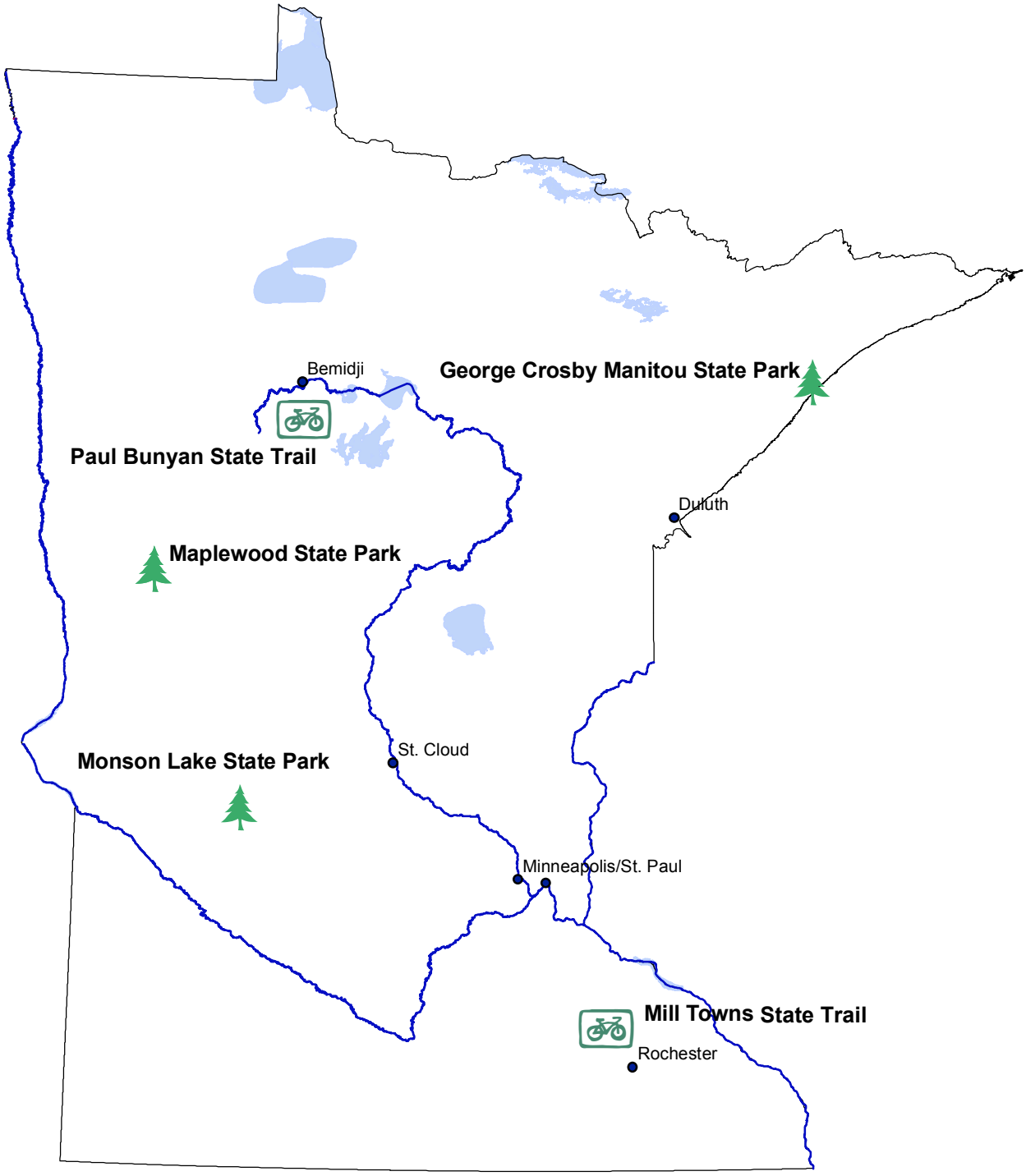
- **M.S. 86A.05, Subd. 4 –** Establishes state trails as part of the Outdoor Recreation System and defines their purpose and use
- **M.S. 86A.07, Subd. 2** – Authorizes acquisition of units of the outdoor recreation system
- **M.S. 85.015, Subd. 1 –** Authorizes acquisition of lands for state trails
- **M.S. 85.015, Subd. 2 –** Authorizes the Casey Jones State Trail
- **M.S. 85.015, Subd. 4** – Authorizes the Goodhue-Pioneer State Trail
- **M.S. 85.015, Subd. 5** – Authorizes the Glacial Lakes State Trail
- **M.S. 85.015, Subd. 7(a)** – Authorizes the Blufflands State Trail - Root River State Trail
- **M.S. 85.015, Subd. 7(b)** – Authorizes the Blufflands Sate Trail - Chester Woods Segment
- **M.S. 85.015, Subd. 7(b)** – Authorizes the Blufflands State Trail - Forestville Segment
- **M.S. 85.015, Subd. 8a** – Authorizes the Mill Towns State Trail
- **M.S. 85.015, Subd 11** – Authorizes the Willard Munger State Trail
- **M.S. 85.015, Subd 12** – Authorizes the Heartland State Trail
- **M.S. 85.015, Subd 13** – Authorizes the Arrowhead, North Shore, and Taconite State Trails
- **M.S. 85.015, Subd. 14** – Authorizes the Gateway State Trail
- **M.S. 85.015, Subd. 15** – Authorizes the Paul Bunyan State Trail
- **M.S. 85.015, Subd. 17** – Authorizes the Shooting Star State Trail
- **M.S. 85.015, Subd. 19** – Authorizes the Blazing Star State Trail
- **M.S. 85.015, Subd. 21** – Authorizes the Gitchi-Gami State Trail
- **M.S. 85.015, Subd. 22** – Authorizes the Minnesota River State Trail
- **M.S. 85.015, Subd. 23** – Authorizes the Central Lakes State Trail
- **M.S. 85.015, Subd. 24** – Authorizes the Cuyuna Lakes State Trail
- **M.S. 85.015, Subd. 25** – Authorizes the Great River Ridge State Trail
- **M.S. 84.029, Subd. 2 -** Authorizes acquisition of land for trails

Resource Connections:

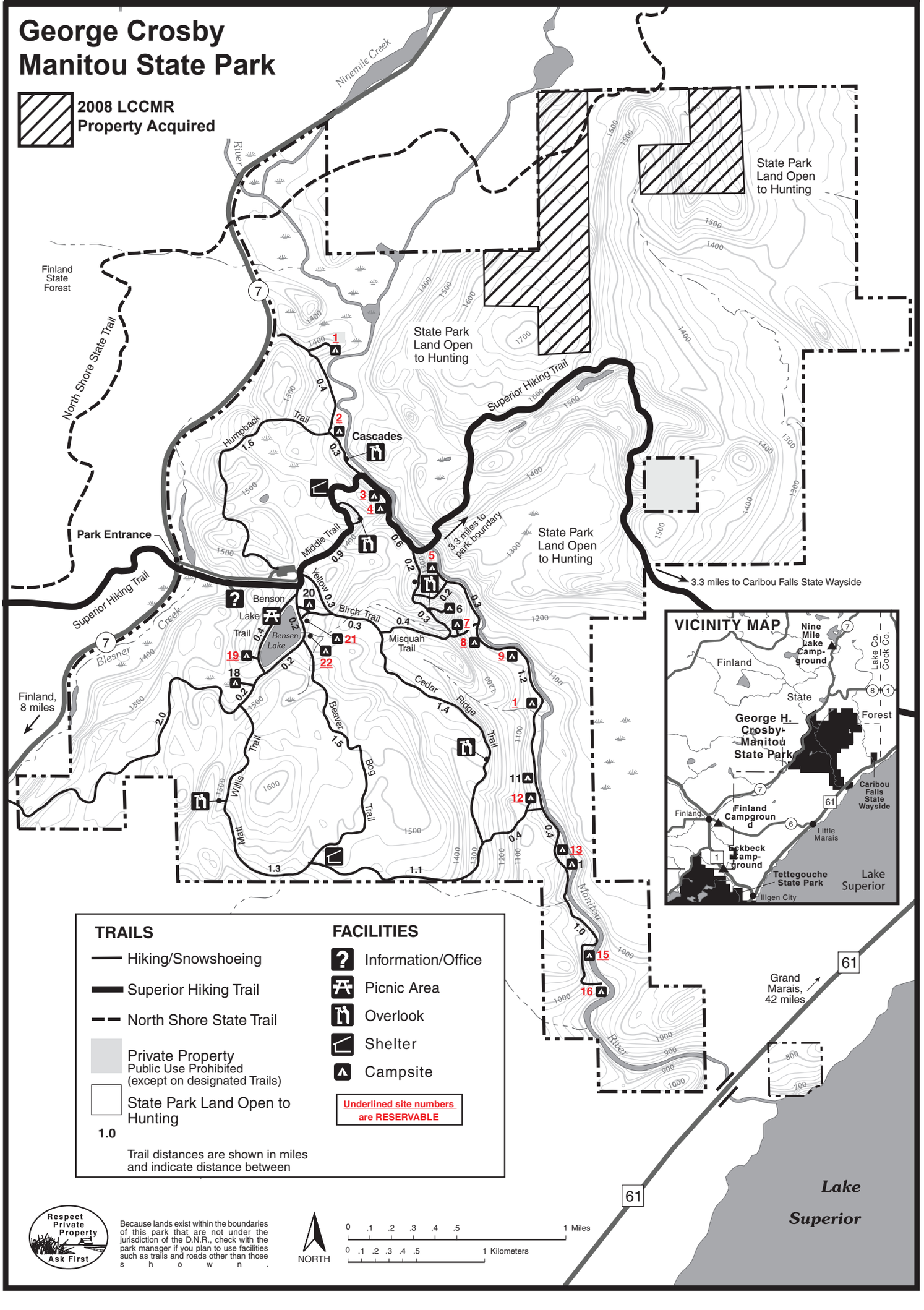
Minnesota State Trails represent a system of 1,249 miles of corridor developed and managed for recreational use and habitat. In addition to providing recreation opportunities to bicyclists, in-line skaters, hikers, horseback riders, snowmobilers, cross-country skiers, and dogsledders, the state trail lands are also actively managed for resource purposes.

Through an active vegetation restoration and management program, the Minnesota state trail lands provide long, contiguous habitat corridors that cross diverse local environmental zones. In a number of areas these the narrow linear corridors of natural vegetation also serve as natural buffers along the margins of a number of rivers, lakes and streams. In addition to the recreational opportunities provided to active trail users, in many areas the trail corridor's natural habitat provides an excellent location for bird watching and hunting. Hunting is a defined and allowable use of state trail lands. As well as the purely recreational aspects of state trail use, the developed trails also provide alternative transportation corridors that serve to reduce traffic congestion and conserve energy.

2008 LCCMR REVISED 8/13/2010
State Park and Trail Land Acquisition
Completed Projects



2008 LCCMR Acquired Property
State Parks Land Acquisition



2008 Project Abstract
For the Period Ending August 15, 2011

PROJECT TITLE: Metropolitan Regional Park System Land Acquisition
PROJECT MANAGER: Arne Stefferud
AFFILIATION: Metropolitan Council
MAILING ADDRESS: 390 North Robert Street
CITY/STATE/ZIP: St. Paul, MN 55101
PHONE: 651-602-1360
FAX: 651-602-1467
E-MAIL: arne.stefferud@metc.state.mn.us
WEBSITE: www.metrocouncil.org
FUNDING SOURCE: Minnesota Environment and Natural Resources Trust Fund
LEGAL CITATION: ML 2008, Chap. 367, Sec. 2, Subd. 3(i)

Overall Project Outcome and Results

This $1.5 million appropriation leveraged a total of $1,833,241 of other funds to acquire 66.7 acres for the Metropolitan Regional Park System as follows:

- 0.5 acres including shoreline of the Mississippi River for Above the Falls Regional Park in Minneapolis (Grant SG-2008-143: $81,392 Environment Trust Funds and $54,261 Metro Council bonds, and matched with $45,216 of Minneapolis Park & Rec. Board funds for a total of $180,870).
- 9.42 acres along Rush Creek for Rush Creek Regional Trail managed by Three Rivers Park District in suburban Hennepin County (Grant SG-2009-021: $244,440 Environment Trust Funds and $152,528 Metro Council bonds, and matched with $132,233 of Three Rivers Park District funds for a total of $529,200).
- 8.89 acres including shoreline of Schulz Lake for Carver Park Reserve, managed by Three Rivers Park District in Carver County (Grant SG-2009-059: $431,640 Environment Trust Funds and $287,760 Metro Council bonds, and matched with $239,800 Three Rivers Park District funds for a total of $959,200).
- 8.12 acres including shoreline of Cedar Lake for Cedar Lake Farm in Scott County (Grant SG-2009-062: $221,810 Environment Trust Funds and $147,873 Metro Council bonds, and matched with $123,228 of Scott County funds for a total of $492,911).
- 38 acres including shoreline of the Mississippi River for Grey Cloud Island Regional Park in Washington County (Grant SG-2010-045: $445,455 Environment Trust Funds, and $296,970 Metro Council bonds, and matched with $247,475 of Washington County funds for a total of $989,900).
- 1.8 acres including shoreline of the St. Croix River for the St. Croix Valley Regional Trail in Washington County (Grant SG-2010-052: $75,263 Environment Trust Funds and $60,608 Metro Council bonds, and matched with $45,290 of Washington County funds for a total of $181,161).

Project Results Use and Dissemination

Each regional park agency that received a grant or grants from this appropriation informs the public about the land acquisitionwith its own website and news releases. The Metropolitan Council also publishes a “Regional Parks Directory and Map” that informs the public about the recreation activities available at each regional park and trail and includes website addresses and phone numbers for each park agency for more information. Finally, the Metropolitan Council’s website includes an interactive parks map that contains the same information as the paper version of the “Regional Parks Directory and Map” at www.metrocouncil.org/parks/r-pk-map.htm

Trust Fund 2008 Work Program Final Report

Date of Report: August 15, 2011
Final Report

I. PROJECT TITLE: Metropolitan Regional Park System Land Acquisition

Project Manager: Arne Stefferud
Affiliation: Metropolitan Council
Mailing Address: 390 North Robert Street
City / State / Zip : St. Paul, MN 55101
Telephone Number: 651-602-1360
E-mail Address: arne.stefferud@metc.state.mn.us
FAX Number: 651-602-1467
Web Page address: www.metrocouncil.org

Location: Regional Parks and Trails located in Anoka, Carver, Dakota, Scott, Hennepin, Ramsey and Washington Counties (see attached map titled "Land Acquisition Areas That Would Be Eligible for Acquisition Opportunity Grant Fund")

Total Trust Fund Project Budget:		**M.L. 2008**
Trust Fund Appropriation:	**$**	**1,500,000**
Minus Amount Spent:	**$**	**1,500,000**
Equal Balance:	**$**	**0**

Legal Citation:
ML 2008, Chap. 367, Sec. 2, Subd. 3(i).
2008 Appropriation Language: (i) Metropolitan Regional Park System Land Acquisition. $1,500,000 is from the trust fund to the Metropolitan Council for subgrants for the acquisition of lands within the approved park unit boundaries of the metropolitan regional park system. This appropriation may not be used for the purchase of residential structures. Subdivision 11 applies to grants awarded in the approved work program. A list of proposed fee title and easement acquisitions must be provided as part of the required work program. All funding for conservation easements must include a long-term stewardship plan and funding for monitoring and enforcing the agreement. This appropriation must be matched by at least 40 percent of nonstate money and must be committed by December 31, 2008, or the appropriation cancels. This appropriation is available until June 30, 2011, at which time the project must be completed and final products delivered, unless an earlier date is specified in the work program.

Subd. 11. Payment Conditions and Capital Equipment Expenditures

All agreements, grants, or contracts referred to in this section must be administered on a reimbursement basis unless otherwise provided in this section. Notwithstanding Minnesota Statutes, section 16A.412, expenditures made on or after July 1, 2008, or the date the work program is approved, whichever is later, are eligible for reimbursement unless otherwise provided in this section. Periodic payment must be made upon receiving

documentation that the deliverable items articulated in the approved work program have been achieved, including partial achievements as evidenced by progress reports. Reasonable amounts may be advanced to projects to accommodate cash flow needs or match federal money. The advances must be approved as part of the work program. No expenditures for capital equipment are allowed unless expressly authorized in the project work program.

II and III. FINAL PROJECT SUMMARY

This $1.5 million appropriation leveraged a total of $1,833,241 of other funds to acquire 66.7 acres for the Metropolitan Regional Park System as follows:

- 0.5 acres including shoreline of the Mississippi River for Above the Falls Regional Park in Minneapolis (Grant SG-2008-143: $81,392 Environment Trust Funds and $54,261 Metro Council bonds, and matched with $45,216 of Minneapolis Park & Rec. Board funds for a total of $180,870).
- 9.42 acres along Rush Creek for Rush Creek Regional Trail managed by Three Rivers Park District in suburban Hennepin County (Grant SG-2009-021: $244,440 Environment Trust Funds and $152,528 Metro Council bonds, and matched with $132,233 of Three Rivers Park District funds for a total of $529,200).
- 8.89 acres including shoreline of Schulz Lake for Carver Park Reserve, managed by Three Rivers Park District in Carver County (Grant SG-2009-059: $431,640 Environment Trust Funds and $287,760 Metro Council bonds, and matched with $239,800 Three Rivers Park District funds for a total of $959,200).
- 8.12 acres including shoreline of Cedar Lake for Cedar Lake Farm in Scott County (Grant SG-2009-062: $221,810 Environment Trust Funds and $147,873 Metro Council bonds, and matched with $123,228 of Scott County funds for a total of $492,911).
- 38 acres including shoreline of the Mississippi River for Grey Cloud Island Regional Park in Washington County (Grant SG-2010-045: $445,455 Environment Trust Funds, and $296,970 Metro Council bonds, and matched with $247,475 of Washington County funds for a total of $989,900).
- 1.8 acres including shoreline of the St. Croix River for the St. Croix Valley Regional Trail in Washington County (Grant SG-2010-052: $75,263 Environment Trust Funds and $60,608 Metro Council bonds, and matched with $45,290 of Washington County funds for a total of $181,161).

IV. OUTLINE OF PROJECT RESULTS*:*

Result 1: Acquisition Opportunity Fund Grants

Description: Awarded sub grants to regional park agencies to acquire land within approved regional park unit boundaries when acquisition CIP funds had been spent by that agency. 66.7 acres were acquired. Grants were awarded when land was available to purchase. Trust Funds financed 60% of each sub grant and Metropolitan Council bonds financed 40% of each sub grant. The Metropolitan Council determined the maximum amount a regional park implementing agency could receive from this appropriation. The premise for the sub grant limit to a park agency is that it provides at least partial funding for large scale acquisitions in several locations. The sub-grants financed 75% of acquisition

costs. The regional park implementing agencies provided the remaining 25%. In this case, $883,242 was provided by the regional park implementing agencies.

August 15, 2011 Final Summary Budget Information for Result 1:

Trust Fund Budget:	$1,500,000
Amount Spent (08/15/2011):	$1,500,000
Balance (08/15/2011):	**$** 0

#	Deliverables	Completion Date	Budget	Status
1	0.5 acres	October 12, 2009	$ 81,392	Grant closed
2	9.42 acres	July 20, 2010	$ 244,440	Grant closed
3	8.89 acres	October 22, 2010	$ 431,640	Grant closed
4	8.12 acres	June 2, 2011	$ 221,810	Grant closed
5	38 acres	January 4, 2011	$ 445,455	Grant closed
6	1.8 acres	January 5, 2011	$ 75,263	Grant closed

Detail on the acquisitions, including the expenditure of the Metro Council bond match and related expenditures such as legal fees and property tax equivalency payments required to be paid on each acquisition is shown in Attachment A: Budget Detail.

Result Status as of June 10, 2008: Initial work program approved.

Result Status as of August 15, 2011:

Deliverable 1: $81,392 of Trust Fund appropriation matched with $54,261 of Metropolitan Council bonds that financed 75% of acquisition costs for 0.5 acres for Above the Falls Regional Park in Minneapolis. The Minneapolis Park & Recreation Board provided $45,216 to finance 25% of the acquisition costs.

Deliverable 2: $244,440 of Trust Fund appropriation matched with $152,528 of Metropolitan Council bonds that financed 75% of acquisition costs for 9.42 acres of shoreline along Rush Creek for the Rush Creek Regional Trail by Three Rivers Park District. Three Rivers Park District provided $132,233 to finance 25% of the acquisition costs.

Deliverable 3: $431,640 of Trust Fund appropriation matched with $287,760 of Metropolitan Council bonds that financed 75% of the costs to acquire 8.89 acres for Carver Park Reserve by Three Rivers Park District. Three Rivers Park District provided $239,800 to finance 25% of acquisition costs.

Deliverable 4: $221,810 of Trust Fund appropriation matched with $147,873 of Metropolitan Council bonds that financed 75% of the cost to acquire 8.12 acres for Cedar Lake Farm Regional Park in Scott County. Scott County provided $123,228 to finance 25% of acquisition costs.

Deliverable 5: $445,455 of Trust Fund appropriation matched with $296,970 of Metropolitan Council bonds to finance 75% of acquisition costs for 38 acres including

Mississippi River shoreline in Grey Cloud Island Regional Park in Washington County. Washington County provided $ 247,475 to finance 25% of acquisition costs.

Deliverable 6: $75,263 of Trust Fund appropriation matched with $60,608 of Metropolitan Council bonds to finance 75% of acquisition costs to acquire 1.8 acres including shoreline of the St. Croix River for the St. Croix Valley Regional Trail in Washington County. Washington County provided $ 45,290 to finance 25% of acquisition costs.

V. TOTAL TRUST FUND PROJECT BUDGET: $1,500,000

Acquisition, fee title: $1,493,502 to acquire in fee title 66.7 acres of land within approved regional park unit boundaries. The title of the land will be held by the regional park agency that received a sub grant from this appropriation and partially financed the acquisition of the land with the sub grant. Each recipient regional park agency will be responsible for the initial and annual Trust Fund land reports.
Staff or Contract Services: $5,483 for legal services and appraisals on land acquired with subgrants.
Other-Property Tax Equivalency Payment: $1,015 was inadvertently spent from the Trust Fund appropriation for a property tax equivalency payment. The Metropolitan Council is required to finance this payment for lands acquired for the Metropolitan Regional Park System under M.S. 473.341. The error was corrected by financing an additional $1,015 of land acquisition costs with Metro Council bonds instead of with the Trust Fund appropriation.

Explanation of Capital Expenditures Greater Than $3,500:
No capital expenditures will be financed with this appropriation.

VI. OTHER FUNDS & PARTNERS:

A. Project Partners:
The following regional park implementing agencies were eligible to receive an Acquisition Opportunity Grant from the appropriation. The amount each agency received is dependent on the amount needed for a particular subgrant and reported in Attachment A:Budget Detail.

Regional Park Agency Contact	Regional Park Agency Name
John VondeLinde	Anoka County Parks Dept.
Randy Quale	City of Bloomington Parks Dept.
Marty Walsh	Carver County Parks Dept.
Steve Sullivan	Dakota County Parks Dept.
Mike Kimble	Minneapolis Park & Recreation Board
Greg Mack	Ramsey County Parks Dept.
Jody Martinez	City of St. Paul Parks Dept.

Mark Themig	Scott County Parks Dept.
Boe Carlson	Three Rivers Park District
John Elholm	Washington County Parks Dept.

B. Other Funds Proposed to be Spent during the Project Period:
The Metropolitan Council provided $1 million of its park bonds as a match to the $1.5 million Environment and Natural Resources Trust Fund appropriation. The Council's bonds were used in part to pay the property tax equivalency payment due at closing to the affected city or township. This payment (180% of the city or township taxes due in the year the land is purchased) is required under MS 473.341.

In addition to the $1,000,000 of Metropolitan Council bonds, regional park agencies provided $833,242 of matching funds to subgrants financed with the Trust Fund appropriation and Council bonds. The amount of match provided by the regional park agencies in percentage terms is 25% of the costs to acquire the parcel. The matching funds can be from the park agency's capital budget and/or from other non-State sources such as a watershed district grant. The agency matching funds are not included in the Budget Detail

C. Past Spending:
In 2007, $2,500,000 from the Environment and Natural Resources Trust Fund was appropriated for this purpose under the condition that the Metropolitan Council provide a match of $1,666,000, and that no residential structures could be acquired. Those funds have been spent to partially finance the acquisition of 5 parcels totaling 528 acres.

D. Time:
All sub grants awarded with this appropriation were authorized, and the land acquired between the time the work program was approved on June 10, 2008 and June 30, 2011.

VII. DISSEMINATION:
The Metropolitan Council uses its website www.metrocouncil.org to publish requests for subgrants financed with this appropriation as part of its consideration of those subgrant requests. The public may comment on those subgrant requests at meetings conducted by the Metropolitan Parks and Open Space Commission and the Metropolitan Council.

VIII. REPORTING REQUIREMENTS:

Periodic work program progress reports were submitted on February 18, 2009, July 6, 2009, February 1, 2010, and September 15 2010. A final work program report and associated products was submitted on August 15, 2011.

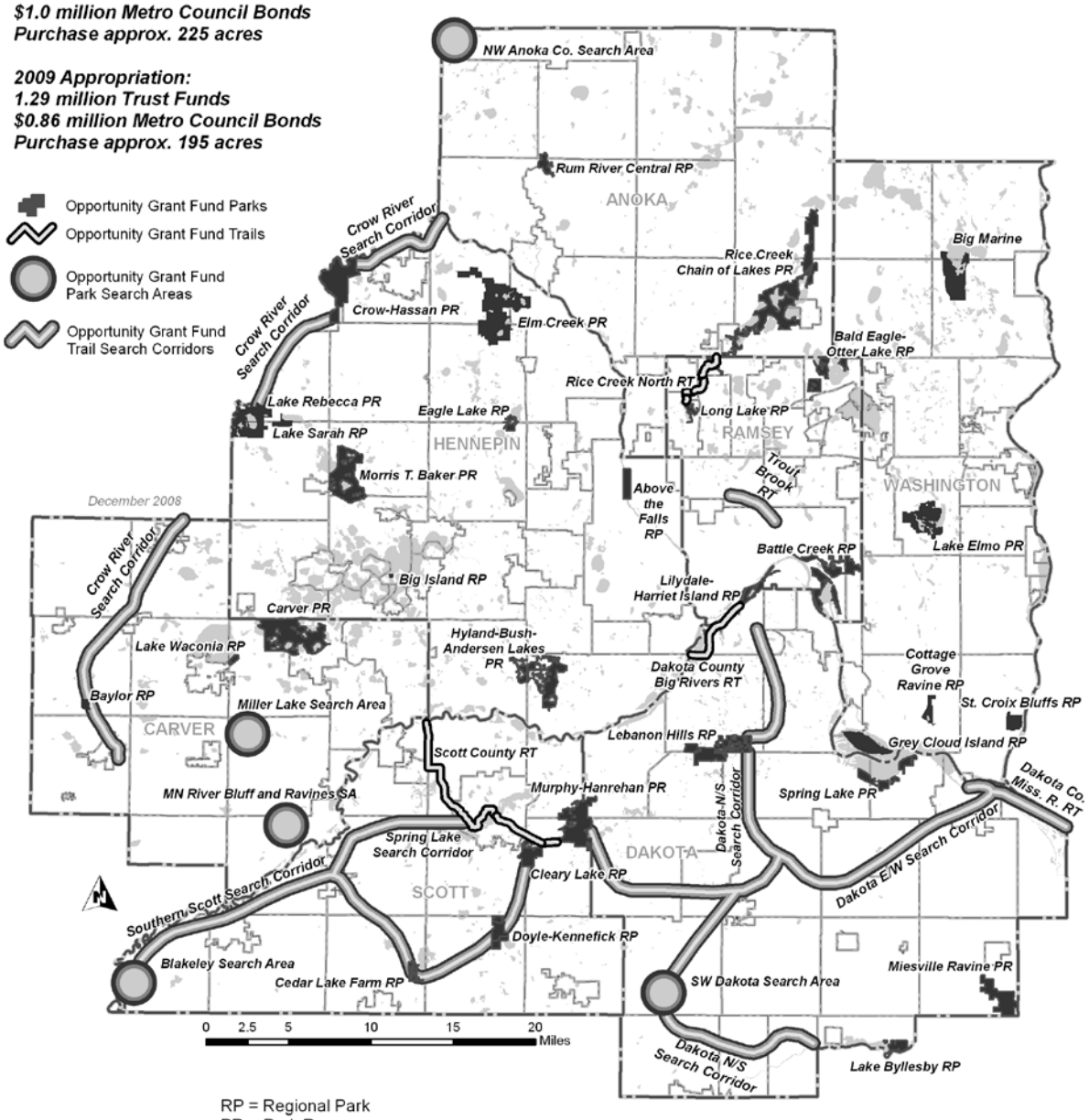
IX. RESEARCH PROJECTS: Not applicable

Result 1: Acquisition Opportunity Grants

Land Acquisition Areas That Would Be Eligible for Acquisition Opportunity Grant Fund

2008 Appropriation:
$1.5 million Trust Funds
$1.0 million Metro Council Bonds
Purchase approx. 225 acres

2009 Appropriation:
1.29 million Trust Funds
$0.86 million Metro Council Bonds
Purchase approx. 195 acres



RP = Regional Park
PR = Park Reserve
RT = Regional Trail
Search Area = Proposed park location; boundary determined by master plan
Search Corridor = Proposed trail alignment; location determined by master plan

Metropolitan Council

Deliverable 1: $81,392 of Trust Fund appropriation matched with $54,261 of Metropolitan Council bonds that financed 75% of acquisition costs for 0.5 acres for Above the Falls Regional Park in Minneapolis. The Minneapolis Park & Recreation Board provided $45,216 to finance 25% of the acquisition costs.

1808 and 1812 Marshall St. NE parcels purchased for Above the Falls Regional Park, Mpls. Park & Rec. Board. Environmental Trust Fund appropriation partially financed area outlined in red.

Deliverable 2: $244,440 of Trust Fund appropriation matched with $152,528 of Metropolitan Council bonds that financed 75% of acquisition costs for 9.42 acres of shoreline along Rush Creek for the Rush Creek Regional Trail by Three Rivers Park District. Three Rivers Park District provided $132,233 to finance 25% of the acquisition costs.

Ganzer parcel acquisition at Rush Creek Regional Trail, Three Rivers Park District. Environmental Trust Fund appropriation partially financed that portion shown in red.

Ganzer Property

Parcel ID: 04-119-22-11-0008
Property Type: Residential
10825 Fernbrook Lane North
Maple Grove, MN 55369

Legend

Ganzer Proposed Subdivide
Ganzer Property

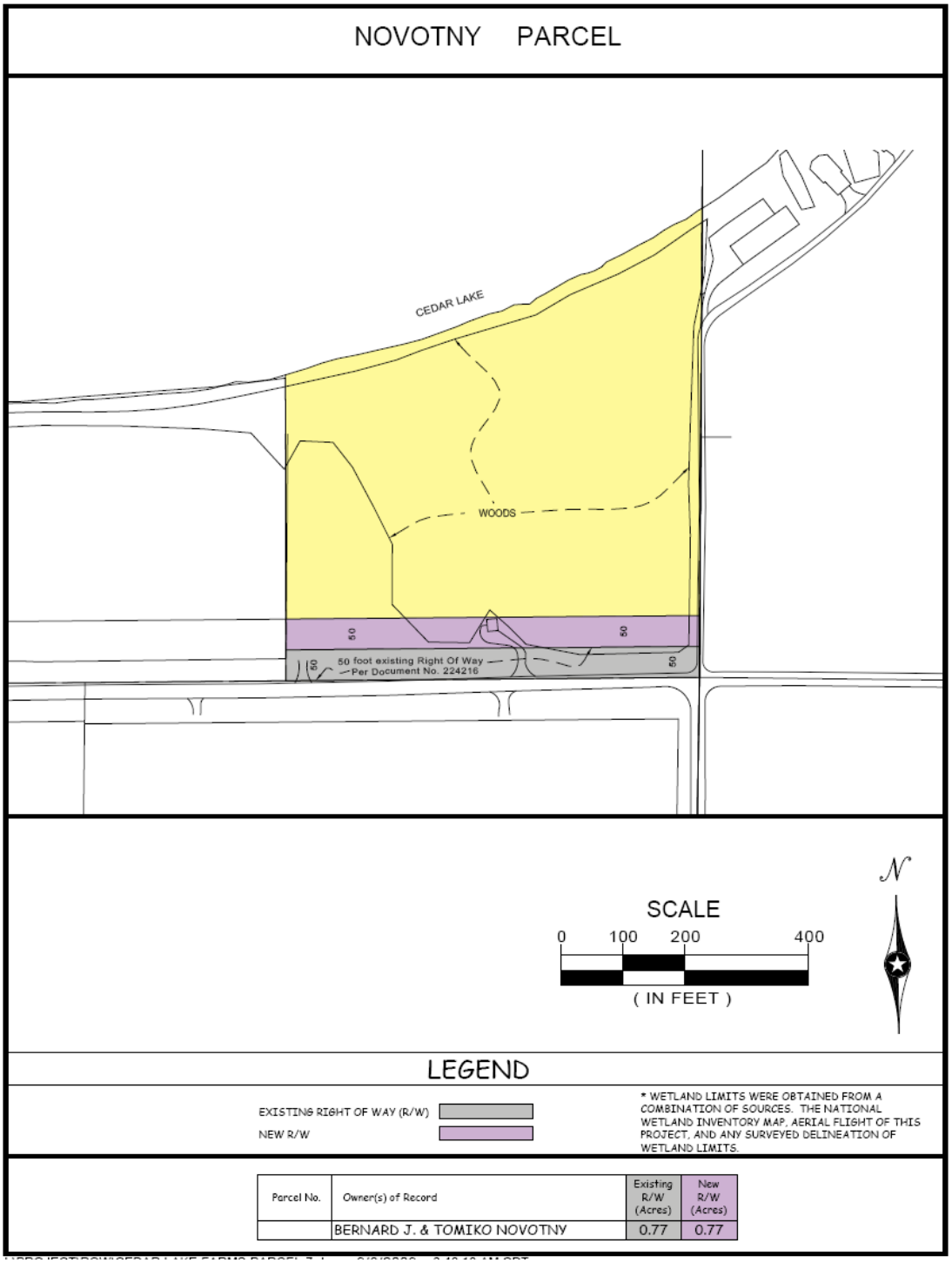
N

Deliverable 3: $431,640 of Trust Fund appropriation matched with $287,760 of Metropolitan Council bonds that financed 75% of the costs to acquire 8.89 acres for Carver Park Reserve by Three Rivers Park District. Three Rivers Park District provided $239,800 to finance 25% of acquisition costs.

Hedtke parcel acquired for Carver Park Reserve, Three Rivers Park District. Structure shown in aerial map was financed by Three Rivers Park District. Remaining portion of land partially financed with Environmental Trust Fund appropriation.

Deliverable 4: $221,810 of Trust Fund appropriation matched with $147,873 of Metropolitan Council bonds that financed 75% of the cost to acquire 8.12 acres for Cedar Lake Farm Regional Park in Scott County. Scott County provided $123,228 to finance 25% of acquisition costs.

Novotny parcel acquired for Cedar Lake Farm Regional Park . Map shows park land partially financed with Environmental Trust Fund appropriation and highway right of way that was not acquired with Environmental Trust Fund appropriation.



Deliverable 5: $445,455 of Trust Fund appropriation matched with $296,970 of Metropolitan Council bonds to finance 75% of acquisition costs for 38 acres including Mississippi River shoreline in Grey Cloud Island Regional Park in Washington County. Washington County provided $ 247,475 to finance 25% of acquisition costs.

Appert parcel acquired for Grey Cloud Island Regional Park. Environmental Trust Fund appropriation partially financed 3 lots of the parcel that did not include a residential structure. The residential structure lot was financed with other revenues.

Deliverable 6: $75,263 of Trust Fund appropriation matched with $60,608 of Metropolitan Council bonds to finance 75% of acquisition costs to acquire 1.8 acres including shoreline of the St. Croix River for the St. Croix Valley Regional Trail in Washington County. Washington County provided $ 45,290 to finance 25% of acquisition costs.

Pontius property acquired for St. Croix Valley Regional Trail financed in part with Environmental Trust Fund appropriation--shown in yellow

Attachment A: Budget Detail for 2008 Trust Fund Projects - Summary

Project Title: Metropolitan Regional Park System Land Acquisition

Project Manager Name: Arne Stefferud

Trust Fund Appropriation: $1,500,000

2008 Trust Fund Budget	**Deliverable 1 Trust Fund Budget:**	**Deliverable 1 Metro Council Bond Match Budget:**	**Trust Fund Amount Spent** *(8-15-2011)*	**Metro Council Bond Match Amount Spent** *(8-15-2011)*	**Trust Fund Balance** (8-15-2011)	**Metro Council Bond Match Balance** *(8-15-2011)*
Metropolitan Regional Park System Land Acquisition						
BUDGET ITEM						
Land acquisition	1,493,502	971,401	1,493,502	971,401	0	0
Professional Services for Acq.	5,483	23,500	5,483	23,500	0	0
Other--Property tax equivalency payment	1,015 *	5,099	1,015	5,099	0	0
COLUMN TOTAL	**$1,500,000**	**$1,000,000**	**$1,500,000**	**$1,000,000**	**$0**	**$0**

* Note: $1,015 of the Trust Fund appropriation was inadvertantly spent on a property tax equivalency payment, which is not consistent with the approved work program. Since the appropriation was disbursed and the applicable grant is closed, $1,015 of Metropolitan Council bonds was disbursed instead of $1,015 of the Trust Fund appropriation on the next grant to correct this error.

Attachment A: Budget Detail for 2008 Trust Fund Projects - Budget Page for Deliverable 1: Acquire 0.5 acres for Above the Falls Regional Park, Minneapolis Park & Recreation Board

Project Title: Metropolitan Regional Park System Land Acquisition

Project Manager Name: Arne Stefferud

Trust Fund Appropriation: $81,392

2008 Trust Fund Budget	**Deliverable 1 Trust Fund Budget:**	**Deliverable 1 Metro Council Bond Match Budget:**	**Trust Fund Amount Spent** *(8-15-2011)*	**Metro Council Bond Match Amount Spent** *(8-15-2011)*	**Trust Fund Balance** (8-15-2011)	**Metro Council Bond Match Balance** *(8-15-2011)*
Metropolitan Regional Park System Land Acquisition						
BUDGET ITEM						
Land acquisition	79,584	51,111	79,584	51,111	0	0
Professional Services for Acq.	793	3,150	793	3,150	0	0
Other--Property tax equivalency payment	1015 *	0	1,015	0	0	0
COLUMN TOTAL	**$81,392**	**$54,261**	**$81,392**	**$54,261**	**$0**	**$0**

* Note: $1,015 of the Trust Fund appropriation was inadvertantly spent on a property tax equivalency payment, which is not consistent with the approved work program. Since the appropriation was disbursed and the applicable grant is closed, $1,015 of Metropolitan Council bonds was disbursed instead of $1,015 of the Trust Fund appropriation on the next grant to correct this error.

Attachment A: Budget Detail for 2008 Trust Fund Projects - Budget Page for Deliverable 2: Acquire 9.42 acres for Rush Creek Regional Trail, Three Rivers Park District

Project Title: Metropolitan Regional Park System Land Acquisition

Project Manager Name: Arne Stefferud

Trust Fund Appropriation: $244,440

2008 Trust Fund Budget	**Deliverable 1 Trust Fund Budget:**	**Deliverable 1 Metro Council Bond Match Budget:**	**Trust Fund Amount Spent** *(8-15-2011)*	**Metro Council Bond Match Amount Spent** *(8-15-2011)*	**Trust Fund Balance** (8-15-2011)	**Metro Council Bond Match Balance** *(8-15-2011)*
Metropolitan Regional Park System Land Acquisition						
BUDGET ITEM						
Land acquisition	243,415	149,129	243,415	149,129	0	0
Professional Services for Acq.	1,025	3,200	1,025	3,200	0	0
Other--Property tax equivalency payment	0	199	1,015	199	0	0
COLUMN TOTAL	**$244,440**	**$152,528**	**$245,455**	**$152,528**	**$0**	**$0**

Attachment A: Budget Detail for 2008 Trust Fund Projects - Budget Page for Deliverable 3: Acquire 8.89 acres for Carver Park Reserve, Three Rivers Park District

Project Title: Metropolitan Regional Park System Land Acquisition

Project Manager Name: Arne Stefferud

Trust Fund Appropriation: $431,640

2008 Trust Fund Budget	**Deliverable 1 Trust Fund Budget:**	**Deliverable 1 Metro Council Bond Match Budget:**	**Trust Fund Amount Spent** *(8-15-2011)*	**Metro Council Bond Match Amount Spent** *(8-15-2011)*	**Trust Fund Balance** (8-15-2011)	**Metro Council Bond Match Balance** *(8-15-2011)*
Metropolitan Regional Park System Land Acquisition						
BUDGET ITEM						
Land acquisition	430,575	280,260	430,575	280,260	0	0
Professional Services for Acq.	1,065	5,500	1,065	5,500	0	0
Other--Property tax equivalency payment	0	2,000	0	2,000	0	0
COLUMN TOTAL	**$431,640**	**$287,760**	**$431,640**	**$287,760**	**$0**	**$0**

Attachment A: Budget Detail for 2008 Trust Fund Projects - Budget Page for Deliverable 4: Acquire 8.12 acres for Cedar Lake Farm Regional Park, Scott County

Project Title: Metropolitan Regional Park System Land Acquisition

Project Manager Name: Arne Stefferud

Trust Fund Appropriation: $221,810

2008 Trust Fund Budget	**Deliverable 1 Trust Fund Budget:**	**Deliverable 1 Metro Council Bond Match Budget:**	**Trust Fund Amount Spent** *(8-15-2011)*	**Metro Council Bond Match Amount Spent** *(8-15-2011)*	**Trust Fund Balance** (8-15-2011*)*	**Metro Council Bond Match Balance** *(8-15-2011)*
Metropolitan Regional Park System Land Acquisition						
BUDGET ITEM						
Land acquisition	220,910	143,323	220,910	143,323	0	0
Professional Services for Acq.	900	3,650	900	3,650	0	0
Other--Property tax equivalency payment	0	900	0	900	0	0
COLUMN TOTAL	**$221,810**	**$147,873**	**$221,810**	**$147,873**	**$0**	**$0**

Attachment A: Budget Detail for 2008 Trust Fund Projects - Budget Page for Deliverable 5: Acquire 38 acres for Grey Cloud Island Regional Park , Washington County

Project Title: Metropolitan Regional Park System Land Acquisition

Project Manager Name: Arne Stefferud

Trust Fund Appropriation: $445,455

2008 Trust Fund Budget	**Deliverable 1 Trust Fund Budget:**	**Deliverable 1 Metro Council Bond Match Budget:**	**Trust Fund Amount Spent** *(8-15-2011)*	**Metro Council Bond Match Amount Spent** *(8-15-2011)*	**Trust Fund Balance** (8-15-2011*)*	**Metro Council Bond Match Balance** *(8-15-2011)*
Metropolitan Regional Park System Land Acquisition						
BUDGET ITEM						
Land acquisition	444,355	290,770	444,355	290,770	0	0
Professional Services for Acq.	1,100	5,000	1,100	5,000	0	0
Other--Property tax equivalency payment	0	1,200	0	1,200	0	0
COLUMN TOTAL	**$445,455**	**$296,970**	**$445,455**	**$296,970**	**$0**	**$0**

Attachment A: Budget Detail for 2008 Trust Fund Projects - Budget Page for Deliverable 6: Acquire 1.8 acres for St. Croix Valley Regional Trail, Washington County

Project Title: Metropolitan Regional Park System Land Acquisition

Project Manager Name: Arne Stefferud

Trust Fund Appropriation: $75,263

2008 Trust Fund Budget	**Deliverable 1 Trust Fund Budget:**	**Deliverable 1 Metro Council Bond Match Budget:**	**Trust Fund Amount Spent** *(8-15-2011)*	**Metro Council Bond Match Amount Spent** *(8-15-2011)*	**Trust Fund Balance** (8-15-2011)	**Metro Council Bond Match Balance** *(8-15-2011)*
Metropolitan Regional Park System Land Acquisition						
BUDGET ITEM						
Land acquisition	74,663	56,808	74,663	56,808	0	0
Professional Services for Acq.	600	3,000	600	3,000	0	0
Other--Property tax equivalency payment	0	800	0	800	0	0
COLUMN TOTAL	**$75,263**	**$60,608**	**$75,263**	**$60,608**	**$0**	**$0**

2008 Project Abstract
For the Period Ending June 30, 2011
PROJECT TITLE: Local Initiative Grants – Regional Parks and Natural and Scenic Areas
PROJECT MANAGER: Wayne Sames
AFFILIATION: MN Department of Natural Resources
MAILING ADDRESS: 500 Lafayette Road
CITY/STATE/ZIP: St. Paul, MN, 55155-4010
PHONE: (651) 259-5559
FAX: (651) 296-6047
E-MAIL: wayne.sames@dnr.state.mn.us
WEBSITE: www.mndnr.gov
FUNDING SOURCE: Environment and Natural Resources Trust Fund
LEGAL CITATION: M. L. 2008, Chap. 367, Sec. 2, Subd. 3(j)

APPROPRIATION AMOUNT: $1,000,000

Overall Project Outcome and Results

The first phase of acquisition for the proposed regional park on the Bertram Chain of Lakes in Wright County was completed in December, 2008 with the acquisition of 319 acres having a total purchase price of $3.6 million. This land will form the nucleus of a new regional park that, when acquisition is completed, will total approximately 1,200 acres. A map showing the area acquired is attached. The lake shore acquired through this first phase, including shore land on one of the largest of the chain of lakes (Long Lake), totals 6,279 linear feet.

This is the first of a series of acquisitions for the Bertram Chain of Lakes project. Wright County and the City of Monticello have a MOU with the YMCA of Minneapolis, owner of the property, until 12-31-2013 to complete the entire purchase. Funding for this first phase includes the $1 million appropriated through this subdivision as well as $200,000 from a grant through the Metro Greenways program.

The goal is to complete acquisition of the entire 1,200 acres (approximately 200 acres of lakes and 1,000 acres of land), including four undeveloped lakes (consisting of 5.75 miles of shore land and 1.5 miles of streams) in Wright County (Monticello Township/Monticello City). The land will be used for the preservation and protection of shore land, open space, natural resources and access for public recreation and enjoyment.

Project Results and Dissemination

Several site tours of the proposed park property have been conducted by Wright County and the City of Monticello for legislators, state and local government staff and officials, and other interested individuals. Background information, photos and maps have been disseminated to explain the proposed project and illustrate the features of the landscape.

Trust Fund 2008 Work Program Final Report

Date of Report: February 2, 2009
Trust Fund 2008 Work Program Final Report
Date of Work program Approval: June 10-11, 2008
Project Completion Date: January 2009

I. PROJECT TITLE: **Local Initiative Grants - Regional Parks and Natural Areas**

Project Manager: Wayne Sames
Affiliation: MN Department of Natural Resources
Mailing Address: 500 Lafayette Road
City / State / Zip : St. Paul, MN, 55155-4010
Telephone Number: (651) 259-5559
E-mail Address: wayne.sames@dnr.state.mn.us
FAX Number: (651) 296-6047
Web Page address: www.mndnr.gov

Co- Project Manager: Marc Mattice
Affiliation: Wright County Parks
Mailing Address: 1901 Highway 25 North
City / State / Zip : Buffalo, MN 55313
Telephone Number: (763) 682-7693
E-mail Address: marc.mattice@co.wright.mn.us
FAX Number: (763) 682-7313
Web Page address:

Location: The project location is in Wright County and the property is located in Monticello Township with a zip code of 55362. Attached is a map of the acquisition site.

Total Trust Fund Project Budget:	**Trust Fund Appropriation:**	$ 1,000,000
	Minus Amount Spent:	$ 1,000,000
	Equal Balance:	$ 0

Legal Citation: M.L. 2008, Chap. 367, Sec. 2, Subd. 3(j).

Appropriation Language:
$1,000,000 is from the trust fund to the commissioner of natural resources for a grant to Wright County for land acquisition for a proposed regional park on the Bertram Chain of Lakes in Wright County. If the acquisition for a proposed regional park on the Bertram Chain of Lakes is not completed by June 30, 2010, then the appropriation is available for matching grants to other local governments for acquisition of regional parks and natural and scenic areas as provided in Minnesota Statutes, section 85.019, subdivisions 2, paragraph (b), and 4a. This appropriation is available until June 30, 2011, at which time the project must be

completed and final products delivered, unless an earlier date is specified in the work program.

II. and III. FINAL PROJECT SUMMARY

Overall Project Outcome and Results

The first phase of acquisition for the proposed regional park on the Bertram Chain of Lakes in Wright County was completed in December 2008 with the acquisition of 319 acres having a total purchase price of $3.6 million. This land will form the nucleus of a new regional park that, when acquisition is completed, will total approximately 1,200 acres. A map showing the area acquired is attached. The lake shore acquired through this first phase, including shore land on one of the largest of the chain of lakes (Long Lake), totals 6,279 linear feet.

This is the first of a series of acquisitions for the Bertram Chain of Lakes project. Wright County and the City of Monticello have a MOU with the YMCA of Minneapolis, owner of the property, until 12-31-2013 to complete the entire purchase. Funding for this first phase includes the $1 million appropriated through this subdivision as well as $200,000 from a grant through the Metro Greenways program.

The goal is to complete acquisition of the entire 1,200 acres (approximately 200 acres of lakes and 1,000 acres of land), including four undeveloped lakes (consisting of 5.75 miles of lake shore and 1.5 miles of streams) in Wright County (Monticello Township/ Monticello City). The land will be used for the preservation and protection of shore land, open space, natural resources and access for public recreation and enjoyment.

Project Results Use and Dissemination

Several site tours of the proposed park property have been conducted by Wright County and City of Monticello for legislators, state and local government staff and officials, and other interested individuals. Background information, photos and maps have been disseminated to explain the proposed project and illustrate the features of the landscape.

IV. OUTLINE OF PROJECT RESULTS*:*

Result 1: First phase of the three-phase acquisition of Bertram Chain of Lakes Regional Park (outline for proposed acquisition process attached).

Description: Final outcome of this three-phase project is a joint partnership with Wright County and the City of Monticello to acquire fee title to1200 acres of natural lands including three undeveloped lakes with over 7 miles of shore lands by the end of the 2013. The land will be managed and operated as a regional park. The YMCA has owned this property since 1963 and has offered a day camp focused on the natural resources and outdoor activities.

Summary Budget Information for Result 1:	**Trust Fund Budget:**	$1,000,000.00
	Amount Spent:	$1,000,000.00
	Balance:	$0

Deliverable	**Completion Date**	**Budget**	**Status**
1. Fee Title Acquisition	January, 2009	$1,000,000	Completed

Final Report Summary: (January, 2009): The first phase was completed with the acquisition in December 2008 of 319 acres. The land acquired consists of two parcels. The first (Parcel #6) includes 174.64 acres of upland. Marsh and wetlands located in the southeastern corner of the property. The second (Parcel #5A) consists of 104.33 acres of upland and wooded shore land. This includes 6,279 linear feet of shoreline on Long Lake. The remaining acreage acquired consists of 39.7 acres of open water.

Result 2: If the acquisition for a proposed regional park on the Bertram Chain of Lakes is not completed by June 30, 2010, then the appropriation is available for matching grants to other local governments for acquisition of regional parks and natural and scenic areas as provided in Minnesota Statutes, section 85.019, subdivisions 2, paragraph (b). This appropriation is available until June 30, 2011, at which time the project must be completed and final products delivered, unless an earlier date is specified in the work program.

Description: To be determined contingent on inability to complete Result 1.

Summary Budget Information for Result 2:	**Trust Fund Budget:**	$0
	Amount Spent:	$0
	Balance:	$0

Deliverable	**Completion Date**	**Budget**	**Status**
1. Fee title acquisition	June 30, 2011	$0	N/A

Final Report Summary: (January, 2009): This result is not applicable since the first phase of the project outlined in Result 1 was completed.

V. TOTAL TRUST FUND PROJECT BUDGET:

Staff or Contract Services: $0.00
Equipment: $0.00
Development: $ 0.00
Restoration: $ 0.00
Acquisition, including easements: $ 1,000,000.00 (approximately 319 acres, including land and water)

Other: The acquisition of this Regional Park is a partnership between Wright County and the City of Monticello. The partners contributed $2,400,000 towards the purchase in the first phase. During phase II and III each partner will contribute additional funds for a grand total local match of $11.5 million over the three phases.

The City and County will also be seeking assistance through other state funding sources to raise $8,000,000 more that will secure this acquisition.

TOTAL TRUST FUND PROJECT BUDGET: $1,000,000.00

Explanation of Capital Expenditures Greater Than $3,500:

VI. OTHER FUNDS & PARTNERS:

A. Project Partners: There are no additional partners in this project. Wright County and the City of Monticello will jointly be responsible.

B. Other Funds Proposed to be Spent during the Project Period: Additional funds for the first phase acquisition included a Metro Greenways Program grant of $200,000. Other matching funds that may be spent for future acquisition have not been finalized at this point. The partners will be using funds from a variety of sources, including in-kind labor, equipment and supplies, park dedication funds, donations, and general revenue dollars to create facilities, restore natural resources, and make improvements to the future regional park.

C. Past Spending: An appraiser was hired to draft an appraisal guiding the value of the property. No other funds have been expended at this time.

D. Time: The Phase I acquisition process was completed by the end of 2008. Wright County and the City of Monticello will continue to work towards obtaining additional funds through future State Bonding Bills, LCCMR allocations, and other grant opportunities. Following the purchase, funds will be raised through a variety of means for the purpose of restoration of natural communities and facility development.

VII. DISSEMINATION: The partners used a variety of media sources, including the local papers, radio and mass email to keep citizens updated on the progress of this purchase.

VIII. REPORTING REQUIREMENTS:

A work program was submitted and approved in June, 2008,. A final work program report and associated products was submitted January 2009.

IX. RESEARCH PROJECTS: N/A, Acquisition Project.

Attachment A: Budget Detail for 2008 Projects - Summary and a Budget page for each partner (if applicable)

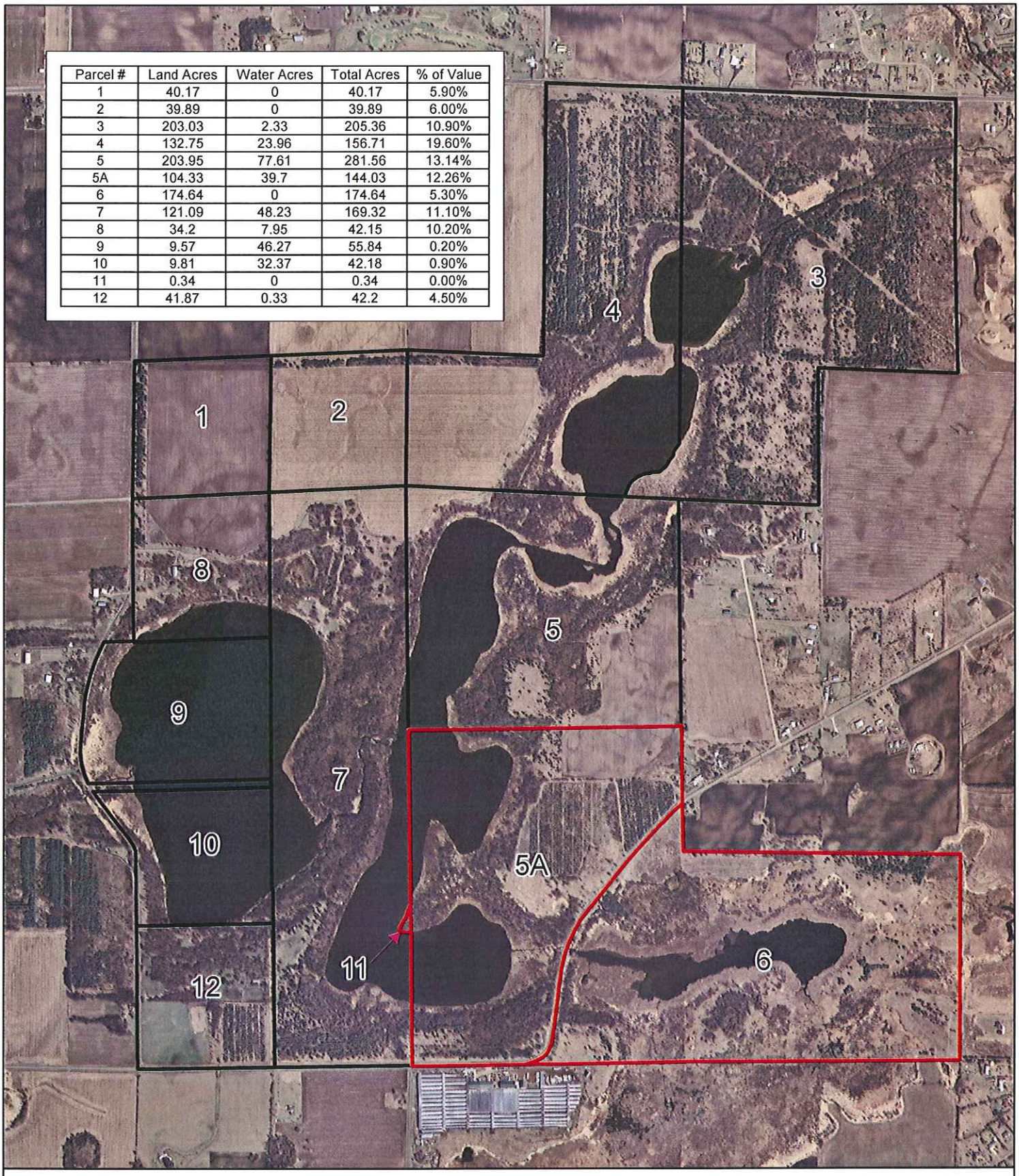
Project Title: Nonmetropolitan Regional Parks and Natural and Scenic Areas (Bertram Chain of Lakes Acquisition)

Project Manager Name: Wayne Sames and Marc Mattice

Trust Fund Appropriation: $1,000,000

2008 Trust Fund Budget	**Result 1 Budget:**	**Amount Spent**	**Balance**	**Result 2 Budget:**	**Amount Spent**	**Balance**	**TOTAL BUDGET**	**TOTAL BALANCE**
	Bertram Chain of Lakes acquisition			*Other Reg. Park/Nat. and Scenic Areas*				
BUDGET ITEM								
Land acquisition	1,000,000	1,000,000	0	0	0	0	1,000,000	0
COLUMN TOTAL	**$1,000,000**	**$1,000,000**	**$0**	**$0**	**$0**	**$0**	**$1,000,000**	**$0**

Parcel #	Land Acres	Water Acres	Total Acres	% of Value
1	40.17	0	40.17	5.90%
2	39.89	0	39.89	6.00%
3	203.03	2.33	205.36	10.90%
4	132.75	23.96	156.71	19.60%
5	203.95	77.61	281.56	13.14%
5A	104.33	39.7	144.03	12.26%
6	174.64	0	174.64	5.30%
7	121.09	48.23	169.32	11.10%
8	34.2	7.95	42.15	10.20%
9	9.57	46.27	55.84	0.20%
10	9.81	32.37	42.18	0.90%
11	0.34	0	0.34	0.00%
12	41.87	0.33	42.2	4.50%



Bertram Chain of Lakes

2008 Acquisition

The YMCA of Metropolitan Minneapolis

2008 Acquisition

YMCA Owned

May, 2008

N W E S

0 400 800 1,600 Feet

Wright County Parks

Created by: Wright County GIS, Office of the County Surveyor

2008 Project Abstract
For the Period Ending June 30, 2010

PROJECT TITLE: Conservation Partners/Environmental Partnerships Matching Grant Program

PROJECT MANAGER: Wayne Sames
AFFILIATION: Department of Natural Resources
MAILING ADDRESS: OMBS, Box 10, 500 Lafayette Road
CITY/STATE/ZIP: St. Paul, MN 55155-4010
PHONE: 651-452-7845
E-MAIL: wayne.sames@state.mn.us
WEBSITE: www.mndnr.gov
FUNDING SOURCE: Environment and Natural Resources Trust Fund
LEGAL CITATION: M.L. 2008, Chap. 367, Sec. 2, Subd. 3(k)

$150,000 is from the trust fund to the commissioner of natural resources to provide matching grants to local governments and private , nonprofit organizations for projects that enhance fish, wildlife, and native plant habitat, provide related research or surveys, and protect and enhance the state's natural environment.

APPROPRIATION AMOUNT: $150,000

Overall Project Outcome and Results

A total of seven projects were completed for a total grant amount of $123,000. Five Conservation Partners habitat projects were completed for $87,000. The projects included reforestation and invasive species removal in Coon Rapids Dam Regional Park; improving the aquatic ecology of a 130 acre shallow lake in Kandiyohi County; restoration of 1,300 feet of Minnesota River shoreline in Mankato; a 15 acre restoration of prairie, savanna and wetland in Ramsey County; and implementation of several lake shore conservation projects in Stearns County.

Two Environmental Partnership projects were completed for $36,000. The projects involved implementation of innovative storm water management and interpretation at Square lake Regional Park and demonstration of innovative storm water management practices with environmental interpretation by the Washington County Conservation District.

Two projects originally awarded grants were withdrawn by the applicants.

Administration of the grants was completed by DNR local grants staff for a total of $10,000. A summary of the funded projects is attached.

Project Results Use and Dissemination

Grant recipients are required to submit a final report on the project to the DNR. This information is maintained in the project file and is available on request. Some projects involve the development of informational signing, brochures, booklets, etc., that are made available to the public.

Trust Fund 2008 Work Program Final Report

Date of Report: October 11, 2010
Final Report
Date of Work Program Approval: June, 2008
Project Completion Date: June 30, 2010

I. PROJECT TITLE: **Conservation Partners / Environmental Partnerships Matching Grant Program**

Project Manager: Wayne Sames
Affiliation: Department of Natural Resources
Mailing Address: OMBS, Box 10, 500 Lafayette Road
City/State/Zip: St. Paul, MN 5515504010
Telephone Number: (651) 259-5559
E-Mail Address: wayne.sames@state.mn.us
FAX Number: 651) 296-6047
Web Page Address: http://www.mndnr.gov

Location: Statewide

Total Trust Fund Project Budget:	**Trust Fund Appropriation:**	**$ 150,000**
	Minus Amount Spent:	**$ 133,000**
	Equal Balance:	**$ 17,000**

Legal Citation: M.L. 2008, Chap. 367, Sec. 2, Subd. 3(k)

Appropriation Language:
$150,000 is from the trust fund to the commissioner of natural resources to provide matching grants to local governments and private, nonprofit organizations for projects that enhance fish, wildlife, and native plant habitat, provide related research or surveys, and protect and enhance the state's natural environment.

II. and III. FINAL PROJECT SUMMARY: A total of seven projects were completed for a total grant amount of $123,000. Five Conservation Partners habitat projects were completed for $87,000. The projects included reforestation and invasive species removal in Coon Rapids Dam Regional Park; improving the aquatic ecology of a 130 acre shallow lake in Kandiyohi County; restoration of 1,300 feet of Minnesota River shoreline in Mankato; a 15 acre restoration of prairie, savanna and wetland in Ramsey County; and implementation of several lake shore conservation projects in Stearns County.

Two Environmental Partnership projects were completed for $36,000. The projects involved implementation of innovative storm water management and interpretation at Square lake Regional Park and demonstration of innovative

storm water management practices with environmental interpretation by the Washington County Conservation District.

Two projects originally awarded grants were withdrawn by the applicants.

Administration of the grants was completed by DNR local grants staff for a total of $10,000. A summary of the funded projects is attached.

IV. OUTLINE OF PROJECT RESULTS:

Result 1: Conservation Partners Grants
Final Report Summary: Five projects were completed for a total of $87,000. One grant totaling $8,000 was withdrawn by the applicant because of a timing issue involving a larger project. See the attached project summary for details of the completed projects.

Summary Budget Information for Result 1:	**Trust Fund Budget:**	**$95,000**
	Amount Spent:	**$87,000**
	Balance:	**$8,000**

Result 2: Environmental Partnerships Grants

Final Report Summary: Two projects were completed for a total of $36,000. One grant totaling $9,000 was withdrawn by the applicant. See the attached project summary for details of the completed projects.

Summary Budget Information for Result 2:	**Trust Fund Budget:**	**$45,000**
	Amount Spent:	**$36,000**
	Balance:	**$9,000**

Result 3. Administrative Costs

Final Report Summary: A total of seven grants were successfully solicited, managed and closed out according to the terms of the grant agreements.

Summary Budget Information for Result 3:	**Trust Fund Budget:**	**$10,000**
	Amount Spent:	**$10,000**
	Balance:	**$0**

V. TOTAL TRUST FUND PROJECT BUDGET:

Staff or Contract Services: $10,000
This funding supported DNR personnel costs for administering the two grant programs. The grant staff, consisting of the grants program manager, two grant specialists, and various financial transactions staff, were involved in grant solicitation, evaluation and ranking, grant agreement management and project billings. A collective full time equivalent for all of the DNR staff involved over a one year period would equal about .125 FTE, or about one-sixteenth FTE per year.
Equipment: $0
Development: $0
Restoration: $87,000
Acquisition, including easements: $0
Other: $36,000 (for innovative storm water management projects and related interpretive projects)
Unspent Balance: $17,000

TOTAL TRUST FUND PROJECT BUDGET: $150,000

Explanation of Capital Expenditures Greater Than $3,500:

VI. OTHER FUNDS & PARTNERS:

A. **Project Partners:** Partners were local governments and watershed or conservation districts. They provided match dollars as well as in-kind and volunteer contributions. They will also assume all long-term maintenance costs for restorations or similar ongoing projects.
B. **Other Funds Proposed to be Spent during the Project Period:** Grant recipients provided a match of at least $133,000.
C. **Past Spending:** The 2005 Trust Fund appropriation for these two grant programs was $500,000. The local match was at least $460,000 ($40,000 was for administrative costs).
D. **Time:** Ending the project period on June 30, 2010 helped to provide one full season for restoration projects.

VII. DISSEMINATION: Grant recipients are required to submit a final report on the project to the DNR. This information is maintained in the project file and is available on request. Some projects involve the development of informational signing, brochures, booklets, etc. that are made available to the public.

VIII. REPORTING REQUIREMENTS:

Periodic work program progress reports will be submitted no later than December 31, 2008; June 30, 2009; and December 31, 2009. A final work program report and associated products was submitted on October 11, 2010 as requested by the LCCMR.

2009 LCMR Project History - Final Report
Conservation Partners and Environmental PartnershipsGrant Programs
October 11, 2010

Conservation Partners

CP09-001	Anoka	Reforestation Initiative	$18,000
CP09-003	Mankato	Minnesota River Bank Restoration	$18,000
CP09-002	Ducks Unlimited	Olson Lake Enhancement	$15,000
CP09-004	Ramsey	Teal Pond Restoration	$18,000
CP09-006	Stearns County SWCD	Fish & Wildlife Habitat Conservation	$18,000
Projects: 5		**Total Program Award**:	$87,000

Environmental Partnerships

EP09-001	Carnelian Marine St. Croix Watershed District	Square Lake Park Water Quality Initiative	$18,000
EP09-003	Washington Conservation District	Storm water Treatment Project	$18,000
Projects: 2		**Total Program Award**:	$36,000

Appropriation Summary:

Appropriation Total:	140,000
Project Awards:	123,000
Balance:	17,000
Total Projects Funded:	7

Attachment A: Budget Detail for 2008 Projects - Summary and a Budget page for each partner (if applicable)

Project Title: Conservation Partners/Environmental Partnerships Matching Grant program

Project manager name: Wayne Sames

Trust Fund Appropriation: $150,000

2008 Trust Fund Budget	**Result 1 Budget:**	**Amount Spent** *(date)*	**Balance Dec. 2007**	**Result 2 Budget:**	**Amount Spent** *(date)*	**Balance Dec. 2007**	**Result 3 Budget:**	**Amount Spent**	**Balance Dec. 2007**	**TOTAL BUDGET**	**TOTAL BALANCE**
	Conservation Partner Grants			*Environmental Partnership Grants*			*Admin. Costs*				
BUDGET ITEM											
Personnel: wages and benefits (includes classified staff)							10,000	10,000	0	10,000	0
Other Land Improvement: Fish, wildlife and native plant habitat	95,000	87,000	8,000							95,000	8,000
Other: Various conservation projects (education/interpretive; monitoring; sampling; research; clean-up; etc.)			0	45,000	36,000	9,000				45,000	9,000
COLUMN TOTAL	**$95,000**	**$87,000**	**$8,000**	**$45,000**	**$36,000**	**$9,000**	**$10,000**	**$10,000**	**$0**	**$150,000**	**$17,000**

Conservation Partners and Environmental Partnerships
2008 Program Results
OMB / Local Grants Unit

County	Year	Title - Recipient	Scope	Award
Anoka	2009	County of Anoka Reforestation Initiative	Removal of invasive species and reforestation in areas affected by Dutch Elm Disease and Oak Wilt in Coon Rapids Dam Regional Park. Reforestation efforts would be focused on the planting of bare root trees and spring ephemera's utilizing native plant materials.	$18,000
Kandiyohi	2009	Ducks Unlimited Olson Lake Enhancement	This project will improve Orson Lake, a 130-acre meandered shallow lake basin that is very turbid and provides little wildlife habitat, by installing a water control structure and drawdown pipe to allow temporary water level drawdowns to rejuvenate the basin’s aquatic ecology.	$15,000
Blue Earth	2009	City of Mankato Minnesota River Bank Restoration	Construction of bend way weirs and re-grading and restoration of 1300 feet of riverbank along the Minnesota River to repair erosion problem. Restoration will be with native plantings and stone.	$18,000
Ramsey	2009	County of Ramsey Teal Pond Restoration	The 15 acre project will include a 6-acre prairie restoration, a 4-acre savanna, 3.4 acres of undesirable tree removal surrounding a 3.5 acre wetland.	$18,000
Stearns	2009	Stearns County SWCD Fish & Wildlife Habitat Conservation	Enhance fish and wildlife habitat by addressing lakeside area resource concerns through implementation of conservation practices in areas identified by the Sterns County Lakeside Project. Approximately five project sites will be identified by locating priority areas and implementing conservation projects using grant funds.	$18,000
Washington	2009	Carnelian Marine St. Croix Square Lake Park Water Quality Initiative	Innovative storm water management and interpretation at Square Lake Park.	$18,000
Washington	2009	Washington Conservation Storm water Treatment Project	Demonstration of innovative storm water management practices with environmental interpretation.	$18,000
Statewide Total		7 Projects		$123,000

2008 Project Abstract
For the Period Ending June 30, 2010

PROJECT TITLE: County Trail System Design: Brown, Lyon, Redwood & Renville
PROJECT MANAGER: Mary Vogel
AFFILIATION: Center for Changing Landscapes, College of Design, University of Minnesota
MAILING ADDRESS: 100 Rapson Hall, 89 Church St. S.E.
CITY/STATE/ZIP: Minneapolis, MN 55455
PHONE: 612-626-7417
E-MAIL: vogel001@umn.edu
WEBSITE: ccl.design.umn.edu
FUNDING SOURCE: Environment and Natural Resources Trust Fund
LEGAL CITATION: M.L. 2008, Chap. [367], Sec. [2], Subd. 3(l).

APPROPRIATION AMOUNT: $175,000

Overall Project Outcome and Results

Project Abstract
Using a publicly engaged process involving citizens, county trail committees, local officials, and trail users, and building on the Center's previous state trail work, the Center for Changing Landscapes created designs/plans for individual county trail systems in Brown, Lyon, Redwood, and Renville Counties. While celebrating the region's and each county's environmental and cultural assets, the county-wide, community, district, and site scale plans/designs link the counties and the communities within them and connect to the existing city trails and the authorized state trails.

Project Goals

- Create county trail plans/designs that promote recreation and environmental awareness and stewardship by addressing issues of environmental type, quality, and preservation along trail corridors and in the larger trail landscapes by preserving, enhancing, and interpreting natural and cultural landscape systems and features;
- Leverage the effectiveness of existing and planned recreational, natural, and cultural assets such as parks, trails, historic sites, conservation lands;
- Create community and county consensus around trail opportunities; and
- Create plans/designs for use to empower county trail funding from local and other sources.

Project Products:

- Community-focused and county-wide trail discussions: local input and critiques of plans/designs were given in over 25 public meetings with trail committees, citizens, and local officials;
- *A* printed and digital report that includes:
  - Analyses of the landscape of the region and the four counties
  - 4 county trail system plans/designs,
  - 49 county system routes through individual communities
  - 54 community trailhead locations,

  - 19 community trailhead designs,
  - 5 trailhead & special place designs,
  - 5 county park trailhead designs,
  - 4 signature element package that brand each county trail: logos, signs, kiosks, and rest areas, and
  - A plan/design for the Chief Sleepy Eye Spur.
- Over 60 display boards of trail work for trail committee and larger public meetings
- Power point presentations for committee and public meetings

Plans are available for download at http://ccl.design.umn.edu/publications.html.

Project Results Use & Dissemination

- Local media have publicized project meetings and the work. There have been newspaper articles, newsletter articles, radio interviews, and website postings.
- The plans/designs have been presented to and discussions held with county trail committees, park committees, city councils, and county boards.
- Plans/designs for Chief Sleepy Eye Spur were presented to the Minnesota Senate's Capitol Investment Committee and the House's Capitol Investment Finance Division
- The work has been adopted in plans:
  - The newly updated Southwestern Trail Plan includes the work.
  - Lyon County has adopted the County's trail plan in its comprehensive plan.
- Plans are being made for a public meeting in September that will roll out all of the work in the four counties and set the stage for cooperation among the counties and for the development of a coordinated implementation strategy.
- Project results distributed to each county in both printed and digital form for their use and posted on LCCMR's and the Center for Changing Landscapes' websites.

Trust Fund 2008 Work Program Final Report

Date of Report: August 16, 2010
Final Report
Date of Work program Approval: June 10, 2008
Project Completion Date: June 15, 2010

I. PROJECT TITLE: County Trail System Design

Project Manager: Mary Vogel
Affiliation: Center for Changing Landscapes, U of M
Mailing Address: College of Design, 151 Rapson Hall 89 Church Street
City / State / Zip: Minneapolis, MN 55455
Telephone Number: 612-626-7417
E-mail Address: vogel001@umn.edu
FAX Number: 612-626-7424
Web Page address: http://ccl.gis.umn.edu (old address)
http://ccl.design.umn.edu (new address)

Location: Lyon, Brown, Redwood, & Renville Counties

Total Trust Fund Project Budget:	**Trust Fund Appropriation:**	**$ 175,000**
	Minus Amount Spent:	**175,000**
	Equal Balance:	**0**

Legal Citation: M.L. 2008, Chap. [367], Sec. [2], Subd. 3(l).

Appropriation Language:
$175,000 is from the trust fund to the Board of Regents of the University of Minnesota to design recreational trail systems for Lyon, Brown, Redwood, and Renville Counties.

II. & III FINAL PROJECT SUMMARY:
Using a publicly engaged process involving citizens, county trail committees, local officials, and trail users, and building on the Center's previous state trail work, the Center for Changing Landscapes created designs/plans for individual county trail systems in Brown, Lyon, Redwood and Renville Counties. While celebrating the region's and each county's environmental and cultural assets, the county-wide, community, district, and site scale plans/designs link the counties and the communities within them and connect to the existing city trails and the authorized state trails.

Project Goals

- Create county trail plans/designs that promote recreation and environmental awareness and stewardship by addressing issues of environmental type, quality, and preservation along trail corridors and in the larger trail landscapes by

preserving, enhancing, and interpreting natural and cultural landscape systems and features;

- Leverage the effectiveness of existing and planned recreational, natural, and cultural assets such as parks, trails, historic sites, conservation lands;
- Create community and county consensus around trail opportunities; and
- Create plans/designs for use in grant applications that empower county trail funding from local and other sources.

Project Products:

- Community-focused and county-wide trail discussions: local input and critiques of plans/designs were given in over 25 public meetings with trail committees, citizens, and local officials;
- *A* printed and digital report that includes:
  - Analyses of the landscape of the region and the four counties
  - 4 county trail system plans/designs,
  - 49 county system routes through individual communities
  - 54 community trailhead locations,
  - 19 community trailhead designs,
  - 5 trailhead & special place designs,
  - 5 county park trailhead designs,
  - 4 signature element package that brand each county trail: logos, signs, kiosks, and rest areas, and
  - A plan/design for the Chief Sleepy Eye Spur.
- Over 60 display boards of trail work for trail committee and larger public meetings
- Power point presentations for committee and public meetings

The state trail system has generated interest at the local level to create county trail systems that link to state trails and celebrate regional environmental and cultural assets. The state has recognized the value of such trails by establishing a regional grant program. However, most rural counties lack the planning and design resources themselves or the funds to engage outside planning/design assistance that would move a county trail system forward. This proposal for four county trail systems is a response to the many requests that we have received for planning/design assistance at the county level. The design/planning work will include county, community, district, and site designs/plans. A project team from the Center for Changing Landscapes, an interdisciplinary center at the University of Minnesota, will work with counties, communities, trail groups, and citizens in a community-engaged process to ensure local and user input. The plans/designs goals are to:

1. Create county trail plans/designs that support and promote recreation and environmental awareness and stewardship by addressing issues of environmental type, quality, and preservation along new trail corridors and in the larger trail landscapes to preserve, enhance, and interpret natural and cultural landscape systems and features,
2. Leverage the effectiveness of existing and planned local, regional, and state recreational, natural, and cultural assets such as parks, trails, historic sites, conservation lands,
3. Create community consensus around trail opportunities, and

4. Empower counties and citizens to effectively seek regional trail funding by creating planning/design tools that can be used for grant applications.

IV. OUTLINE OF PROJECT RESULTS*:*

Result 1: Work with counties and communities to create plans and designs for county trail systems that connect community, county, and state natural and cultural assets in Brown County, Lyon County and Tatanka Bluffs (Redwood and Renville Counties).

Description: The following activities were done for each of the county groups:
Activity A: Collect & Analyze Data, Identify Issues for the County Existing data describing the physical environment from both the natural systems and cultural perspectives were gathered which identified local, regional, and state resources. Work with the county, communities, and trail groups ensured local and user input on natural resource, recreational, tourism, and community issues.
Activity B: Develop Alternative Design Concepts for the County Using the data, planning/design concepts for a county trail system that connects to the communities and to the current and planned state trails and parks in each county were created. Places for environmental interpretation for use by trail users and by environmental educators and other local teachers were identified. Environmental and cultural amenities that can be visited or observed from the trail were identified.
Activity C: Presentation of Plans/Designs for Feedback Trail committee meetings and countywide public meetings for discussion and feedback were held. Environmentalists, local officials and special interest groups such as trail groups, tourism organizations, other citizen organizations, and citizens were involved.
Activity D: Refine and Complete Plans/Designs The feedback received from the trail committees and public meetings informed the final designs.
Activity E: Publish Results in Print & Digital Form A county trail design framework plan and designs for specific trail-related areas was produced in both printed and digital graphic format. They are understandable, accessible, and useful tools for local trail grant applications.

Summary Budget Information for Result 1:	**Trust Fund Budget:**	**$175,000**
	Amount Spent:	**$175,000**
	Balance:	**$ 0**

Deliverable	Completion Date	Budget	Status
1. Lyon County: County Trail Plan/ Design book, large format maps and drawings for public display, and digital copies of the work.	January 15, 2010	$58,000	complete
2. Brown County: County Trail	February 15,	$58,500	complete

Plan/ Design book", large format maps and drawings for public display, and digital copies of the work.	2010		
3. Redwood County Trail & Renville County Trail **(**Tatanka Bluffs): County Trail Plan/ Design books, large format maps and drawings for public display, and digital copies of the work.	June 30, 2010	$58,500	complete

V. TOTAL TRUST FUND PROJECT BUDGET: $175,000

Staff or Contract Services: $170,255
Equipment: Not applicable
Development: Not applicable
Restoration: Not applicable
Acquisition, including easements: Not applicable
Other: Travel Expenses in Minnesota: $1,387
Duplicating and supplies: $3,358
TOTAL TRUST FUND PROJECT BUDGET: $175,000
1. Personnel $162,566 increased to $170,255
2. Duplicating $6,443 decreased to $ 3,358: $3,076 transferred to personnel
3. Travel $6,000 decreased to $1,387: $4,613 transferred to personnel

The transfer within categories was necessary because of some project delays and changes in the designs/plans:
1. The responses from the communities delayed the work and required extra staff time to implement the changes in the designs/plans.
2. The printing of the final reports and the materials for the public meetings in September are taking place outside of the project time frame.
3. Travel to some of the meetings was covered by other budgets; meetings were clustered.
4. The matching money is funding the printing costs, staff time, and some travel in September.

Explanation of Capital Expenditures Greater Than $3,500: Does not apply

VI. OTHER FUNDS & PARTNERS:

A. Project Partners: No partners are receiving trust fund dollars for this project.

B. Other Funds Proposed to be Spent during the Project Period: The time to be spent by local citizens, citizen groups, and local government staff working with the design team as community partners are a local match. At $10.00 an hour for citizen time and $25.00 for local government staff time, the estimate for the in-kind match

exceeds $25,000 for each county group. The project was not able to be informed by the historical work done by the Great River Greening for its Green Corridor Project funded by LCCMR because the historic sites were not identified. $45,000 was raised by Renville and Redwood Counties to increase resources for the project in Redwood and Renville Counties. These matching funds were used for additional design/planning work, printing the final reports, and for expenses associated with the multi-county meeting planned for September that is outside the LCCMR scope of work.

C. Past Spending: Time was spent by in each county by local citizens, citizen groups, and local government staff working together to develop trail groups and trail visions. At $10.00 an hour for citizen time and $25.00 for local government staff time, the estimate for the in-kind match exceeds $25,000. In Lyon County the Center for Changing Landscapes' work with the City of Marshall developed a city trail system that connects and complements the county trail work. The Center received a $50,000 grant for the Marshall work.

D. Time: The period July 1, 2009-June 15, 2010 is needed to work with the communities and local governments to create designs/plans that reflect local needs and aspirations. The work funded by the match wil extend tthrough September 2010 in order to accommodate scheduling the meetings.

VII. DISSEMINATION: The project's results created in Activity E to is to be distributed to each county in both printed and digital form for their use. They will also be available on LCCMR's and the Center for Changing Landscapes' websites. Project work dissemination has included*:*

- Local media have publicized project meetings and the work. There have been newspaper articles and radio interviews.
- The plans/designs have been presented to and discussions held with county trail committees, park committees, city councils, and county boards.
- Plans/designs for Chief Sleepy Eye Spur were presented to the Minnesota Senate's Capitol Investment Committee and the House's Capitol Investment Finance Division.
- The work has been adopted in plans:
  - The newly updated Southwestern Trail Plan includes the work.
  - Lyon County has adopted the County's trail plan in its comprehensive plan.
- Plans are being made for a public meeting in September that will roll out all of the work in the four counties and set the stage for cooperation among the counties and for the development of a coordinated implementation strategy.

VIII. REPORTING REQUIREMENTS:

Periodic work program progress reports will be submitted not later than:

- **January 15, 2009**
- **July 15, 2009**
- **January 21, 2010**

A final work program report and associated products will be submitted:

- **Between June 30 and August 16, 2010 as requested by the LCCMR**

IX. RESEARCH PROJECTS: Not applicable

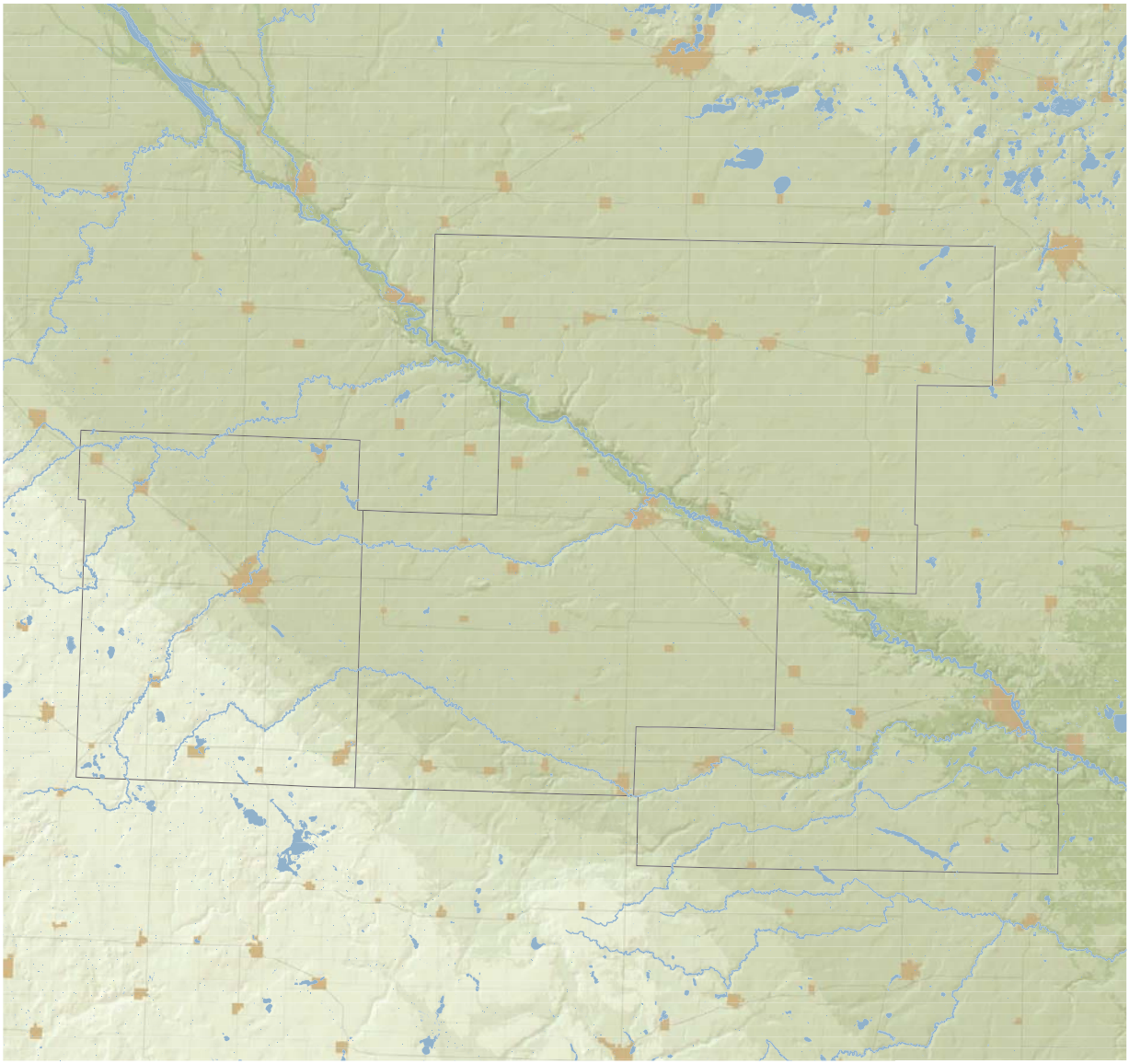
Attachment A: Budget Detail for 2008 Projects

Project Title: *County Trail Systems for Recreation & Environmental Awareness*

Project Manager Name: *Mary Vogel*

		Result 1 Budget:			Budget Total		
Budget Item	**Detail Budget**	**Budget**	**Amount Spent 6/30/2010**	**Ending Balance 6/30/2010**	**Budget**	**Amount Spent**	**Ending Balance**
Personnel: Staff Salaries & Fringe	$ 162,566	$ 162,566	$ 170,255	$ (7,689)	$ 162,566	$ 170,255	$ (7,689)
Project Leader : 50%	$ 30,243						
Research Fellows: 2 @ 75%, 1 @ 47%	$ 83,174						
Senior Fellows: Designers at $75/Hr. & 100 Hrs.	$ 7,500						
Administrative Staff: 5%	$ 7,463						
Personnel: Staff Benefits							
Project Leader @ 33% Fringe	$ 9,919						
Research Fellows @ 33% & 20% Fringe	$ 21,205						
Senior Fellows: Designers @ 7% Fringe	$ 525						
Administrative Staff @ 33% Fringe	$ 2,537						
Duplicating & Other Supplies: Drawing Paper, Ink, ect	$ 6,434	$ 6,434	$ 3,358	$ 3,076	$ 6,434	$ 3,358	$ 3,076
Travel Expenses in Minnesota	$ 6,000	$ 6,000	$ 1,387	$ 4,613	$ 6,000	$ 1,387	$ 4,613
Column Total	**175,000**	**$ 175,000**	**$ 175,000**	**$ (0)**	**$ 175,000**	**$ 175,000**	**$ (0)**

COUNTY TRAIL SYSTEM DESIGN: BROWN, LYON, REDWOOD & RENVILLE COUNTIES



JUNE 2010

2008 Project Abstract
For the Period Ending June 30, 2010

PROJECT TITLE: **Accelerated Prairie Management, Survey, Acquisition and Evaluation**

PROJECT MANAGER: Carmen Converse
AFFILIATION: Division of Ecological and Water Resources, MN Department of Natural Resources

MAILING ADDRESS: Box 25, 500 Lafayette Road
CITY / STATE / ZIP: St Paul, MN 55155
PHONE: (651) 259-5083
E-MAIL: Carmen.converse@state.mn.us
WEBSITE: http://www.dnr.state.mn.us/eco
FUNDING SOURCE: Environment and Natural Resources Trust Fund

LEGAL CITATION: ML 2008, Chap. 367, Sec. 2, Subd. 3(m).
$1,250,000 is from the trust fund to the commissioner of natural resources to provide for a rapid assessment of remaining native prairie, accelerate the Minnesota county biological survey in the prairie region, provide technical assistance to private prairie landowners, accelerate management of public and private prairie lands, evaluate and monitor prairie conditions and associated wildlife, and acquire prairie natural areas, prairie bank easements, and buffers. At least $475,000 of this appropriation must be spent on acquisition. A list of proposed restorations and fee title and easement acquisitions must be provided as part of the required work program. All funding for conservation easements must include a long-term stewardship plan and funding for monitoring and enforcing the agreement.

APPROPRIATION AMOUNT: $1,250,000

Overall Project Outcome and Results (includes Use and Dissemination)
Minnesota's native prairie covered about 18 million acres at the time of the public land surveys (1847-1908); currently less than one percent remains. This multi-faceted prairie project was designed to increase conservation of native prairie and provide tools for long-term management and assessment of this rare resource. Project results addressed:

1. Rapid assessment of remaining native prairie;
2. Completion of the Minnesota County Biological Survey (MCBS) in six prairie counties;
3. Increased technical assistance to private prairie landowners;
4. Acceleration of management of public and private prairie lands;
5. Establishment of a baseline dataset for long-term status trend monitoring and analysis;
6. Acquisition of prairie bank easements.

Results:
1) Rapid Assessment: The effectiveness of a computerized procedure to detect changes in mapped prairies was explored in this result. Detailed feature extraction, segmentation, and change analysis procedures using the SPRING software was completed for 1,521 prairie/savanna sites identified by the MCBS prior to 1994. The total area assessed included 65,444 acres of prairie/savanna habitat in 32 counties and over 192,000 acres of surrounding

“buffer” area. Statewide, the prairie habitat examined had a 4% change affecting 2,332 acres from 1991 to 2008. Prairie habitat outside of protected areas had significantly higher amounts of prairie loss or woody vegetation encroachment. A separate report, *Accelerated prairie management, survey, acquisition and evaluation result 1: Rapid assessment of remaining native prairie* was completed.

2) MCBS completed surveys in six counties. Less than 1,700 acres of prairie in these counties was recorded as compared to approximately 2,053,300 acres recorded in the late 1800’s. The rarity of prairie species is largely due to prairie habitat loss and fragmentation. Rare plant populations were recorded at 281 new locations, including new distributional data on species such as Wild quinine and Valerian. Vegetation samples (relevés) were collected at 26 locations. A State Wildlife Grant for concurrent animal surveys resulted in 70 new records. Sites of high biodiversity significance such as the 15 acre Dexter Prairie were identified for protection as natural areas.

3) Technical assistance: DNR prairie specialists provided consultation regarding management and protection strategies for native prairies at eight public events and individually to 63 private landowners. Forty prairie stewardship plans were delivered to landowners.

4) Management: The Scientific and Natural Area program (SNA) prairie management activities resulted in 545 acres of woody plant removal, 2085 acres of prescribed burning, 2162 acres of exotic species treatments, and 84.5 acres of prairie reconstruction.

5) Status Trend Monitoring: A total of 683 vegetation transects, 42 relevés, and 1596 bird point counts were completed at 38 sites containing high quality prairie providing a baseline dataset for future proposed long-term monitoring and analysis on at least 35 sites. A separate report, *Accelerated prairie management, survey, acquisition and evaluation result 5: Prairie monitoring and evaluation* was completed.

6) Protection: SNA protected high quality prairies in Big Stone, Pipestone, Goodhue, and Fillmore counties through acquisition of five Native Prairie Bank conservation easements (totaling 476.2 acres) that provide habitat for species such as Greater Prairie Chicken, Chestnut-collared Longspur, Prairie bush clover and Plains wild indigo.

Trust Fund 2008 Work Program Final Report

Date of Report: October 31, 2010
Final Report:
Date of Work Program Approval: June 10, 2008
Project Completion Date: June 30, 2010

I. PROJECT TITLE: **Accelerated Prairie Management, Survey, Acquisition and Evaluation**

Project Manager: Carmen Converse
Affiliation: Division of Ecological and Water Resources, MN Department of Natural Resources
Mailing Address: Box 25, 500 Lafayette Road
City / State / Zip: St Paul, MN 55155
Telephone Number: (651) 259-5083
E-mail Address: Carmen.converse@state.mn.us
FAX Number: (651) 296-1811
Web Page address: http://www.dnr.state.mn.us/eco
Location: See attached maps- Minnesota's prairie region

Total Trust Fund Project Budget: Trust Fund Appropriation:		**$ 1,250,000**
	Minus Amount Spent:	**$ 1,247,738**
	Equal Balance:	**$ 2,262**

Legal Citation: ML 2008, Chap. 367, Sec. 2, Subd. 3(m).

Proposed Appropriation Language:
$1,250,000 is from the trust fund to the commissioner of natural resources to provide for a rapid assessment of remaining native prairie, accelerate the Minnesota county biological survey in the prairie region, provide technical assistance to private prairie landowners, accelerate management of public and private prairie lands, evaluate and monitor prairie conditions and associated wildlife, and acquire prairie natural areas, prairie bank easements, and buffers. At least $475,000 of this appropriation must be spent on acquisition. A list of proposed restorations and fee title and easement acquisitions must be provided as part of the required work program. All funding for conservation easements must include a long-term stewardship plan and funding for monitoring and enforcing the agreement.

II. and III. FINAL PROJECT SUMMARY:
Minnesota's native prairie covered about 18 million acres at the time of the public land surveys (1847-1908); currently less than one percent remains. This multi-faceted prairie project was designed to increase conservation of native prairie and provide tools for long-term management and assessment of this rare resource. Project results addressed: 1) Rapid assessment of remaining native prairie 2) Completion of the Minnesota County Biological Survey (MCBS) in six prairie counties 3) Increased technical assistance to private prairie landowners 4) Acceleration of management of public and private prairie lands. 5) Establishment of

a baseline dataset for long-term status trend monitoring and analysis. 6) Acquisition of prairie bank easements.

Results:
1) Rapid Assessment: The effectiveness of a computerized procedure to detect changes in mapped prairies was explored in this result. Detailed feature extraction, segmentation and change analysis procedures using the SPRING software was completed for 1,521 prairie/savanna sites identified by the Minnesota County Biological Survey prior to 1994. The total area assessed included 65,444 acres of prairie/savanna habitat in 32 counties and over 192,000 acres of surrounding "buffer" area. Statewide, the prairie habitat examined had a 4% change affecting 2,332 acres from 1991 to 2008. Prairie habitat outside of protected areas had significantly higher amounts of prairie loss or woody vegetation encroachment. A separate report, *Accelerated prairie management, survey, acquisition and evaluation result 1: Rapid assessment of remaining native prairie* was completed.

2) MCBS completed surveys in six counties. Less than 1,700 acres of prairie in these counties was recorded as compared to approximately 2,053,300 acres recorded in the late 1800's. The rarity of prairie species is largely due to prairie habitat loss and fragmentation. Rare plant populations were recorded at 281 new locations, including new distributional data on species such as Wild quinine and Valerian. Vegetation samples (relevés) were collected at 26 locations. A State Wildlife Grant for concurrent animal surveys resulted in 70 new records. Sites of high biodiversity significance such as the 15 acre Dexter Prairie were identified for protection as natural areas.

3) Technical assistance: DNR prairie specialists provided consultation regarding management and protection strategies for native prairies at eight public events and individually to 63 private landowners. Forty prairie stewardship plans were delivered to landowners.

4) Management: The Scientific and Natural Area program (SNA) prairie management activities resulted in 545 acres of woody plant removal, 2085 acres of prescribed burning, 2162 acres of exotic species treatments, and 84.5 acres of prairie reconstruction.

5) Status Trend Monitoring: A total of 683 vegetation transects, 42 relevés, and 1596 bird point counts were completed at 38 sites containing high quality prairie providing a baseline dataset for future proposed long-term monitoring and analysis on at least 35 sites. A separate report, *Accelerated prairie management, survey, acquisition and evaluation result 5: Prairie monitoring and evaluation* was completed.

6) Protection: SNA protected high quality prairies in Big Stone, Pipestone, Goodhue, and Fillmore counties through acquisition of five Native Prairie Bank conservation easements (totaling 476.2 acres) that provide habitat for species such as Greater Prairie Chicken, Chestnut-collared Longspur, Prairie bush clover and Plains wild indigo.

IV. OUTLINE OF PROJECT RESULTS*:*

Result 1: Rapid assessment of remaining native prairie

Description: This result will assess the status of approximately 2900 prairie sites surveyed by the MCBS over fifteen years ago, using remote sensing. About half of these sites remain unprotected and are vulnerable to conversion including row crop agriculture, mining, housing, or other conversion. Regardless of protection status, native prairie is vulnerable to degradation due to lack of fire, encroachment by woody plants, competition from non-native plants, global climate change, and other factors. Most native prairie currently exists as small and isolated remnants that are especially susceptible to the often negative influences of adjacent land use practices such as herbicide and pesticide use, conversion of Conservation Reserve Program grasslands to row crops, and development of transportation corridors.

This result will use remote sensing to identify which of the approximately 2900 sites have been changed in the last 15 years by agriculture, mining, housing, roads, woody plant invasion, or other factors visible using remote sensing. Air photos from two time periods (1991 and 2006) will be interpreted to assess the type and extent of changes detected. A small number of sites will need further investigation to determine the type of change by first consulting with those currently knowledgeable about the condition of site, leaving a few sites that will require a site visit by DNR staff.

Photos are available at one to two meter resolution as scanned and geographically rectified digital images on the DNR GIS data server. The 1991 aerial photos are black and white infrared images from the National Aerial Photography Program (NAPP) coordinated by the US Geological Survey. The 2006 photos are true-color images from the USDA Farm Service Agency (FSA). True-color photos from 2003-2004 will be used to complement the 2006 photos as needed. Photo interpretation will be conducted by either a contractor or DNR staff with results recorded using a GIS platform.

A report will describe the status of the 2,900 prairie sites using the following three categories: 1) Number of sites with all prairie remaining. 2) Number of sites with some level of change. 3) Number of sites fully and irreversibly changed. Impact to adjacent areas will be reported as number of sites with change within 50 meters and 100 meters. Changes both within and adjacent to sites will be recorded as mining, road, development, agriculture, woody growth, or other. Depending on feasibility, changes will be mapped, allowing for a summary of the amount of area changed or disturbed. This result will not provide updated boundaries of partially converted/changed sites as this requires further field follow-up.

The outcome of Result 1 will be used to develop protocols for future rapid change analysis procedures to assess the extent of Minnesota's native prairie.

Summary Budget Information for Result 1: **Trust Fund Budget: $25,000**
Amount Spent: $24,803
Balance: $ 197

Deliverable	Completion Date	Budget	Status
1. Quantification of amount of remaining native prairie, changed prairie, and level of adjacent land use changes on approximately 2,900 MCBS prairie sites.	6/30/09	$20,000	1,521 sites were selected (65,443 acres)
2. Report and map detailing status of approximately 2,900 prairie sites.	12/31/09	$2,500	Report completed (Attachment B)
3. Protocols for long-term status assessment using new remote sensing tools are developed.	6/30/10	$2,500	Recommendations completed

Final Report Summary:
The rapid assessment of remaining native prairie report that is included in Attachment B was written by Ecologist Andrew Horton who was hired on a temporary basis, in part to complete this portion of the Accelerated Prairie Project. A separate report, *Accelerated prairie management, survey, acquisition and evaluation result 1: Rapid assessment of remaining native prairie* was completed (Attachment B). A summary of that report follows. Additional funding for this Result was provided by a State Wildlife Grant (see section VI below).

Site Selection: A total of 1,521 sites identified by Minnesota County Biological Survey as prairie or savanna habitat prior to 1994 were reviewed for land-use change in the last 15 years. The total area covered included 65,444 acres of prairie/savanna habitat within 32 counties and over 192,000 acres of surrounding buffer. For this report, the entire area was collectively called prairie habitat.

A feature extraction program called SPRING was used to digitize land-use boundaries present in the 2008 photography. The polygons created from this process were used to compare with 1991 imagery and each polygon was updated with a land-use category for both years if there was any change present. Land-use descriptions include detailed categories for Development, Mining, Woody Vegetation Encroachment, Agricultural Activities, Grassland types, Aquatic Habitat or Bare Soil. The final dataset contains a detailed and quantifiable list of non-overlapping land-use change categories.

Change Analysis Results: Statewide, the prairie habitat examined had a 4% change affecting 2,332 acres from 1991 to 2008. The majority of that change was an increase in woody vegetation (1,019 acres), which is potentially reversible through management. Of the areas evaluated, 1.18% of prairie habitat was lost (770 acres) by conversion to development, row crop or mining. There was 544 acres of

woody vegetation removal that was likely a benefit to the prairie habitat. The greatest prairie habitat conversion occurred in the Metro Region due largely to development, and the Minnesota River Valley West Region due to row crop agriculture. The Aspen Prairie Parklands Region had the greatest increase in woody cover growth in mapped prairie habitat when compared with the rest of the evaluated area.

Buffer areas surrounding prairie habitat experienced little change in the past 15 years and results were similar between the 100 meter and 500 meter buffers. Approximately 3% of open grassland was either converted or degraded. Native prairie buffers in the Metro Region had the highest amount of grassland/open space loss from woody encroachment and development.

Of the 1,521 sites evaluated, 1,315 sites had no change from development, mining or agriculture. For the remaining 206 sites, more than half had less than 5% of the overall polygon altered. There were only 11 sites with more than 75% of the original prairie habitat altered and 9 sites in this category were located in the Metro Region.

Of the prairie habitat evaluated, roughly half were considered protected (state, federal, county owned or private enrolled in conservation programs). Prairie habitat not protected had significantly higher amounts of prairie loss or woody vegetation encroachment. Private lands also had less woody vegetation removal than protected-lands. Prairie habitat under protective ownership had little prairie loss (19 acres) with most occurring on county lands and state Wildlife Management Areas.

Quality control checks were done for a small number of sites in Kittson, Red Lake, Mahnomen, Wilkin, Traverse, Big Stone, Grant and Redwood counties. These sites were already scheduled for a site visit to determine questionable or unknown land use, but all other known land use categories were verified and determined to be accurate for each site.

Analysis of Protocols: The change analysis procedure involved many time consuming steps making this project less efficient than originally expected. Problems encountered involved poor image quality for air photos in the southwest part of the state, the seasonal differences in the dates of photography (fall – leaf off in 1991, spring – leaf on in 2008), and the fact that the large spatial extent of area assessed resulted in slow interpretation speed. Steps taken to speed-up processing time included upgrading both computer hardware and the SPRING software and adding additional storage capacity. Given these constraints, it appeared that the processing time still was relatively fast as compared to manually digitizing each prairie and buffer area, assigning them land-use values, and recording observed changes.

Result 2: Accelerated Minnesota County Biological Survey (MCBS) in southern Minnesota counties

Description: The Minnesota County Biological Survey (MCBS) identifies significant natural areas and systematically collects and interprets data on the distribution and ecology of native plant communities, rare plants and rare animals. The information

gathered by MCBS serves as a foundation for the conservation of critical components of Minnesota's biological diversity through ecological monitoring, environmental review, planning, and critical habitat protection.

This project in the six southern Minnesota counties (Dodge, Faribault, Freeborn, Mower, Steele and Waseca) will supplement surveys in progress in other parts of Minnesota as described in Trust Fund 2007 Work Program entitled *Minnesota County Biological Survey.* See also attached map.

Procedure:
Review and site identification: Plant ecologists and zoologists will review existing relevant natural resource data and use Geographic Information Systems and the DNR's Natural Heritage Information System to consolidate and organize data. Examples of reviewed data include wetlands inventories, wildlife habitat inventories, park surveys, soil surveys, land use data, historical public land surveys, biophysical surveys, academic research, and records from museum collections. Staff will supplement this review through interpretation of aerial photography or other imagery in order to identify MCBS sites and species habitats for targeted surveys.

Coordination: Staff will notify and coordinate surveys when possible with other divisions within the DNR, universities, counties, municipalities, watershed districts, federal natural resource agencies, conservation organizations, corporations, and individual landowners.

Field Surveys: Ground surveys to assess natural area and native plant community quality and condition also will include the collection of vegetation samples using relevés in coordination with other sampling (soils, water chemistry etc.) when possible. Additional specialized techniques will be used to survey selected rare species or groups of species (e.g., plants, birds, mammals, reptiles, amphibians, insects, fish).

Natural Heritage Information System: All data collected by MCBS will be entered into the related map, manual and computerized files that make up the Natural Heritage Information System. Some of the databases include: rare features (geographic), relevé (vegetation plot samples), county checklists of plants and animals, MCBS sites, native plant community polygons (GIS), and animal aggregations. Locations of native plant communities are mapped using digital raster graphics, digital orthophotoquads and other digital imagery using ArcGIS. Shape files will be made available on the DNR's Data Deli accessible through the DNR's website. Rare species locations will be entered into Biotics, an information system developed internationally for storing and distributing rare features data such as that collected by MCBS. Photographic vouchers, color slides, digital images, and other digital media will be stored at the DNR, St. Paul and field data sheets will be filed electronically or manually.

Preparation of Collections: All plant and animal specimens will be identified and collections will be prepared for permanent storage in appropriate repositories at the

J.F. Bell Museum of Natural History at the University of Minnesota and at the Science Museum of Minnesota.

Summary Budget Information for Result 2: Trust Fund Budget: $ 100,000
Amount Spent: $ 99,541
Balance: $ 459

Deliverable	Completion Date	Budget	Status
Completed native plant community surveys. Rare plant and rare animal surveys in Dodge, Faribault, Freeborn, Martin, Steele, & Waseca counties.	6/30/10	$100,000	Completed field surveys in six counties.

Final Report Summary:

Field surveys were completed in all six counties. MCBS has now finished the survey of rare features in all Minnesota counties where prairie and wetlands dominated the terrestrial landscape at the time of the public land surveys (1847-1908). Less than 1,700 acres of prairie in these counties were recorded as compared to approximately 2,053,300 acres at the time of the public land surveys (1847-1908). Railroad and road rights-of-way contain about half of the extant acres.

The rarity of many of the species associated with this landscape is due largely to habitat loss and fragmentation. The conversion of the prairie and wetlands landscape to row-crop agriculture is especially evident in these six counties. In the six counties rare plant populations were recorded in 281 new locations and in 70 locations for animals. The identification of the remaining parcels of native habitat is intended to help set conservation priorities in this region. In some portions of the region, forested sites associated with riparian features represent some of the best opportunities for conservation.

The collection of vegetation plot data (relevés) at 26 new sites will be especially useful in guiding restoration and prairie monitoring efforts. The survey of species such as the Wood Turtle is contributing to the development of a statewide monitoring project of the populations of this species.

Review and Site Identification/Coordination: A part time botanist/plant ecologist, Derek Anderson was trained in MCBS procedures by senior plant ecologist/botanists and conducted most of the MCBS site, native plant community and rare plant surveys with some assistance from contractors and volunteers. He worked with the animal survey staff in identification of potential survey sites through review of the most recent air photos from the USDA Farm Service Agency (FSA). This was supplemented by review of other resource data and consultation with local natural resource staff from various agencies and individuals in the counties knowledgeable especially about the location of remnant prairies. Permits to public lands were

obtained when needed and private landowners were contacted to obtain permission for access to their lands.

Various activities in coordination with local groups, agencies and conservation organizations increased awareness and understanding of the rare resources of the region.

Examples:

- The plant ecologist solicited and organized work of volunteers from region for a week long, systematic-survey for the plant Green dragon (*Arisaema dracontium*). This plant is currently being considered for listing as a species of special concern. Plants were found in four of five sites surveyed along the Straight River in Steele County and the Cedar River in Mower County.
- A presentation to the Mower County Audubon Society highlighted MCBS 2009 outcomes in the county.
- A presentation to Boy Scout troop leaders provided information about the plants, animals and native plant communities of their region to assist with their planning of future Scout nature programs and activities.
- A MCBS booth at the Waseca County Chautauqua highlighted MCBS findings from the county. Information ranging from rare species descriptions, significant natural areas, and invasive species was shared with over 600 individuals from the greater region.
- The plant ecologist met with staff from DNR's Division of Parks and Trails to help design the Stagecoach Trail to avoid routes that would negatively impact small prairie remnants in the rights-of-way along a number of roads in Dodge and Steele counties.
- Technical assistance related to rare features was provided to the Soil and Water Conservation District of Waseca County.
- The plant ecologist assisted the landowner of a small strip of prairie along a former railroad right-of-way in interpretation and plant identification for a tour by members of the Changing Seasons Garden Club of Rose Creek.

Field Surveys/Natural Heritage Information System:

Locations of native plant communities and MCBS sites of biodiversity significance recorded during field surveys were mapped using ArcGIS for addition to DNR's Data Deli, a public site where users have access to these digital GIS files.

The statewide prairie map available on DNR's website will be updated by December 2010 to include new shape files from prairie native plant community data collected in these counties. http://files.dnr.state.mn.us/eco/mcbs/prairie_map.pdf

The classification used to map native plant communities is presented in two published field guides: *Field guide to the native plant communities of Minnesota: The Eastern Broadleaf Forest Province* and *Field guide to the native plant communities of Minnesota: The Prairie Parkland and Tallgrass Aspen Parklands provinces (2005)* Minnesota Department of Natural Resources (partial funding for these field guides

provided by the Minnesota Environment and Natural Resources Trust Fund). See also the DNR website http://www.dnr.state.mn.us/npc/classification.html

Native plant communities surveyed and mapped in the six counties.

FDs37 – Southern Dry-Mesic Oak (Maple) Woodland

- MHs37 – Southern Dry-Mesic Oak Forest
- MHs38 – Southern Mesic Oak-Basswood Forest
  - MHs38b – Basswood – Bur Oak – (Green Ash) Forest
  - MHs38c – Red Oak – Sugar Maple – Basswood – (Bitternut Hickory) Forest
- MHs39 – Southern Mesic Maple-Basswood Forest
  - MHs39a – Sugar Maple – Basswood (Bitternut Hickory) Forest
  - MHs39c – Sugar Maple Forest (Big Woods)
- MHs49 – Southern Wet-Mesic Hardwood Forest
  - MHs49a – Elm – Basswood – Black Ash – (Hackberry) Forest
- FFs59 – Southern Terrace Forest
  - FFs59a – Silver Maple – Green Ash – Cottonwood Terrace Forest
  - FFs59c – Elm – Ash – Basswood Terrace Forest
- FFs68 – Southern Floodplain Forest
- LKi54b – Mud Flat (Inland Lake)
- CTs33b – Mesic Limestone-Dolomite Cliff (Southern)
- OPp93c – Calcareous Fen (Southeastern)
- UPs13b – Dry Sand – Gravel Prairie (Southern)
- UPs23a – Mesic Prairie (Southern)
- UPs24a – Mesic Oak Savanna (Southern)
- Wps54b – Wet Prairie (Southern)
- WMs83 – Southern Seepage Meadow/Carr
  - WMs83a1– Seepage Meadow/Carr (Tussock Sedge Subtype)
- MRn93a – Bulrush Marsh (Northern)
- MRn93b – Spikerush – Bur Reed Marsh (Northern)

Vegetation samples (relevés) collected at 26 locations were added to the Relevé Database. Relevé methods are described in: Minnesota Department of Natural Resources. 2007. *A handbook for collecting vegetation plot data in Minnesota: the relevé method.* Minnesota County Biological Survey, Minnesota Natural Heritage and Nongame Research Program, and Ecological Land Classification Program. Biological Report 92. St. Paul: Minnesota Department of Natural Resources. Also available on the DNR website:
http://www.dnr.state.mn.us/eco/mcbs/vegetation_sampling.html

Improvement to the computerized functionality of the Relevé Database was completed (with other funding provided to MCBS by the Environmental Trust Fund) resulting in more expedient entry of these samples.

Preparation of Plant Collection: Plant collections were made following DNR and Bell Museum of Natural History herbarium guidelines. Species identifications were verified and collections were deposited in the Museum herbarium.

Rare plants were documented at 401 locations as new records or updates to previously known populations. Due to the rarity of prairie and associated rare plants in these counties, verification of previously recorded locations was a priority. All rare plant records were entered into the Natural Heritage Information System (Biotics). The following table provides a summary of rare plant collections.

Scientific Name	Common Name	Current Status	New Locations	Updated Locations
Arisaema dracontium	Green dragon	Non	26	0
Arnoglossum plantagineum	Tuberous Indian-plantain	T	3	4
Arnoglossum reniforme	Great Indian plantain	Non	3	0
Asclepias hirtella	Prairie milkweed	T	2	2
Asclepias sullivantii	Sullivant's milkweed	T	14	5
Baptisia alba	White wild indigo	SC	42	4
Baptisia bracteata	Plains wild indigo	SC	6	4
Cacalia suaveolens	Sweet smelling Indian plantain	E	1	0
Cypripedium candidum	Small white lady's slipper	SC	7	2
Dodecatheon meadia	Prairie shooting star	E	1	2
Eryngium yuccifolium	Rattlesnake master	SC	58	36
Erythronium propullans	MN dwarf trout lily	FE	0	1
Gymnocladus dioica	Kentucky coffee tree	Non	8	0
Hydrastis canadensis	Goldenseal	E	1	0
Juglans cinerea	Butternut	SC	5	0
Lespedeza leptostachya	Prairie bush clover	FT	0	2
Napaea dioica	Glade mallow	T	4	0
Oxypolis rigidior	Cowbane	Non	25	8
Parthenium integrifolium	Wild quinine	E	36	17
Phlox maculata	Wild sweet William	Non	14	0
Platanthera praeclara	W. prairie fringed orchid	FT	0	1
Taenidia integerrima	Yellow pimpernel	Non	3	0
Valeriana edulis	Valerian	T	9	17
Total			**268**	**105**

Current status of species on federal and state lists: FE=federally endangered, FT=federally threatened, E= state endangered, T=state threatened, SC=state special concern, Non=tracked in the Natural Heritage Information System but not state listed.

Plant specimens were collected for counties that had no previously documented collection in the Bell Museum herbarium. These collections contribute to the understanding of the distribution and known ranges of rare and common native species as well as non-native species in Minnesota. Distributional data on species is a valuable for designing restorations using local species and provides a baseline for future monitoring related to management activities and climate change. It is used to update products such as the *Orchids of Minnesota* and the Rare Species Guide (found on the DNR website). The following table provides a summary of county record plant collections.

Scientific Name	Common Name	Counties
Alliaria petiolata	Garlic mustard	Dodge, Faribault, Mower
Antennaria neglecta	Field pussytoes	Dodge
Aplectrum hyemale	Putty root	Steele
Arisaema dracontium	Green dragon	Dodge, Faribault, Mower
Asclepias verticillata	Whorled milkweed	Steele
Astragalus canadensis	Canada milkvetch	Dodge
Beckmannia syzigachne	American slough grass	Mower
Betula pumila	Bog birch	Freeborn
Botrychium virginianum	Rattlesnake fern	Faribault, Freeborn, Mower, Waseca
Brachyelytrum erectum	Long-awned wood grass	Waseca
Bromus kalmia	Kalm's brome	Dodge, Mower
Cardamine bulbosa	Spring cress	Dodge
Cardamine concatenata	Cut-leaf toothwort	Dodge, Waseca
Carex albursina	White bear sedge	Dodge
Carex lasiocarpa	Fen wiregrass sedge	Freeborn
Carex sprengelii	Sprengell's sedge	Waseca
Carex tetanica	Rigid sedge	Freeborn
Caulophyllum thalictroides	Blue cohosh	Freeborn
Ceanothus americanus	New Jersey tea	Dodge, Waseca
Claytonia virginica	Spring beauty	Waseca
Comandra umbellata	Bastard toadflax	Waseca
Comarum palustre	Marsh cinquefoil	Freeborn
Cuscuta pentagona	Dodder	Mower
Cynoglossum officinale	Common hound's tongue	Waseca
Dalea candida v. candida	White prairie clover	Freeborn, Steele
Doellingeria umbellata	Flat-topped aster	Freeborn
Epilobium leptophyllum	American marsh willow-herb	Freeborn
Eragrostis hypnoides	Creeping love grass	Waseca

Eutrochium purpureum	Purple Joe-pye weed	Waseca
Fallopia scandens	Climbing false buckwheat	Mower
Galearis spectabilis	Showy orchis	Mower
Gentiana alba	White/cream gentian	Freeborn
Hackelia virginiana	Stickseed	Freeborn
Hydrophyllum appendiculatum	Appendaged waterleaf	Freeborn
Hypoxis hirsute	Yellow-star grass	Freeborn
Impatiens capensis	Orange jewel weed	Freeborn
Juniperus communis	Common juniper	Dodge
Koeleria macrantha	June grass	Freeborn
Liatris aspera	Rough blazing star	Dodge
Liparis liliifolia	Lily-leaved twayblade	Mower
Lithospermum latifolium	American gromwell	Dodge
Lysimachia terrestris	Swamp candles	Mower
Lythrum salicarisa	Purple loosestrife	Waseca
Maianthemum canadense	Canada mayflower	Dodge, Mower
Onoclea sensibilis	Sensitive fern	Dodge
Onosmodium bejariense	Western false gromwell	Freeborn, Steele
Oxalis violacea	Violet wood sorel	Freeborn
Penstemon grandiflorus	Large-flowered beard-tongue	Freeborn
Physocarpus opulifolius	Ninebark	Dodge
Physostegia virginiana	Obedient plant	Freeborn, Steele
Polemonium reptans	Jacob's ladder	Freeborn
Prenanthes alba	White lettuce	Dodge
Ranunculus flabellaris	Yellow water buttercup	Freeborn
Salix candida	Sage-leaved willow	Mower
Salix serissima	Autumn willow	Mower
Sceptridium dissectum	Dissected grapefern	Mower
Solidago nemoralis	Gray goldenrod	Dodge
Solidago ridellii	Riddell's goldenrod	Steele
Solidago speciosa	Showy goldenrod	Dodge
Thelypteris palustris	Marsh fern	Freeborn
Utricularia vulgaris	Bladderwort	Waseca
Uvularia grandiflora	Large-flowered bellwort	Dodge, Freeborn
Zizania palustris	Wild rice	Waseca

Animal surveys were funded through a State Wildlife Grant (see section VI.B). A separate report associated with this federal project includes additional detail on the accomplishments in these six counties.

Amphibian and reptile surveys were conducted between July 2008 and June 2010. Techniques used to survey terrestrial habitats included herp searches, placement of cover objects, and road surveys. Aquatic habitats were surveyed using turtle traps, aquatic funnel traps, back-packing shocking, and anuran call

surveys. Wood Turtles (*Glyptemys insculpta*) were tracked with radio-telemetry in two watersheds to locate nesting and overwintering sites and to gather information about habitat use and movements. A total of 12 species of amphibians and 12 species of reptiles were documented. This includes 27 new county records (first documented record in the county) for amphibians and 30 new records for reptiles. New locations for two state threatened species, Wood Turtle and Blanding's Turtle (*Emydoidea blandingii*) were recorded.

Scientific Name	Common Name	Current Status (E,T, SC, Non)	New Records
Glyptemys insculpta	Wood Turtle	T	4
Emydoidea blandingii	Blanding's Turtle	T	6
Total			**10**

Bird surveys began in 2009 and were completed in 2010. Bird survey staff completed 105 point counts and compiled 232 species lists.

A total of 142 potential breeding bird species were found in the south-central counties. Forty-nine records of rare species were documented.

Scientific Name	Common Name	Current Status	New Records
Cygnus buccinator	Trumpeter Swan	T	6
Botaurus lentiginosus	American Bittern	Non	3
Grus canadensis	Sandhill Crane	Non	13
Bartramia longicauda	Upland Sandpiper	Non	5
Leucophaeus pipixcan	Franklin's Gull	SC	2
Lanius ludovicianus	Loggerhead Shrike	T	1
Vireo bellii	Bell's Vireo	Non	4
Dendroica cerulea	Cerulean Warbler	SC	1
Wilsonia citrina	Hooded Warbler	SC	1
Chondestes grammacus	Lark Sparrow	Non	2
Ammodramus henslowii	Henslow's Sparrow	E	11
Total			**49**

Fish surveys were conducted in all six counties in 2009, resulting in the documentation of five rare species and the second known location of Slenderhead Darter (*Percona phoxocepha*) in the Cedar River drainage.

Scientific Name	Common Name	Current Status	New Records
Clinostomus elongatus	Redside Dace	Non	1
Etheostoma microperca	Least Darter	SC	1
Lythrurus umbratilis	Redfin Shiner	Non	3
Moxostoma duquesnei	Black Redhorse	Non	1
Notropis nubilus	Ozark Minnow	SC	5
Total			**11**

Small mammal surveys were conducted in all six counties in 2009. Twelve species were documented. No rare species were found, but twenty new county records were added.

Preparation of Animal Collections: When animal collections are made, DNR and Bell Museum of Natural History guidelines are followed for specimen preparation and are deposited in the collections of the Bell Museum.

A new MCBS web location displays maps and data on bird survey data.

http://www.dnr.state.mn.us/eco/mcbs/bird_map_list.html

Potential Natural Areas-Examples of Sites of Outstanding and High Biodiversity Significance

Dexter Prairie in Mower County includes 15 acres of high quality mesic prairie, a native plant community that is exceedingly rare in the six counties. The site contains populations of the rare plants, Tuberous Indian-plantain, Valerian, Rattlesnake master and Cowbane. These rare plant species were once relatively widespread in southern Minnesota prairies but have declined in native populations due to the extreme loss of habitat. The MCBS plant ecologist wrote an ecological evaluation for Dexter Prairie and presented this site to the Commissioner's Advisory Committee where it was approved for potential acquisition as a state Scientific and Natural Area (SNA).

In Dodge County, a small prairie knoll was identified as a site of high biodiversity significance. This site contains a dry prairie, with a large population of the federally threatened Prairie bush clover.

Also in Dodge County, a site containing a largely forested portion of Dodge Center Creek was evaluated to be of high biodiversity significance. The creek and associated floodplain and cliff native plant communities provide important habitat for a number of rare species. This includes a population of the endangered plant, Goldenseal, a large population of the state threatened species, Glade mallow, the special concern species, Butternut and Green dragon. The threatened Wood Turtle inhabits portions of Dodge Center Creek. An ecological evaluation describing the importance of this site is being prepared.

Several other large forested tracts in good condition were located along rivers and streams in the region. For example, in Faribault County, seven high quality forests were located along the Blue Earth River. Reports to the landowners include a description of the significance of their woods and conservation options. At least one site will be summarized in an Ecological Evaluation and proposed as a potential Scientific and Natural Area.

Very little remains of the native prairies that once covered a large proportion of the six county region. In Faribault County, for example, only four new locations of prairies were recorded, all on privately-owned land. Reports to the landowners

related the extreme rarity of these communities and informed them of conservation options such as prairie bank.

Result 3: Accelerated technical assistance on privately owned prairie

Description: The goal is to accelerate long-range planning assistance to private landowners through management consultation and delivery of prairie stewardship plans to landowners. DNR Prairie Specialists will offer six prairie management workshops and field days for private landowners. In addition, private-sector consultants or DNR Prairie Specialists will personally meet with fifty landowners in order to listen to their goals, examine their property, and provide technical consultation as to how to best manage their prairie. Forty of these landowners will then receive a comprehensive prairie stewardship plan that includes an evaluation of the condition of their prairie, identification of management needs, and recommendations for management action. DNR Prairie Specialists can then deliver financial and project management assistance to landowners who wish to implement their stewardship plan.

Summary Budget Information for Result 3: **Trust Fund Budget: $200,000**
Amount Spent: $198,394
Balance: $ 1,606

Deliverable	Completion Date	Budget	Status
1. Six workshops/field days developed for prairie landowners	Two by 6/30/09; four more by 1/31/10, and a total of six by 6/30/10	$5,500	8 workshops / fields completed
2. Consultations, guidance, management assistance, etc. provided to 50 landowners	50% by 6/30/09 and 100% by 6/30/10	$90,000	63 landowners provided management guidance
3. Stewardship plans provided to 40 prairie landowners	50% by 6/30/09 and 100% by 6/30/10	$104,500	40 stewardship plans provided to landowners

Final Report Summary:
SNA field staff persons hosted or collaborated on eight different events where prairie management and protection information was provided to private landowners. The dates and names of these events are listed below:

8/23/08 – Minnesota River Bluff Workshop (Location: Fort Ridgely State Park)
3/12/09 – Native Pollinator, Birds, and Grasslands (Location: St. James, MN)
8/4-6/09 – Farmfest: answer landowner questions re: conservation options (Redwood County)
8/7/09 – SNA Prairie Tours: management demonstration, landowner awareness (Mower County)
8/20/09 - Prairie ecology and history presentation (Mankato, MN)

8/29/09 – Prairie Tour: raising awareness and appreciation (Martin County)
2/25/10 – Working Lands Workshop – Prairie management options for landowners (Sunburg, MN)
4/10 & 17/2010 - Prairie Tours – “First Rite of Spring”: raising prairie awareness and appreciation (Martin County).

DNR prairie specialists provided consultation to 63 landowners regarding management and protection strategies for their native prairies. These consultations provided prairie owners an opportunity for a one-on-one conversation with a prairie resource specialist. These consultations have resulted in four new Native Prairie Bank applications from landowners, generated interest from 18 new landowners now pursuing stewardship action on their lands, and have raised the awareness and understanding of the rare prairie resource.

Contracts were awarded and completed for prairie stewardship planning services on 35 native prairie sites throughout the western and southern regions of Minnesota. DNR prairie specialists also completed another five prairie stewardship plans. These comprehensive prairie stewardship plans provide owners with an evaluation of their prairie’s condition, identification of critical management needs, and recommendations for implementing those management actions. These plans combine both the landowner’s goals for future land use and the state’s interest in prairie conservation.

Result 4: Accelerated prairie management (public/private)

Description: This result will help to maintain healthy native prairies by implementing management activities on priority public and private prairie, including: woody encroachment removal (100 acres), exotic species treatment (85 acres), prescribed burning (875 acres), and native seed harvests and restorations (~~60~~ 40 acres). Prairie management crews and/or contractors will implement prairie management across multiple programs and ownerships, including: SNA, State Parks, Wildlife Management Areas, Prairie Bank easements, and Prairie Tax Exemption lands. In many cases, the DNR will package groups of projects, such as prescribed burns, into larger contracts for competitive bidding in order to efficiently provide quality services to landowners at the lowest possible cost. As identified in Section VI.B, Statewide Wildlife Grant (federal) funds will leverage additional native prairie management on public lands.

Summary Budget Information for Result 4:	**Trust Fund Budget:**	**$280,000**
	Amount Spent:	**$280,000**
	Balance:	**$ 0**

Deliverable	Completion Date	Budget	Status
1. Woody removal from 100 acres of prairie/grassland	50% by 6/30/09 and 100% by 6/30/10	$75,000	545 acres treated on 30 units
2. Prescribed burning on 875 acres of prairie/grassland	50% by 6/30/09 and 100% by 6/30/10	$105,000	2,085 acres burned on 42 units
3. Exotic species treatment on 85 acres of prairie/grassland	50% by 6/30/09 and 100% by 6/30/10	$60,000	2,162 acres treated on 48 units
4. Prairie reconstruction on 40 acres to benefit native prairie	50% by 6/30/09 and 100% by 6/30/10	$40,000	84.5 acres reconstructed on 7 units

Final Report Summary:
The SNA program exceeded the stated deliverable goal for this result. This is in part due to the fact that a suppressed economy is making vendors compete vigorously for state contracting opportunities. The result became a better value for every ETF dollar. Contracted services were used for 36% of funding provided for implementation of projects. The ability to exceed stated acreage goals was also due in part to the nature of the specific projects completed - many projects were large in size with low to moderate complexity in management planning and execution. The SNA program completed 545 acres of woody removal, 2,085 acres of prescribed burning, 2,162 acres of exotic species treatments, and 84.5 acres of prairie reconstructions. For woody removal a variety of techniques were used including girdling, cut and stump treat, and mechanical mowing – all designed to be low impact to the prairie. A variety of low impact techniques were also used for invasive species control projects including hand pulling, spot treatments, and biological controls. All projects were completed on designated Scientific and Natural Areas and permanently protected Native Prairie Bank easements.

Result 5: Evaluate prairie condition and animal species.

Description: This result will develop and test protocols for evaluating the condition of prairies and constituent animal populations on 24 to 48 selected, high-quality native prairie sites. A critical, but often neglected, aspect of natural resource management is monitoring and evaluation. Monitoring is necessary to assess if management actions have achieved desired objectives. More broadly, monitoring can provide status and trend information to signal changes that require further action. This monitoring project focuses on the status and trends of important indicators of prairie condition and associated animal species populations.

Selection of the high-quality prairie sites will be stratified by several factors such as landscape context (embedded, isolated), prairie community class, size, ownership and geographic location (within some or all of the five focus areas identified on the attached map). Management practices will be recorded for use as covariates during

analysis. Prairie condition monitoring will test and apply existing protocols, such as belt transect and invasive species protocols, in order to perform sensitivity analyses and to develop a baseline of information for long-term monitoring on the selected prairie sites. Animal species monitoring will focus on several taxa groups and will use area-occupancy designs as described in “Occupancy Estimation and Modeling” (MacKenzie et al. 2006) and components of multiple species sampling protocols (Manley et al. 2006, Kinkead 2006). The first season (2008) will largely be used to test optimal sampling methods and to determine species detectability. This information will be used to develop preliminary protocols and sampling designs to be applied in the following field seasons. This project will be conducted by a combination of contractors, university students, and DNR staff. Databases and mobile data units will be developed to allow for data collection, storage, and analysis.

References Cited:

Kinkead, K. 2006. Iowa Multiple Species Inventory and Monitoring Program Technical Manual. Iowa Department of Natural Resources.

Mackenzie, D.I, J.D. Nichols, J.A Royle, K.H. Pollock, L.L. Bailey, and J.E. Hines. 2006. Occupancy Estimation and Modeling. Academic Press. Burlington, MA.

Manley, P.N., B. Van Horne, J.K. Roth, W.J. Zielinski, M.M. McKenzie, T.J. Weller, F.W. Weckerly, and C. Vojta. 2006. Multiple Species Inventory and Monitoring. USDA Forest General Technical Report W0-73.

Summary Budget Information for Result 5: **Trust Fund Budget: $170,000**
Amount Spent: $170,000
Balance: $ 0

Deliverable	Completion Date	Budget	Status
1. Prairie quality and condition monitoring protocols developed, tested and applied.	8-16 sites by 12/30/08	$15,000	Protocol developed and field tested.
2. Prairie quality and condition monitoring protocols refined followed by additional application.	16-32 sites by 12/30/09	$21,000	Vegetation monitoring completed at 38 sites.
3. Multiple species monitoring protocols developed and tested for several animal taxa.	8-16 sites by 12/30/08	$25,000	Animal species monitoring was explored for various taxa. Bird monitoring selected as the focus of this project

4. Multiple species monitoring protocols for several animal taxa refined and applied.	16-32 sites by 12/30/09	$35,000	Bird monitoring completed at 38 sites. Complimentary projects for other taxa explored with other funding/collaborators.
5. Databases developed and tested, data entered and analyzed.	6/30/10	~~$49,000~~ $69,000	Vegetation and bird monitoring databases created, data entered, analyzed. Contributed to the ongoing development of the Adaptive Management Spatial Database.
6. Report detailing monitoring protocols and sampling procedures.	6/30/10	$5,000	See Attachment C

Final Report Summary:
Daren Carlson, an ecologist in the Division of Ecological Resources who has oversight on monitoring efforts of the State Wildlife Action Plan (SWAP) coordinated the evaluation of prairie condition and animal species (Result 5). He also wrote a separate report, *Accelerated Prairie Management, Survey, Acquisition and Evaluation; Result 5: Prairie monitoring and evaluation* found in Attachment C. A summary of that report follows. Additional funding for this Result was provided by a State Wildlife Grant (see section VI below).

Site Monitoring: A total of 38 high quality prairie sites were monitored for baseline vegetation and bird data over the 2008-2010 field seasons. Sites were selected from sites identified by the Minnesota County Biological Survey as high quality native prairie, and were stratified according to geography and landscape context.

A total of 683 vegetation transects, 42 relevés, and 1,596 bird point counts were completed across the 38 sites, providing a substantial dataset for establishing baselines of bird and plant community conditions across the matrix of sites, testing and modifying monitoring protocols, and initiating long-term trend monitoring and analysis. Current long-term plans are to monitor a total of 35 sites on a five year rotation (7 sites per year), with five additional sites monitored every year to detect annual variation.

Collaboration: DNR staff participated in a multi-agency Grassland Adaptive Management Collaborative to develop models, refine protocols, and train field staff. This Trust Fund project was designed in part to address outstanding monitoring protocol questions such as sampling density, transect length, and selection of indicator species.

Bird Results: Over the three field seasons of bird surveys, 163 bird species were recorded using standard point count methodology. Fifty-four species were Species in Greatest Conservation Need as identified in the SWAP, 16 were state listed, and 24 were grassland dependent species. Bird community monitoring became the only

animal focus for this project. Other prairie animals, such as insects and reptiles, are now being studied in separate, but complementary projects.

For all bird species, richness (the number of bird species recorded per point) significantly increased from the southern to northern focus areas, but was not influenced by landscape context (large-embedded vs. small-isolated). For grassland dependent birds, however, the species richness was significantly higher in large-embedded sites in all but one focus area, and also followed the same geographic trend as for all species. Species abundance (the number of bird individuals recorded per point) followed similar patterns as species richness, with a few exceptions detailed in the main report.

After three years of data collection, no trends or patterns of change were detected for abundance of individual bird species per site. This indicates the value of long-term monitoring to determine species trends.

Vegetation Monitoring: The primary purposes of the 2008-2009 field seasons for prairie vegetation monitoring were to test the efficacy of the hierarchical belt transect protocols developed by Grassland Adaptive Management Collaborative as well as to collect baseline data for the long-term prairie monitoring effort. Vegetation monitoring measured four main components: 1) Rapid condition assessment (called the plant group score). 2) Presence of indicator species. 3) Vegetation structure. 4) Plant species composition.

A total of 435 plant species were recorded over the two sampling years. Species richness (number of species per transect) and plant group score was highest in the two northern-most focus areas. Certain individual plant species showed geographic patterns. In particular, Kentucky bluegrass (*Poa pratensis*), a non-native species and the most frequently measured plant overall, increased in both frequency and, more significantly, cover from north to south. The number of indicator species did not show any relationship to geography (the focus areas) or landscape context.

Sensitivity Analyses of Protocols: Preliminary findings from sensitivity analyses of the monitoring protocols are:

1) Plant group score, a rapid assessment for evaluating prairie condition, shows a fairly strong relationship to species richness and number of indicator species, although considerable variability in the relationships indicates it should not be used as a sole-measure.

2) The current suite of quality indicators are more likely to be present in Upland Prairie systems than Wet Prairie Systems and are rarely present in Wet Meadow systems. The quality indicator list should be modified to include more species typical of the wetter prairie systems.

3) Sampling density (number of transects per acre) for capturing species richness is variable by site. Sampling density may be reduced and still effectively capture quality indicators.

4) Preliminary analyses show that reducing transect length by as much as half (12.5 m or 25 quadrates) will increase sampling speed and likely not substantially alter most of the vegetation measures.

Data management: Development of applications for field entry of bird monitoring data and vegetation indicator species into mobile data recorders enabled efficient and accurate data recording, and saved considerable time and cost by not having to enter hand-written datasheets into a database following the field season.

DNR staff modified a grassland monitoring database developed by the US Fish and Wildlife Service as part of the Grassland Adaptive Management Collaborative to enable entry and storage of the most-detailed protocols while maintaining the database structure. This allowed relatively easy transfer of the core data to the Collaborative (currently managed by the USFWS Morris Wetland District).

This project contributed to the development of an Adaptive Management Spatial Database (AMSD) that allows users to set management objectives, define, track and report on management activities and track and report on biological outcomes (monitoring data).

Result 6: Native prairie acquisition

Description: The Scientific and Natural Area program will protect and buffer high priority native prairie by fee acquisition and designation as a Scientific and Natural Area (SNA) of approximately 100 acres and by acquisition of Native Prairie Bank conservation easements (administered by the SNA program) on approximately 50 acres. This high quality prairie will contain rare and endangered plant and animal species, undisturbed plant communities, and key habitats for Species of Greatest Conservation Need identified in the State Wildlife Action Plan. Sites to be acquired under this appropriation have been identified as priorities for protection by the Minnesota County Biological Survey (MCBS). In addition, to be eligible for SNA acquisition, an Ecological Evaluation for each geographic area must be approved by the Commissioner's Advisory Committee.

Currently, 144 SNAs encompassing over 181,800 acres have been designated in Minnesota, including 65 sites protecting about 11,000 acres of native prairie. Sites acquired in fee as SNA will be open to the public for scientific study, education, and nature observation and will be designated and managed as provided in MN Statute 86A.05 and MN Rules 6136.

Currently, 79 Native Prairie Bank (NPB) conservation easements totaling 6,145 acres have been acquired and protected (plus 4 sites that subsequently have become SNAs). Each Native Prairie Bank easement is, in essence, a partnership between the SNA program and the landowner. NPB easements restrict the use of the prairie in order to protect it but can (and sometimes do) allow the fee title landowner to retain limited haying, grazing, or seed collection rights on the prairie. When a landowner retains any of these rights their payment is reduced. Currently all NPB easements allow public access.

Land acquired with this appropriation will be sufficiently improved to meet at least minimum management standards as determined by the commissioner. Baseline data (i.e. a property report) for easement stewardship monitoring will be collected for easements acquired with this funding. DNR will be addressing long-term easement stewardship as part of the separate LCCMR project on conservation easement monitoring and how DNR can receive and invest/endow a fund for long term easement monitoring. Natural resource stewardship on properties acquired through this Result will be initiated (as timing permits) through Result 3 and 4 of this LCCMR project, and with other LCCMR and non-LCCMR funding (as available) through the Division's Prairie Stewardship Program for private lands and through SNA site management. All required Trust Fund acquisition reports for each acquisition will be submitted to the LCCMR.

Specifically, to date the following areas with significant native prairie have been identified as conservation priorities for potential SNA fee and/or NPB easement acquisition under this grant:

- Felton Prairie SNA addition (Clay Co)
- Chanarambie Creek (Murray Co)
- Morton Outcrops (Renville Co)
- Boiling Springs Prairie (Redwood Co)
- Big Stone Moraine prairie complex (Big Stone Co)
- Des Moines River valley prairies (Jackson Co)
- Lower Antelope Valley prairie complex (Yellow Medicine Co)
- Mikkelson Prairie (Swift Co)
- Ten Mile Creek Prairie (Lac Qui Parle Co)
- Kasota Prairie SNA addition (Le Sueur Co)
- No. Prairie Coteau prairie macrosite (Sioux Nation Area) (Yellow Medicine Co)

In addition, sites in the following townships have quality native prairie with potential for Native Prairie Bank conservation easement acquisition through this funding:

- Altona and Burke Twsp (Pipestone Co)
- Great Bend and Delton Twsp (Cottonwood Co)
- Westerheim Twsp (Lyon Co)
- Marble Twsp (Lincoln Co)
- Tilden Twsp (Polk Co)
- Benson Twsp (Swift Co)
- Akron Twsp (Big Stone Co)
- Rushford Twsp (Fillmore Co)
- Stanton Twsp (Goodhue Co)

Summary Budget Information for Result 6: Trust Fund Budget: $475,000
Amount Spent: $475,000
Balance: $ 0

Deliverable	Completion Date	Budget	Status
1. 250 acres NPB easements acquired.	6/30/2010	$475,000	308 acres acquired via 5 NPB acquisitions

Final Report Summary:
Five Native Prairie Bank (NPB) Conservation Easements totaling 476.2 acres were acquired in whole or part through this appropriation (308.1 LCCMR acres; 268.1 acres with other state funding – pro-rated on direct landowner payments costs). This included completing base line property reports for each of the NPB's acquired. The specific characteristics of the five sites acquired are listed below and their location is shown on the attached map. Work was initiated on acquiring additions to two SNAs; but one landowner turned down the DNR offer of buying it at appraised value and landownership issues delayed the other project past the timing of this appropriation, so this appropriation was applied entirely to NPB acquisitions.

Altona (Pipestone County) Native Prairie Bank Acquisition
The 160.2-acre Altona 31-2 Native Prairie Bank conservation easement acquisition in Altona Township in Pipestone County closed in February 2009 – with 125.2 acres paid through this funding and the remainder from 2006 NPB bonding and 2008 Prairie bonding. Specifically, the Altona 31-2 NPB is 160 acres of grazed Southern Wet Prairie and Dry Sand-Gravel Prairie that harbors the state-endangered Chestnut Collared Longspur (*Calcarius ornatus*) and includes Topeka Shiner (*Notropis tristis*) critical habitat. The protected property also provides habitat for Richardson's Ground Squirrel (*Speotyto cunicularia*) and Upland Sandpiper. This is the second of two adjoining NPBs acquired in FY09. As specifically permitted under the terms of the easements, the owner of the adjoining Altona 31-1 NPB (this owner's brother) has agreed to reduce the cattle stocking rate on both Altona 31 NPB parcels in order to manage the prairie using an ecologically more appropriate level of grazing, while also sustaining livestock production as part of the local rural economy.

Root River Valley Prairie (Fillmore County) Native Prairie Bank Acquisition
The 40.5-acre Rushford 3-1 Native Prairie Bank conservation easement acquisition in Rushford Township in northern Fillmore County closed in June 2010. The site encompasses Dry Bedrock Bluff Prairie with Outstanding Biodiversity Significance and has multiple occurrences of rare features including the Timber Rattlesnake (*Crotalus horridus*), Clasping milkweed *(Asclepias amplexicaulis)*, Valerian, Goat's rue (*Tephrosia virginiana)*, Jeweled shooting star *(Dodecatheon amethystinum)* and Plains wild indigo.

Lac Qui Parle Prairies (Big Stone County) Native Prairie Bank Acquisition – 2 sites
Two projects within the Correll Target Area in Big Stone County were acquired as NPB in cooperation with the Working Lands Initiative which contributed $75,938.14 of state Heritage Enhancement funds in landowner payments for these two projects and $105,029.82 of 2008 prairie bonding towards the later project. The 63.2-acre (52.1 pro-rated acres with this appropriation) Akron 13-1site is contiguous to both Lac Qui Parle WMA and a USFW Easement. The site encompasses B quality Mesic Prairie with High Biodiversity Significance and has several occurrences of rare species including the Upland Sandpiper, Greater Prairie Chicken (*Tympanuchus cupido*) and Prairie moonwort *(Botrychium campestre).* The 178.8-acre (56.86 pro-rated acres) Akron 11-1 is just North of Lac Qui Parle WMA. The site encompasses Mesic Prairie with Moderate Biodiversity Significance and has multiple occurrences

of vertebrate animals including the Upland Sandpiper, Lark Bunting (*Calamospiza melanocorys*), and Short-eared Owl (*Asio flammeus*).

McKnight Prairie (Goodhue County) Native Prairie Bank Acquisition
Located in northeastern Goodhue County, the 33.4-acre Stanton 18-1 site encompasses Dry Bedrock Bluff Prairie with Outstanding Biodiversity Significance. The site has multiple occurrences of rare species including Prairie Vole (*Microtus ochrogaster*), Long-bearded hawkweed *(Hieracium longipilum)*, Prairie bush clover, and Kitten-tails *(Besseya bullii).*

V. TOTAL TRUST FUND PROJECT BUDGET:

Budget Item	
Staff or contract services: private consulting services, NR Specialists, NR Technicians, NR laborers*	$558,000
Equipment: vehicle fleet costs (e.g. ATV, pick-up, ASV tracked vehicle)	$ 44,000
Development: (improvement to land or building)	$ 0
Acquisition: fee title, easements, professional services for acquisition	$462,000
Restoration: landowner reimbursements; contracts for prescribed burning, prairie reconstructions, woody encroachment, etc.	$125,000
Travel	$ 41,000
Other: $	$ 20,000
TOTAL TRUST FUND PROJECT BUDGET:	$1,250,000

Explanation of Capital Expenditures Greater Than $3,500: None

Explanation of Personnel Costs:

Only time spent on approved projects will be charged to these funds. Without these funds, none of the projects in this work program would be completed. They are an acceleration of related initiatives.

To implement projects in the work program, specialized skills (prescribed burning, knowledge of sites and management implications) are often required. DNR employees with the training, experience and certifications required to do these specialized tasks are used to directly implement these projects, and work with landowners and contractors to design, direct and certify completion of projects they carry out.

*Funds will be used to extend existing DNR seasonal crews or natural resource technicians and specialists undertaking projects in this work program. These positions are unclassified and classified (all AFSCME employees must be classified as per contract).

VI. OTHER FUNDS & PARTNERS:

A. Project Partners: DNR Scientific and Natural Area Program, DNR Division of Fish and Wildlife Area wildlife managers, and DNR Division of Parks and Recreation.

B. Other Funds Proposed to be Spent during the Project Period:

	Result 1	Result 2	Result 4	Result 5	**Total**
State Wildlife Grants (SWG, federal funds)	$25,000	$100,000	$75,000	$150,000	**$350,000**
Landowner Incentive Program (LIP, federal funds)				$75,000	**$75,000**

Three of the acquisition projects were acquired in part with other funding: $137,144 in state bonding (2006 NPB appropriation and 2008 SNA-NPB prairie appropriation) and $75,938 of Heritage Enhancement funds for DNR Wildlife's Working Lands Initiative. The accomplishment acres above have been pro-rated across the funds for direct landowner payments.

C. Past Spending: SNA/NPB statewide acquisition and development appropriations received in July 2005-June 2007: LCCMR SNA Metro Corridors Phase III: $243,000; LCMR SNA Metro Corridors Phase II: $300,000; 2005 Bonding: SNA $300,000 and NPB $1,000,000; and 2006 Bonding SNA $2,000,000 and NPB $1,000,000. SNA general fund includes approximately $400,000 annually for statewide operations and crew. MCBS July 2005 –June 2007 General Fund: $373,000; RIM Gen $181,400; Heritage Enhancement $1,125,000; SWG $439,000; LCMR $1,000,000. (See also Trust Fund Work Program 2007 Minnesota County Biological Survey).

D. Time: MCBS is proposed for completion in 2021. Future requests for MCBS funding, management, monitoring and acquisition from the Minnesota Legislature and other cooperators are anticipated.

VII. DISSEMINATION:

Data on rapid change assessment and surveys of native prairies and prairie species, guidance for prairie management assistance and locations of SNAs are presented on the DNR website. Many GIS datasets are delivered through the web and through agreements with the requesting agency and the DNR's Ecological and Water Resources Division. For example, for data on locations or rare features, a data request form is also available via the web: http://www.dnr.state.mn.us/eco/nhnrp

Ecological and Water Resources invests considerable time in publishing and distributing results in a variety of formats for various audiences. The DNR and Legislative libraries and other local information repositories (such as county libraries) are sent published products, including maps, reports, field guides and digital media. Increasingly products are available on the DNR website, including GIS shape files of native plant communities and MCBS sites, native plant community field guides,

guides to sampling techniques and monitoring protocols such as vegetation plot data collection using the relevé method. The web site is updated with new information and has links to associated resources.

Staff make presentations that describe goals, methodologies and results to a wide range of audiences including county boards, local planning groups, land managers, citizen and technical advisory groups, and at professional meetings. Staff provide local planners and managers with ecological interpretations related to important sites of biodiversity identified during MCBS to assist with management plans.

DNR staff also lead or participate in technical workshops and field trips to provide training in the application and interpretation of management of native prairie on public and private lands.

Copies of stewardship plans are routinely provided to local DNR managers and used by the landowner in coordination with other agencies and programs.

Monitoring protocols will be made available to other cooperators interested in prairie monitoring. The results of the monitoring efforts will serve as baseline information for long-term monitoring of the selected prairie sites.

The SNA program will issue a press release and/or publicize a dedication event for each acquisition completed through this project.

MCBS delivers data as part of NatureServe and also shares data with cooperators at colleges and universities and with others in a particular ecological region where surveys are ongoing or completed.

Physical collections are deposited at Minnesota repositories, primarily at the University of Minnesota's J.F. Bell Museum of Natural History and the Science Museum of Minnesota, St. Paul, MN. As part of a larger network of museums and herbaria, these cooperators are essential to the documentation and sharing of MCBS results. MCBS and museum staff meet periodically to address curatorial, data management, and interpretive needs.

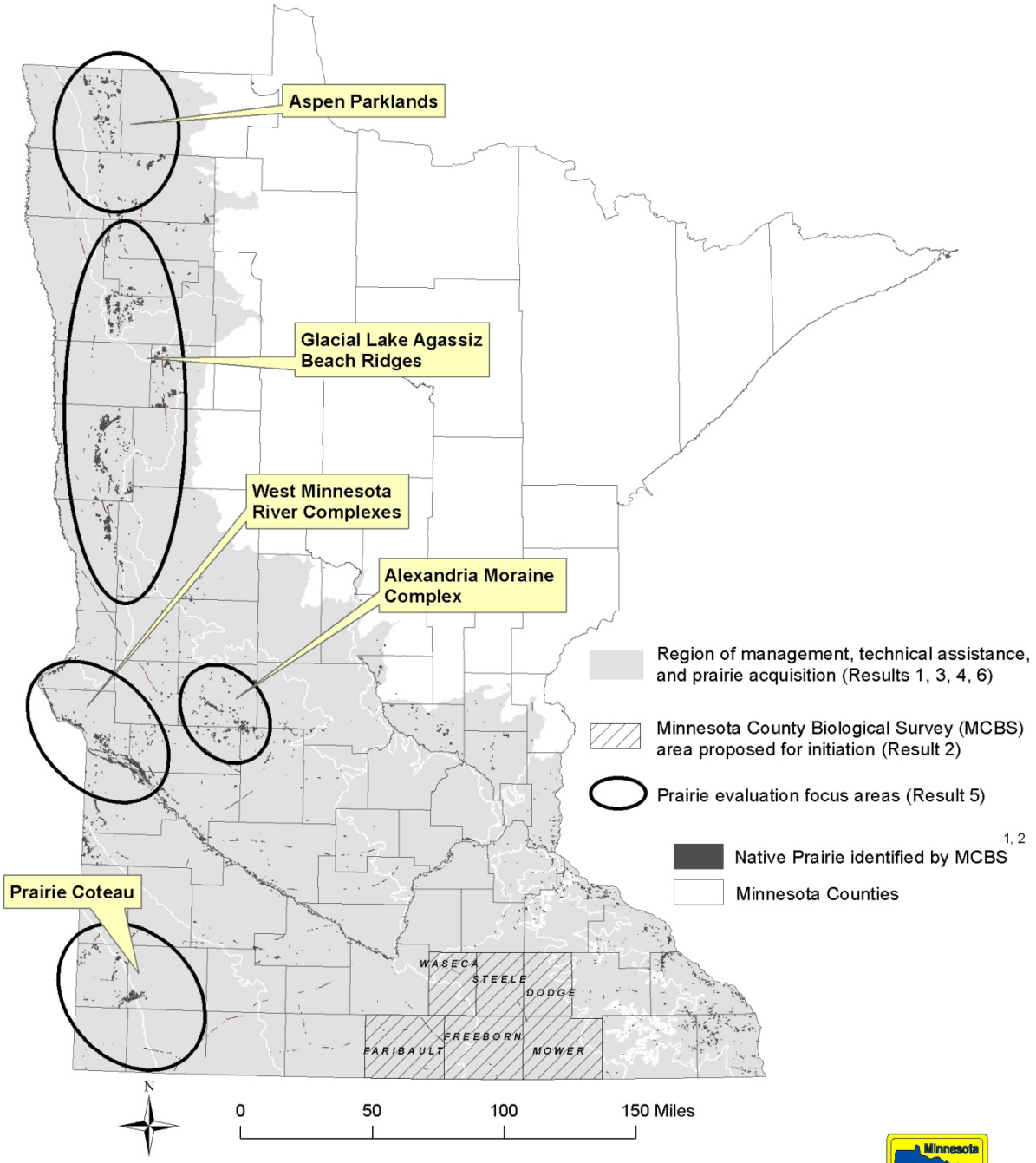
VIII. REPORTING REQUIREMENTS:

Periodic work program progress reports will be submitted no later than April 15, 2009, October 15, 2009, and April15, 2010. A final work program report and associated products will be submitted between June 30 and August 1, 2010 as requested by the LCCMR.

IX. RESEARCH PROJECTS: *NA*

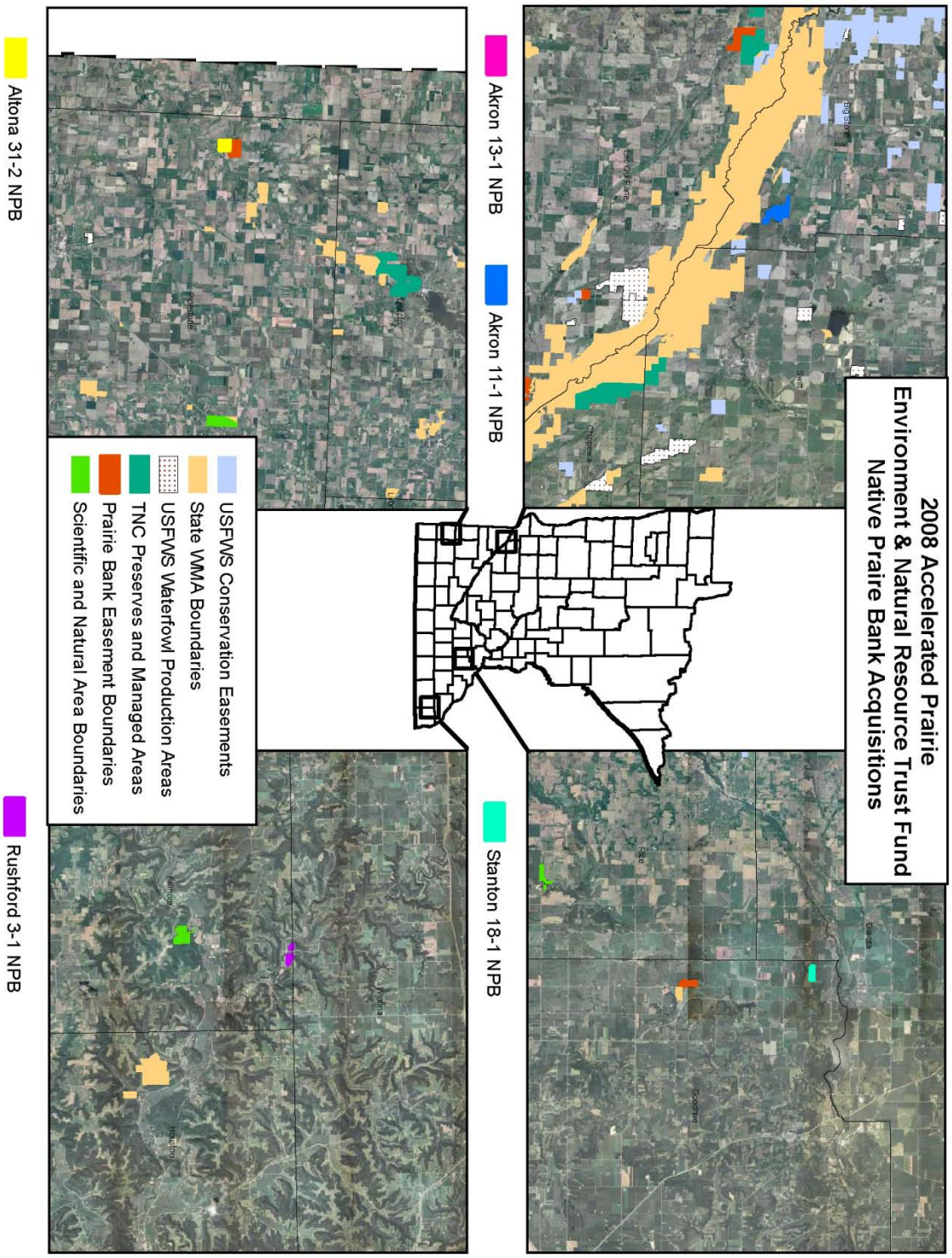
Trust Fund 2008 Work Program

Accelerated Prairie Management, Survey, Acquisition, and Evaluation



[1] Prairies mapped by MCBS in 1998. Locations shown were determined to be good and very good quality prairie as reported in Minnesota's Railroad Rights-of-Way Prairie: A Report to the 1999 Legislature (MNDNR, 1999).

[2] Prairies mapped by MCBS as of October 2007. Additional prairies will be mapped in 2007-2008. Prairie communities included are: upland prairie, wetland prairie, and prairie complexes.


2008 Accelerated Prairie
Environment & Natural Resource Trust Fund
Native Praire Bank Acquisitions
Akron 13-1 NPB
Akron 11-1 NPB
Stanton 18-1 NPB
Altona 31-2 NPB
Rushford 3-1 NPB
USFWS Conservation Easements
State WMA Boundaries
USFWS Waterfowl Production Areas
TNC Preserves and Managed Areas
Prairie Bank Easement Boundaries
Scientific and Natural Area Boundaries

Attachment A: Budget Detail for 2008 Projects

Project Title: Accelerated Prairie Management, Survey, Acquisition and Evaluation

Project Manager Name: Carmen Converse

Trust Fund Appropriation: $ 1,250,000

1) See list of non-eligible expenses, do not include any of these items in your budget sheet

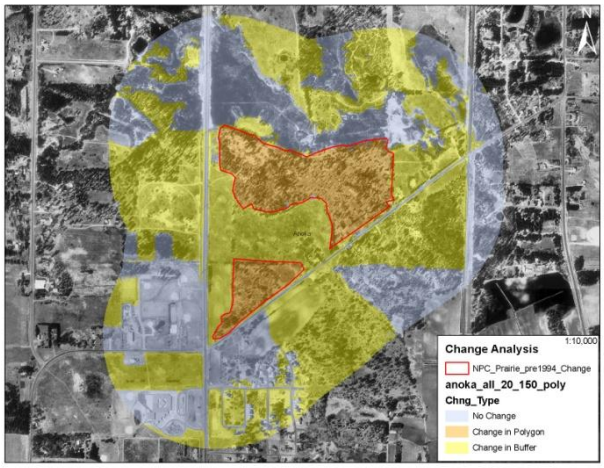
2) Remove any budget item lines not applicable

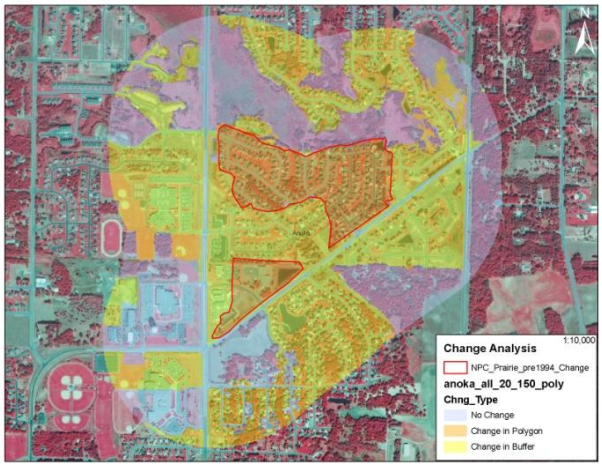
2008 Trust Fund Budget	**Result 1 Budget:**	**Amount Spent**	**Balance**	**Result 2 Budget:**	**Amount Spent**	**Balance**	**Result 3 Budget:**	**Amount Spent**	**Balance**	**Result 4 Budget:**	**Amount Spent**	**Balance**	**Result 5 Budget:**	**Amount Spent**	**Balance**	**Result 6 Budget:**	**Amount Spent**	**Balance**	**TOTAL BUDGET**	**TOTAL BALANCE**
	Rapid assessment of remaining native prairie			**Accelerated MCBS Southern Counties**			**Accelerated Technical Assistance on privately owned prairie**			**Accelerated Prairie Management (public/ private)**			**Evaluate prairie condition and animal species**			**Native Prairie Acquisition**				
BUDGET ITEM			0			0			0			0			0	0		0	0	0
PERSONNEL: wages and benefits: Result 2-plant ecologist; Result 3&4&6 - represents 2.4 FTE's per year. SNA staff paid almost exclusively with special project funds: ~ 0.1 FTE acquisition specialist and ~ 0.1 FTE project crew as needed to bring sites up to minimum standards . Fringe varies from 14 - 20%	25,000	24,803	197	70,000	86,437	-16,437	89,500	88,770	730	125,000	119,654	5,346	148,725	156,950	-8,225	2,384	2,384	0	460,609	-18,389
Contracts			0		5,000	-5,000			0			0			0	0		0	0	-5,000
Professional/technical (Stewardship Plan Consultants, animal survey experts, graduate student, statistics consulting)			0			0	104,500	103,200	1,300			0				0		0	104,500	1,300
Other contracts (contracts for prescribed burning, prairie reconstructions, woody encroachment, etc)			0			0			0	105,000	100,287	4,713			0	0		0	105,000	4,713
Other direct operating costs *(for what? – be specific)*			0			0			0			0			0	0		0	0	0
Equipment / Tools: Results 3, 4, 5 & 6: vehicle fleet costs (e.g. truck, car tractor, trailer, ATV, Pick-up, ASV tracked vehicle), incidental parts for tractor, vehicles, etc.			0			0	4,000	4,090	-90	30,000	34,897	-4,897	160	160	0	141	141	0	34,301	-4,987
Office equipment & computers - NOT ALLOWED unless unique to the project			0			0			0			0			0	0		0	0	0
Other Capital equipment *(list specific items)*			0			0			0			0			0	0		0	0	0
Land acquisition			0			0			0			0			0	0		0	0	0
Land rights acquisition *(less than fee)*			0			0			0			0			0	430,908	430,908	0	430,908	0
Professional Services for Acq.			0			0			0			0			0	41,567	41,567	0	41,567	0
Printing			0			0			0			0			0			0	0	0
Other Supplies: Result 4 - herbicide, safety supplies, fencing. Result 5 - Plot markers, flagging, measuring tape Result 6 - fencing, signs, etc as needed to bring sites up to minimum standards. Result 6: direct expenses not included above for purposes of meeting minimum standards			0			0			0	17,000	21,540	-4,540	156	156	0			0	17,156	-4,540
Travel expenses in Minnesota			0	30,000	8,104	21,896	2,000	2,334	-334	3,000	3,622	-622	959	959	0	0		0	35,959	20,940
Travel outside Minnesota *(where?)*			0			0			0			0			0			0	0	0
Construction *(for what?)*			0			0			0			0			0			0	0	0
Other land improvement:			0			0			0			0			0			0	0	0
Other: service agreement with DNR MIS for database development			0			0			0			0	20,000	11,775	8,225			0	20,000	8,225
COLUMN TOTAL	**$25,000**	**$24,803**	**$197**	**$100,000**	**$99,541**	**$459**	**$200,000**	**$198,394**	**$1,606**	**$280,000**	**$280,000**	**$0**	**$170,000**	**$170,000**	**$0**	**$475,000**	**$475,000**	**$0**	**$1,250,000**	**$2,262**

Attachment B

Accelerated Prairie Management, Survey, Acquisition and Evaluation
Result 1: Rapid assessment of remaining native prairie

Final Report to the Legislative-Citizen Commission on Minnesota Resources
July 1, 2008 to June 30, 2010
ML 2008, Chap. 367, Sec. 2, Subd. 3(m)





September 2010

.

Prepared by Andrew Horton, Ecologist
Division of Ecological and Water Resources, Minnesota Department of Natural Resources

Equal opportunity to participate in and benefit from programs of the Minnesota Department of Natural Resources is available to all individuals regardless of race, color, creed, religion, national origin, sex, marital status, status with regard to public assistance, age, sexual orientation, membership or activity in a local commission, or disability. Discrimination inquiries should be sent to MN-DNR, 500 Lafayette Road, St. Paul, MN 55155-4031; or the Equal Opportunity Office, Department of the Interior, Washington, DC 20240.

Funding provided by the Minnesota Environment and Natural Resources Trust Fund as recommended by the Legislative-Citizen Commission on Minnesota Resources and State Wildlife Grants. ©2010. State of Minnesota, Department of Natural Resources

Purpose

The Division of Ecological and Water Resources in the Department of Natural Resources (DNR) has long recognized that native prairie is one of the state's most threatened habitats. Beginning in 1987, the Minnesota County Biological Survey (MCBS) began the systematic mapping and evaluation of remaining native prairie, revealing that 220,000 acres of native prairie remain from the nearly 18 million acres recorded during the state's early public land surveys (1847-1908). The Department's State Wildlife Action Plan identified native prairie as one of the key habitats for animal species in greatest conservation need due to the tremendous loss of this habitat and its continued vulnerability to degradation or conversion. Since much of the MCBS data on prairie native plant communities were collected over 15 years ago, a project to conduct a rapid assessment of the current extent and condition of prairie was jointly funded by a State Wildlife Grant and by the Minnesota Environment and Natural Resources Trust Fund as recommended by the Legislative-Citizen Commission on Minnesota Resources (LCCMR).

Project Overview

Aerial photography from 1991 and 2008 was used to document and classify changes to prairie and savanna habitat in Minnesota mapped by MCBS in 1993 or earlier. For this analysis 59,184 acres of prairie and 6,260 acres of savanna were evaluated, totaling 65,444 acres. For this report, the entire area was collectively called prairie habitat. Source data are available on the DNR's geographic information system (GIS) data deli and a query was used to select all prairie communities with a date of 1993 or earlier. The purpose of the project was to quantify the number of acres of prairie mapped by MCBS between 1971 and 1993 that have been altered or converted to other uses by 2008. Changes were classified by land use/impact type (Table 1).

The analysis of current land cover for this project used United States Department of Agriculture, Farm Service Agency (FSA) 2008 color-infrared air photos. Photo dates were from mid-summer when deciduou8s trees had full leaf canopy. 2006 and 2003 true-color FSA air photos were also used occasionally when the 2008 photos were insufficient. Black and white air photos, taken in mid-spring before full leaf out, were used for the 1991 comparison.

To help accomplish this project, the computerized feature extraction program SPRING (Camara et al. 1996) was used to create new polygons of similar land cover using the 2008 FSA photos. These new polygons were analyzed and classified as either remaining prairie or one of several change features using the Change Type categories. The difference between the 1991 prairie habitat and prairie habitat present in 2008 was analyzed to determine the number of acres of native prairie converted over the past 17 years.

The second component to the project involved classifying land use surrounding the prairies. Using polygons from the feature extraction program described above within a

100-meter and 500-meter buffer, the area surrounding the prairie habitat was assessed. The buffer analysis highlights the management pressures surrounding the remaining native prairies and assesses the quality of habitat they provide to prairie-dependent species.

Methods

Summary of native prairie polygons:

The original prairie polygons used for this change analysis were mapped by the MN DNR's MCBS from surveys completed in 1993 or earlier. Plant ecologists used air photo interpretation of 1991 color-infrared or older photos to delineate potential native prairie sites. This was followed by field surveys of most sites to determine the extent, condition, and quality of native prairie. When access to a site was not possible, aerial survey or additional remote sensing tools were used. In much of the western part of the state, prairies less than 10 acres were not mapped. In southern and southeastern Minnesota, prairies as small as one acre were mapped largely due to the complexity of matrix landscape (bluff lands) or extreme rarity of prairie in areas of intense row crop agriculture. These data were recorded as native plant community polygons using the GIS tools available in 1993 or earlier. This subset of prairie habitat used for this change analysis consisted of 47 different native plant communities (Table 2).

The area originally considered for this analysis consisted of 2,678 prairie polygons totaling 73,134 acres. In Goodhue, Houston and Winona counties, 1157 prairie polygons totaling 7,690 acres were removed from analysis for the following reasons: 1) aerial photography for these counties had heavy shadows, due to both the time of day the photos were taken and the highly dissected terrain of the area, rendering image analysis unfeasible, 2) many sites were located in oak savanna habitat making precise verification of site boundaries difficult due to woody vegetation cover present in 2008 aerial photos but not visible in the 1991 leaf-off imagery and 3) the mean size for these prairie polygons was 7 acres, well below the rest of the state, reducing the accuracy of polygon boundaries. Thus, 1,521 prairie polygons, totaling 65,444 acres (Figure 1) were selected for final evaluation. The mean size for these prairie sites was 43 acres.

Because of the time required for analyzing buffer polygons surrounding prairie habitat, a simplified procedure was needed. Three counties were selected for a reduced buffer analysis from 500 m to 100 m and three additional counties were classified using a random 20% sampling of 100 m buffers and no 500 m buffers. The counties of Dakota, Washington, and Lac Qui Parle were analyzed using 100 m buffers for each prairie polygon. Dakota and Washington counties were selected for this since we anticipated more buffer change given their proximity to the Metro Region, but the large number of sites in these counties precluded the full 500 m analysis. Lac Qui Parle was also selected for full 100 m sampling of all sites because we observed more errors in this county related to digitizing of the original prairie boundaries than other counties. It was also important to classify as much area as time allowed in this county in case we could rectify any of the boundary issues and adjust the data accordingly. The counties of

Kittson, Marshall, and Pennington were completed with a random 20% sampling of 100 m buffer areas, with the remaining prairie sites in these counties evaluated without a buffer. This sampling approach was applied to the northwest counties because fewer land use changes were observed in the buffer areas.

Digitizing Prairie Polygons:

The computer program SPRING was used to automatically digitize landscape features present on the 2008 FSA color-infrared air photos. This process, called feature extraction and segmentation, creates polygons that are similar in color and "texture" on a digital image based on user-specified sensitivity settings. The process used by this software (called "region growing") starts by selecting a single pixel and then adding neighboring pixels that match the color, texture, and minimum size parameters set by the user. The "polygon" grows by adding similar pixels until the color or texture of the pixels are different enough to stop growing the polygon. A new polygon is then created and begins to "grow" by grouping similar pixels again. The end result is a digitized map of polygons delineating areas of similar color and texture on the photo that can be used to classify land-use. Several iterations were run to get the appropriate sensitivity for the purposes of this analysis, and final parameters were set to a sensitivity such that a "polygon" of the canopy of a single large tree in the 2008 aerial photo could be detected and delineated.

Classifying Segmented Polygons:

Segmentation aided in recognizing change by providing the outlines of buildings, roads, and major land-use grouping such as agriculture. This new dataset was then imported into Esri's ArcMap (version 9.3), a geospatial processing program. When the 1991 aerial photo was compared with the segmented polygon dataset, it was easy to match up features that were present in both time periods (no change), and identify features that differed and required a change classification.

Segmented polygons were classified separately by county to increase ArcMap processing speed. This also enabled the observer to become familiar with identifying regional characteristics, such as wetter soils in the northwest or identifying the presence of more hay fields in certain areas that without extensive review may be confused as row crop agriculture. An attribute table related to the polygon shapefile was created to record the land-use category observed in the 1991 photo and the land-use category observed in the 2008 photo. Segmented polygons inside of MCBS mapped prairie habitat were assigned a three-letter code if land-use changes existed (i.e. land-use was different in 2008 compared to 1991) (see table below). For example; a segmented polygon with woody deciduous natural vegetation present inside of the mapped prairie in 1991 was given a code of WDN. By 2008, the woody vegetation had been removed and open grassland existed (coded as GRA). To simplify the data for reporting purposes, all woody vegetation types were grouped together to reduce the number of change combinations possible. Although the database is detailed enough to identify deciduous or coniferous species and natural occurrence or plantation planting, regional

trends were only determined using a single category for all woody vegetation. For land classified outside the MCBS mapped polygons, within either the 100 m or 500 m buffer, a single or two-letter code was used. For all land-use that was the same between 1991 and 2008, the land-use category for 2008 was listed as “NC” (no change). The final dataset contains a detailed and quantifiable list of non-overlapping land-use change categories by county.

Change Categories:

Outside of Mapped Polygons		**Descriptors Inside of Mapped Polygons**		
Change Category	Description	**Reporting Category**	Change Category	Description of Change Cetegories
NC	No change	**NC**	NC	No change
D	Development	**DR**	DRS	Residential structures
		DO	DOS	Other structures (sheds, buildings, etc)
		DR	DRD	Road Development
		DR	DTR	Trails
		DO	DOO	Other development
M	Mining	**MGR**	MGR	Gravel and or clay mining
W	Woody vegetation encroachment	**Wy**	WCN	Natural invasion of coniferous woody vegetation
		Wy	WCP	Plantation of coniferous woody vegetation
		Wy	WDN	Natural invasion of deciduous woody vegetation
		Wy	WDP	Plantation of deciduous woody vegetation
		Wy	WMM	Mixed coniferous/deciduous encroachment, origin unspecified
Ag	Agricultural activities	**Ag**	ARC	Row crop agriculture
		GRA	AGR	Grazing
		Ag	APD	Pond Dugout
		Ag	AOO	Other agriculture
L	Land Management	**GRA**	LHA	Haying
		GRA	LBU	Prescribed burn
G	Grassland	**GRA**	GRA	Intact native or non-native grassland or open vegetation
A	Aquatic	**A**	ALR	Lake/river
		A	ARP	Retention Pond
		A	AWE	Wetland
O	Misc/other	**OBS**	OBS	Bare soil/dead vegetation/ disturbed ground
		OOT	OOT	Other, describe in notes as needed

Other change classifications were generalized to either decrease review time or simplify reporting categories. Thinning of woody vegetation from 1991 to 2008 was recorded in the dataset, but reported as no change for this report. However, if the woody vegetation present in 1991 was removed and created a contiguous area with prairie or other open habitat, the 2008 classification was listed as grassland. In many areas evaluated, it was possible to identify haying and prescribed burning in both time periods, and they were recorded as such in the dataset. For this report, however, they are listed as grassland since management for both maintain intact grasslands. Developed areas involving residential or other structures were also generalized. All areas within these property boundaries were recorded as Development Residential Structures (DRS) or Development Other Structures (DOS) even though they may include driveways or maintained yards.

Quality control checks were done by visiting a small number of sites in Kittson, Red Lake, Mahnomen, Wilkin, Traverse, Big Stone, Grant and Redwood County. Land use categories surrounding these sites were verified and determined to be accurate.

In this report, changes within prairie habitat and within buffer areas were sometimes referred to using specific descriptors that grouped several change categories:

	Reporting Descriptor	**1991 Land Use**	**2008 Land Use**
PRAIRIE	Prairie Created	Woody Vegetation Bare Soil	Grassland Grassland
	Prairie Degraded	Grassland	Woody Vegetation Bare Soil
	Prairie Converted	Grassland	Housing Other Structure Roads Mining Agriculture
BUFFER	Open Habitat Created	Development Mining Agriculture Woody Vegetation Bare Soil	Grass or Aquatic Habitat
	Grassland Degraded	Grassland Grassland Bare Soil	Bare Soil Woody Vegetation Woody Vegetation
	Grassland Converted	Grassland Bare soil	Housing Other Structure Roads Mining Agriculture
	Other Change	Woody Vegetation Agriculture Agriculture	Development Development Woody Vegetation

Results

Prairie Habitat:

Changes were reported by state, county, and by six distinct regions (Figure 2). The regions include Aspen Parklands, Glacial Ridge, Central, Metro, MN Valley West, MN Valley East, and Southeast.

1,521 mapped prairies were assessed in 32 counties totaling over 65,000 acres. Within MCBS mapped prairie habitat, 1,788 acres (2.73%) were altered in a way that reduced the quality or presence of prairie habitat. Of this, 770 acres were converted to development, row crop, or mining and 1,019 acres had an increase in woody vegetation (Figure 3). When comparing regions, the Aspen Parklands Region had the greatest increase of woody vegetation, the Metro Region had the greatest increase of development, and the Minnesota River Valley West Region had the greatest increase of prairie to row crop conversion (Figure 5). Counties with the greatest acreage of altered prairie were Kittson and Pennington (from increased woody vegetation), Marshall and Clay (from increased woody vegetation and row crop), Big Stone (from conversion to row crop, woody vegetation and development), and Sherburne, Anoka and Washington (from increased development) (Figures 4-9). There was also a change of 544 acres of woody vegetation to prairie which occurred largely in the Aspen Parklands Region and Metro Region (Figure 5). The counties with the greatest acreage of woody vegetation removal included 183 acres in Marshall, 83 acres in Kittson, 77 acres in Anoka and 75 acres in Sherburne (Figures 4-9).

One category that was not reported in the above figures included cultivated agriculture lands identified within the original prairie polygons in 1991 and recorded as grass in 2008. This was most likely either a digitizing or interpretation error during the original MCBS mapping. Since the area was not intended to be marked as prairie habitat, these data were removed from analysis or listed as an error. There was 296 acres that fell in this category.

100 meter & 500 meter Buffer:

Within 100 m and 500 m buffers, 192,000 acres were assessed for land-use changes. Total change in the 100 meter buffer was about 9% (4,765 acres); however 6% (3,226 acres) consisted of open habitat created (Figure 10). Excluding this change only 3% (1,528 acres) of the surrounding 100 m buffer had a reduction in the amount or quality of open grassland habitat. Total change within the 500 meter buffers was 6% (13,764 acres); however 4% (8,014 acres) consisted of open habitat created (Figure 11). Excluding this change, only 3 % (5,750 acres) of the surrounding 500 m buffer had a reduction in the amount or quality of open grassland habitat. In both buffers, a large component of the “open habitat created” category was from cultivated agricultural lands entered into the Conservation Reserve Program (CRP) and identified in 2008 as grassland.

The Metro Region, when compared with other regions, had the highest total acreage of change resulting from prairie converted to development or increased woody vegetation for both the 100 meter and 500 meter buffers (Figure 12-13). The MN Valley West Region had the next highest total acreage of change for these two categories within the 100 meter buffer compared with the remaining regions (Figure 12). MN Valley West Region along with the Glacial Ridge Region had significantly more open habitat created through woody vegetation removal and agriculture lands becoming CRP grasslands (over 1,200 acres each) within the 100 meter buffer than the rest of the evaluated area (Figure 12). Within the 500 meter buffer, the Glacial Ridge Region had more open habitat created (over 5,500 acres) compared to the rest of the evaluated area (Figure 13).

Intact or Altered Status:

The percentage of "converted change" was calculated for each prairie site and grouped into six categories and compared by region (Figure 14). The six categories consisted of: intact (no change), 0-5% altered, 2-25% altered, 25-50% altered, 50-75% altered, 75-100% altered. The prairie converted change classification included grassland, woody vegetation, or bare soil present in 1991 that was classified as road, structure, mining or row crop agriculture in 2008.

Of the 1,521 prairie polygons assessed, 1,304 had no converted change. For the 217 sites with some converted change, most had only a small percentage of converted change (123 sites had 0-5% change, and 73 sites had between 5-50% change). Ten sites had 50-75% change and 11 sites were altered by 75-100% change. Statewide, 14% of the prairies had converted change and of that, less than 1% fell within the 75-100% range. The Metro Region had the most altered sites in the state (Figure 14).

When looking at change from open grassland to development, mining, or agriculture surrounding prairie habitat, 660 sites had change within the 100 meters buffer (610 acres of converted change). The number of sites with converted change within 50 meters was also calculated to determine the impact of these adjacent areas. The results from this differed very little with the 100 meter data, so only the 100 meter results are discussed.

Analysis by Ownership:

The relationship between land ownership and change type was also examined. Ownership was classified into two groups. The first group, "protected", consists of land that was managed for conservation and included land owned by the state, federal and county governments as well as The Nature Conservancy (TNC) and private lands entered into programs such as CRP and Prairie Bank Stewardship. The second group, "unprotected", included all other private land as well as county land not set aside for conservation purposes. Nearly all of the change that resulted in a converted loss of prairie occurred on unprotected land ownership (756 acres). Unprotected lands also had more than twice the amount of woody vegetation expansion than protected lands

and about one-third the amount of prairie enhancement through tree removal (Figure 15).

On “protected” land ownership, the amount and types of changes vary widely (Figure 16). Ownership categories include County, CRP, Prairie Bank, State, State Forest, State Parks, State Reinvest in Minnesota (RIM), TNC, United States Fish and Wildlife Service (USFWS) Refuge and USFWS Waterfowl Production Area. Prairie land listed as “State,” included University of Minnesota (U of M), Minnesota Department of Transportation, Minnesota Department of Corrections, Minnesota Department of Military Affairs (MNDMA) and undifferentiated state-owned land. The category “State SNA” ownership, consisted of state-owned land, but managed by either the State or TNC. It is important to note that percentages of change vary widely based on the total acreage for each land ownership category. Total acreage ranges from 242 acres of State Reinvest in Minnesota lands (RIM) to 15,398 acres of State Wildlife Management Area owned lands.

County owned lands had greater than 1% loss of prairie habitat to development, mining or agriculture, and amounted to 8.5 acres. RIM lands had the next highest percentage of prairie loss (less than 1%) and resulted in the loss of 1 acre. State Wildlife Management Area lands also had less than 1% loss of prairie and resulted in 6 acres of prairie lost. The percent of increased woody vegetation was similar between all ownership categories, but lower on TNC, State Forest, State RIM, and USFWS lands. The most significant expansion of woody vegetation consisted of 209 acres from State WMA, 20 Acres from State SNA, and 19 acres from State Parks. “State” ownership had the highest percentage of woody vegetation removal (over 12%) and nearly all of the 64 acres of change came from the Cedar Creek Ecosystem Science Reserve owned by U of M. “State SNA” had 7% of woody vegetation removal and resulted in 87 acres of change.

Conclusion

The results of this project indicate that statewide, prairie habitat examined had a 4% change affecting 2,332 acres. The majority of that change was an increase in woody vegetation (1,019 acres), which is potentially reversible through management. Of the areas evaluated, 1.18% of prairie habitat was lost by conversion to land uses identified as development, row crop, or mining. The greatest prairie habitat loss occurred in the Metro Region due largely to development and the western portion of the Minnesota River Valley Region due to conversion to row crop agriculture. The Aspen Prairie Parklands Region had the greatest increase in woody cover growth when compared with the rest of the state.

There was little change over the past 15 years surrounding the MCBS mapped prairie habitat when looking at the 100 m and 500 m buffers. Approximately 3% of open grassland was either converted or degraded. Native prairie buffers in the Metro Region had the highest amount of grassland/open space loss from increased woody vegetation and development.

There were 206 sites that were altered by development, mining or agricultural change, although more than half of these sites had less than 5% of the overall polygon altered. A small number of sites had more than 75% of the original prairie habitat altered. Nine of the eleven sites in this category were located in the Metro Region and nearly all on private land. The majority (85.73%) of the prairie sites analyzed remain intact with no change occurring inside of the prairie.

Of the prairie habitat evaluated, roughly half were considered protected (state, federal, county owned or private enrolled in conservation programs). Prairie habitat not protected had significantly higher amounts of prairie loss or increased woody vegetation. Private lands also had less woody vegetation removal than protected-lands. Prairie habitat under protective ownership had little prairie loss (19 acres) with most occurring on County and State WMA owned land.

The results of this project indicate that little prairie has been lost from 1991 for those sites identified by MCBS in 1993 or earlier and evaluated in this study. Much of the change that has taken place consisted of an increase in woody vegetation. Land managers should consider the suitability of woody vegetation in the prairie matrix for each individual site.

The procedures used in this project were challenging in terms of processing time, quality and dates of aerial photographs, and the technology and resources available at the time the original prairie polygons were mapped.

1.) Processing time was the most significant problem encountered. Although the feature extraction and segmentation through SPRING was faster than manually digitizing land-use boundaries, it was still slow and prone to technical difficulties. Large file sizes slowed processing time exponentially requiring some polygons to be processed overnight, often taking more than six hours to complete. The segmentation process of buffer polygons greater than 3,000 acres would often fail half way through the processing time, requiring the polygons to be split in ArcMap and reprocessed. Once the segmented lines were created in SPRING, several time-consuming steps were still needed to create polygons in ArcMap and to project the spatial data correctly. It is estimated that the entire processing time to segment the 1521 buffered polygons (half the original workload) took 5 months of effort. Time expended would have been much longer if processing was not accomplished overnight and on weekends when computer networks were not tied up.

2.) Reviewing overall change for the segmented polygons was also a much more time consuming process than originally anticipated. The use of leaf-on photos for 2008 and leaf-off photos for 1991made interpretation difficult and made woody vegetation appear less dense in the 1991 photos than in the 2008 photos. If this project were repeated, the use of aerial photos taken during the same season is highly recommended. This factor, along with poor photo quality, including

significant shadow effect in Goodhue, Winona, and Houston counties, made interpretation time consuming and unreliable.

Another issue was related to inaccuracies in the mapping of original prairie polygons. Geographic positioning systems (GPS) and geographic information systems (GIS) were either unavailable or rudimentary when these prairies were mapped in the late 1980s and early 1990s. Some polygons contain non-prairie features, such as row crop or housing in 1991 aerial photography. Some of these issues were clearly due to mapping errors, but it was possible that some of the non-prairie features occurred between the time that the prairie was mapped and when the 1991 photo was taken. While the source of the errors could not be determined, the changes for these polygons were still mapped, but removed from the final analysis and results.

Recommendations

1.) Equipment

The original computer used lacked sufficient processing speed and random access memory (RAM) to run the imaging software for feature extraction and segmentation, even when smaller amounts of data were being processed. Once a computer with a processing speed of 2.99 GHz, and 3.25 GB of Ram was purchased, these issues occurred less often.

Due to the volume and size of images being produced through each step, future projects should have access to large network hard drives for file storage.

2.) Software

The slow processing speed of the software SPRING was a problem especially when large file sizes were being segmented and persisted even after upgrading existing hardware. Reducing the file size of images being processed was necessary to alleviate this problem. Reviewing the most recent image processing software is recommended for future projects and should be tested with large batches of data early in the segmentation process to determine if changes need to be made of if other software should be tested.

3.) Dates of Aerial Imagery

High quality aerial photos taken during the same time period for each year being observed should be used if possible. Interpretation of leaf-on and leaf-off photos over multiple years delayed the change analysis, and caused some areas to be discarded from the project.

4.) Testing

Future projects should examine if new software is available to effectively use "Unsupervised" analysis methods to process data. This method involves programming software to recognize specific color and texture parameters as a unique item such as prairie. The computer then analyzes the entire area and makes assumptions that all areas with these parameters are prairie. Manual review of the landscape would only be needed for verification and quality control. At the time of this project however, we felt the software available was not advanced enough to correctly identify the complex landscape.

References

Bakker, K.K. 2003. The effect of woody vegetation on grassland nesting birds: An annotated bibliography. Proceedings of the South Dakota Academy of Science 82:119-141.

Camara G, RCM Souza, UM Freitas, & J. Garrido. 1996. SPRING: Integrating remote sensing and GIS by object-oriented data modeling. Computers & Graphics, 20: (3) 395-403.

Table 1: Prairie Polygon Summary Data

	County	No Change	Development	Woody Vegetation Encroachment	Row Crop	Mining	Woody Vegetation Removal	Prairie Acres
Aspen Park NW	Kittson	7397.25	1.65	372.51	3.57	0.00	83.26	7870.00
Aspen Park NW	Marshall	6790.98	0.66	174.98	49.78	0.00	182.98	7276.48
Aspen Park NW	Pennington	2388.63	3.33	81.44	0.53	0.32	23.10	2532.68
Aspen Park NW	Red Lake	706.27	0.00	25.00	0.00	0.00	0.38	731.65
Glacial Ridge	Clay	8208.66	18.98	59.03	57.20	9.60	4.81	8382.57
Glacial Ridge	Mahnomen	1312.60	0.00	20.96	0.00	0.00	36.40	1371.37
Glacial Ridge	Wilkin	8445.19	0.27	0.43	22.02	0.00	3.59	8488.39
Central	Benton	119.89	1.17	0.00	0.00	0.00	3.05	124.18
Central	Grant	73.24	0.00	1.96	0.00	0.00	0.03	78.10
Central	Morrison	353.46	1.46	9.24	0.01	0.00	1.90	366.26
Central	Pope	51.76	0.00	2.50	2.20	0.00	0.00	57.14
MN Valley W	Big Stone	8291.43	50.09	53.26	116.61	0.38	8.98	8524.62
MN Valley W	Lac Qui Parle	9861.93	8.35	56.72	30.78	0.51	10.92	10131.90
MN Valley W	Swift	1369.69	0.00	1.62	14.13	0.00	0.00	1387.18
MN Valley W	Traverse	3071.42	2.93	5.88	7.35	0.00	1.79	3104.35
MN Valley W	Yellow Medicine	71.33	0.00	5.29	14.65	0.00	0.01	91.36
MN Valley E	Brown	150.93	1.71	3.33	0.23	0.00	0.11	158.07
MN Valley E	Nicollet	11.49	0.31	3.52	0.00	0.00	0.00	15.36
MN Valley E	Redwood	90.73	5.35	11.95	0.00	5.44	0.00	113.89
MN Valley E	Renville	87.85	1.42	10.36	0.91	0.00	0.60	101.80
Metro	Anoka	651.70	78.94	3.43	0.00	0.00	77.36	830.74
Metro	Chisago	85.84	0.06	0.20	0.00	0.00	1.60	87.70
Metro	Dakota	501.04	12.86	14.26	3.09	0.00	9.90	545.83
Metro	Isanti	32.58	0.00	0.48	0.00	0.00	0.00	33.50
Metro	Ramsey	17.17	2.95	1.23	0.00	0.00	0.07	21.47
Metro	Rice	171.70	2.39	37.87	0.00	0.00	1.39	217.87
Metro	Sherburne	1775.17	129.30	10.99	8.74	0.00	74.61	2017.45
Metro	Washington	551.13	97.31	46.28	0.00	0.00	16.82	721.14
SE	Fillmore	2.78	0.00	0.29	0.00	0.00	0.00	3.07
SE	Olmsted	47.03	0.05	3.29	0.00	0.00	0.10	51.51
SE	Wabasha	4.10	0.00	0.45	0.00	0.00	0.20	4.75
	Total	62694.94	421.55	1018.73	331.78	16.26	543.96	65442.38

Table 2 – Native Plant Communities evaluated for change analysis.

NPC	Native Plant Community	NPC	Native Plant Community - Complexes
DOCEBA	Dry Oak Savanna (Central) Barrens Subtype	ABR_CX	Agassiz Beach Ridge Complex
DOCESG	Dry Oak Savanna (Central) Sand-Gravel Subtype	AOX_CX	Aspen - Oak Woodland Complex
DOSEBA	Dry Oak Savanna (Southeast) Barrens Subtype	ASR_CX	Agassiz Shoreline Ridge and Swale Complex
DPCEBA	Dry Prairie (Central) Barrens Subtype	DPW_CX	Dry Prairie - Woodland Complex
DPCESG	Dry Prairie (Central) Sand-Gravel Subtype	PBW_CX	Parkland Brush Prairie - Wetland Complex
DPSEBB	Dry Prairie (Southeast) Bedrock Bluff Subtype	PMA_CX	Wet-Mesic Prairie / Lowland Aspen Complex
DPSEHI	Dry Prairie (Southeast) Hill Subtype	PWL_CX	Prairie Wetland Complex
FDs38a	Oak - Shagbark Hickory Woodland	ROP_CX	Rock Outcrop - Dry Prairie Complex
MPCEXX	Mesic Prairie (Central)	SWP_CX	Saline Wet Prairie Complex
MPSEXX	Mesic Prairie (Southeast)		
MPSWXX	Mesic Prairie (Southwest)		
OPp93	Prairie Extremely Rich Fen		
UPn12a	Dry Barrens Prairie (Northern)		
UPn12b	Dry Sand - Gravel Prairie (Northern)		
UPn12c	Dry Sand - Gravel Brush-Prairie (Northern)		
UPn12d	Dry Hill Prairie (Northern)		
UPn13	Northern Dry Savanna		
UPn13b	Dry Barrens Oak Savanna (Northern)		
UPn13c	Dry Sand - Gravel Oak Savanna (Northern)		
UPn23a	Mesic Brush-Prairie (Northern)		
UPn23b	Mesic Prairie (Northern)		
UPs13a	Dry Barrens Prairie (Southern)		
UPs13b	Dry Sand - Gravel Prairie (Southern)		
UPs13c	Dry Bedrock Bluff Prairie (Southern)		
UPs13d	Dry Hill Prairie (Southern)		
UPs14a2	Dry Barrens Oak Savanna (Southern) Oak Subtype		
UPs14b	Dry Sand - Gravel Oak Savanna (Southern)		
UPs14c	Dry Hill Oak Savanna (Southern)		
UPs23a	Mesic Prairie (Southern)		
UPs24a	Mesic Oak Savanna (Southern)		
WPCEXX	Wet Prairie (Central)		
WPn53a	Wet Seepage Prairie (Northern)		
WPn53b	Wet Brush-Prairie (Northern)		
WPn53c	Wet Prairie (Northern)		
WPn53d	Wet Saline Prairie (Northern)		
WPs54a	Wet Seepage Prairie (Southern)		
WPs54b	Wet Prairie (Southern)		
WPs54c	Wet Saline Prairie (Southern)		

Figure 1 – Blue histogram represents the all sites originally intended for this change analysis project. Red histogram represents the sites evaluated after adjustments were made.

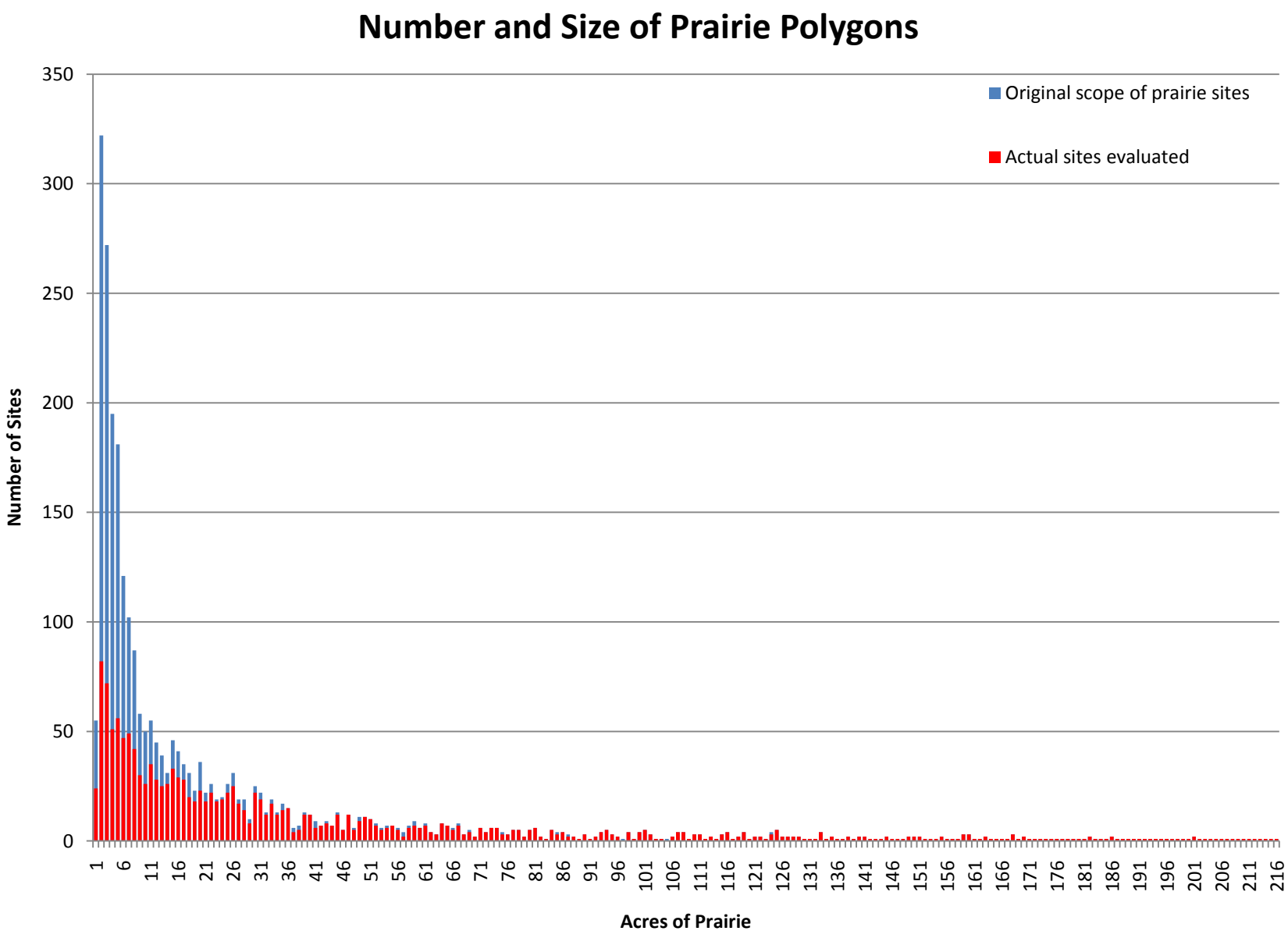


Figure 2 – Prairie habitat evaluated

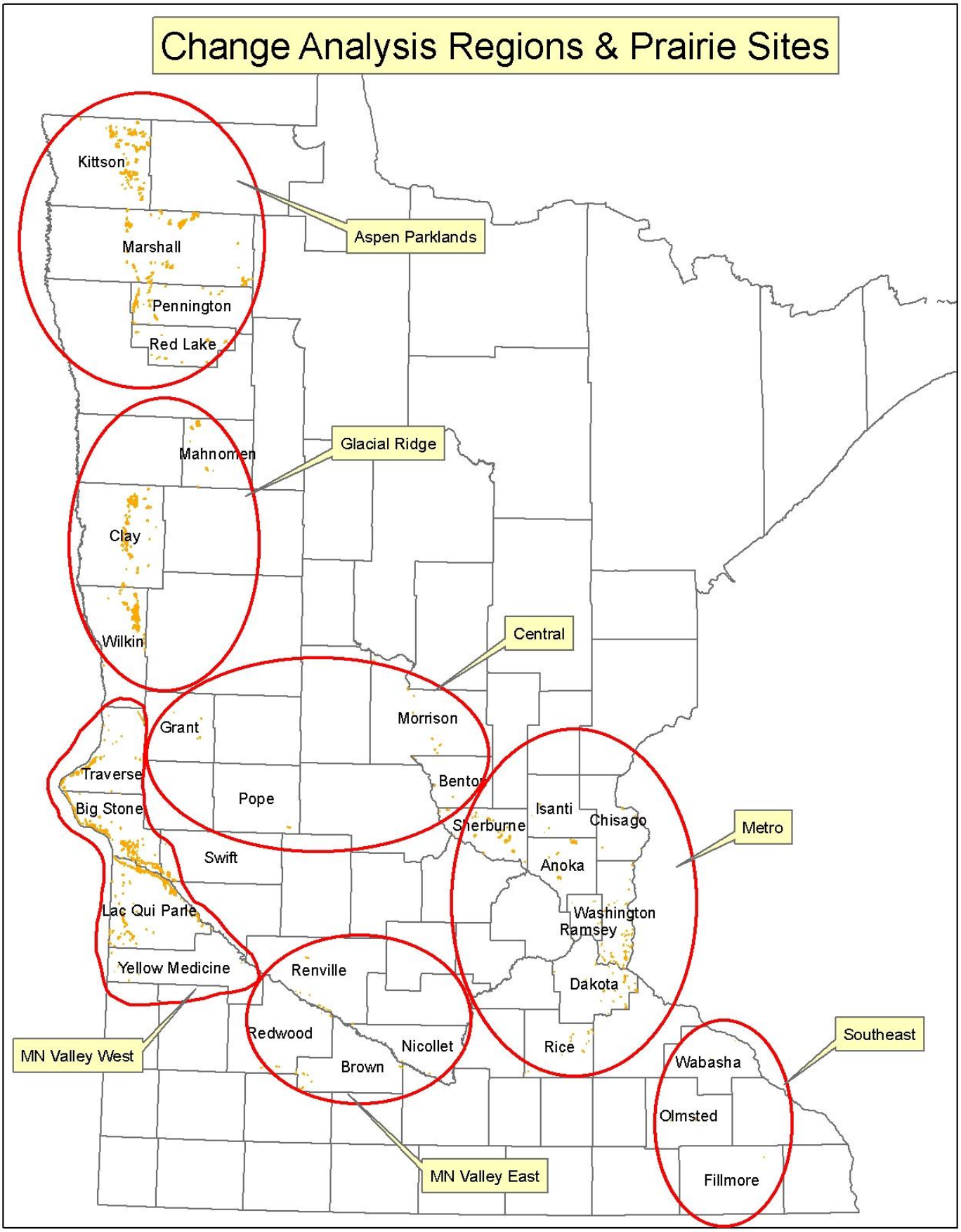


Figure 3 – Left graph represents total change of prairie habitat that was evaluated for this project. Right graph includes detailed categories of change. Development category includes roads, residential structures, and other structures.

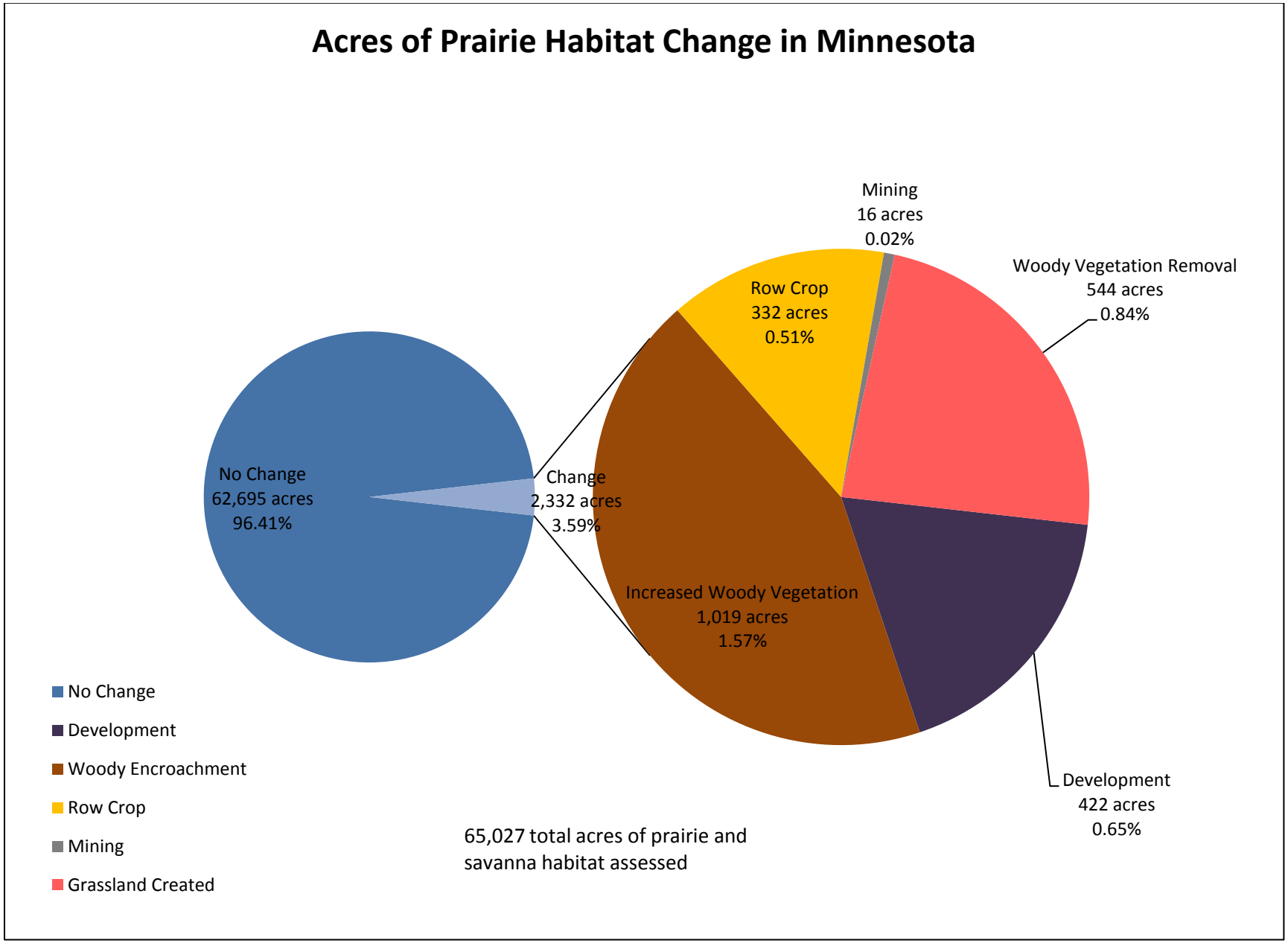


Figure 4 – Increase of prairie habitat includes wood vegetation reduction and bare soil converted to grassland. Loss of prairie habitat includes development, mining, and agriculture row crop conversion.

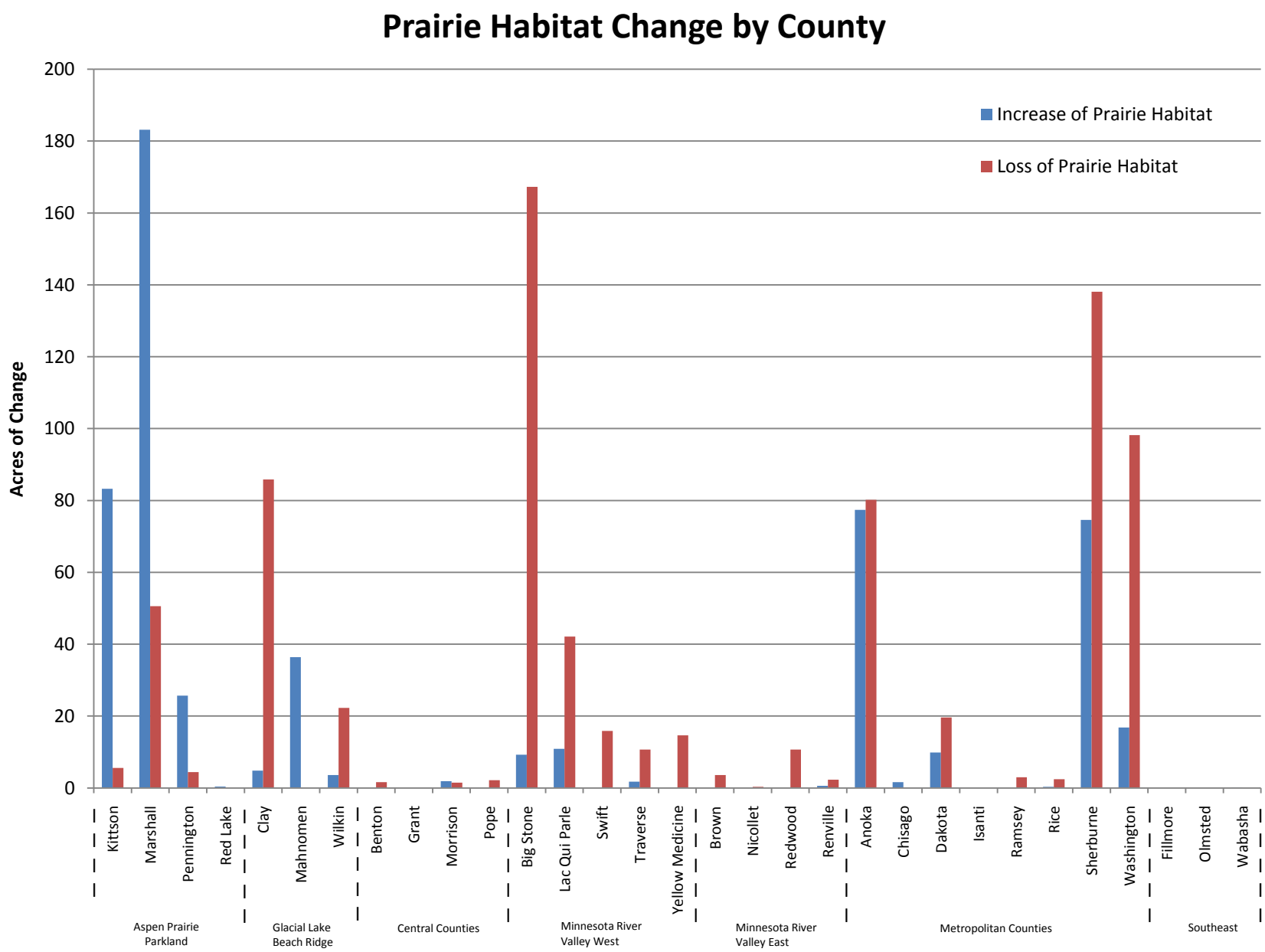


Figure 5 - Bars depict acres of change and are associated with left side of vertical axis, red lines depict total acres and are associated with the right side of the vertical axis. Woody Vegetation Removal also includes a small amount of bare soil to grassland change (<5 acres).

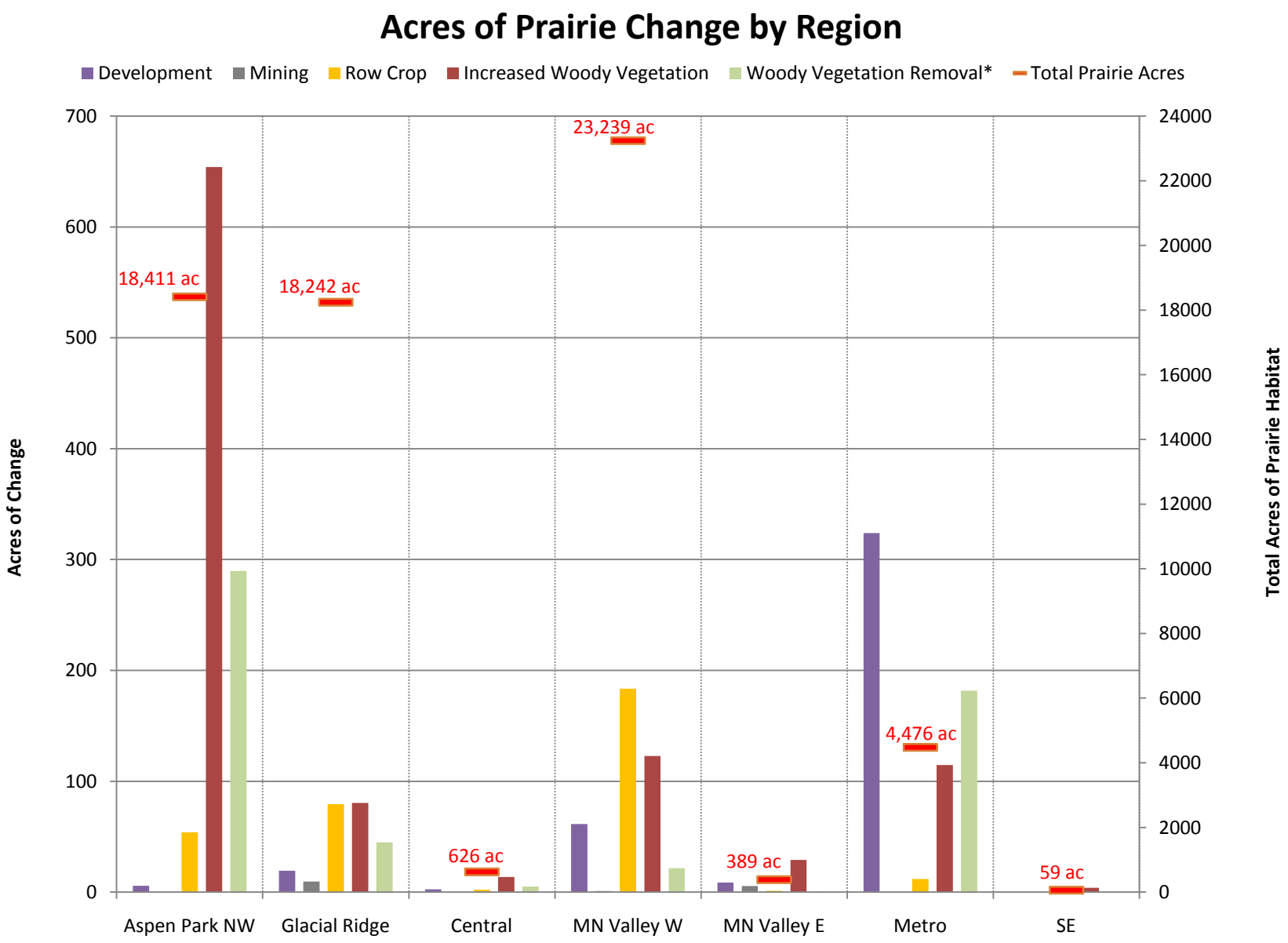


Figure 6 - Bars depict acres of change and are associated with left side of vertical axis, red lines depict total acres and are associated with the right side of the vertical axis. Woody Vegetation Removal also includes a small amount of bare soil to grassland change (<5 acres).

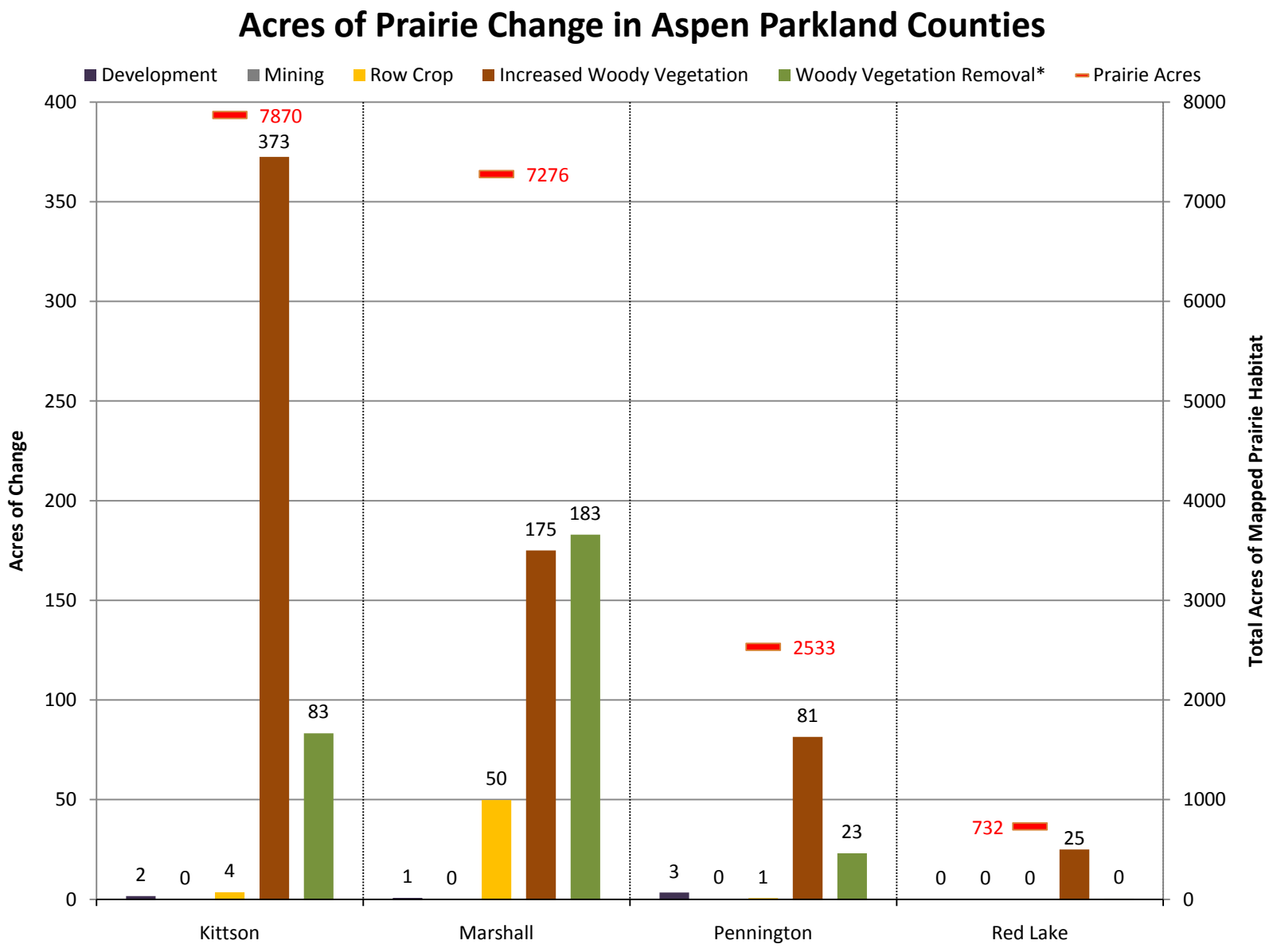


Figure 7 - Bars depict acres of change and are associated with left side of vertical axis, red lines depict total acres and are associated with the right side of the vertical axis. Woody Vegetation Removal also includes a small amount of bare soil to grassland change (<5 acres).

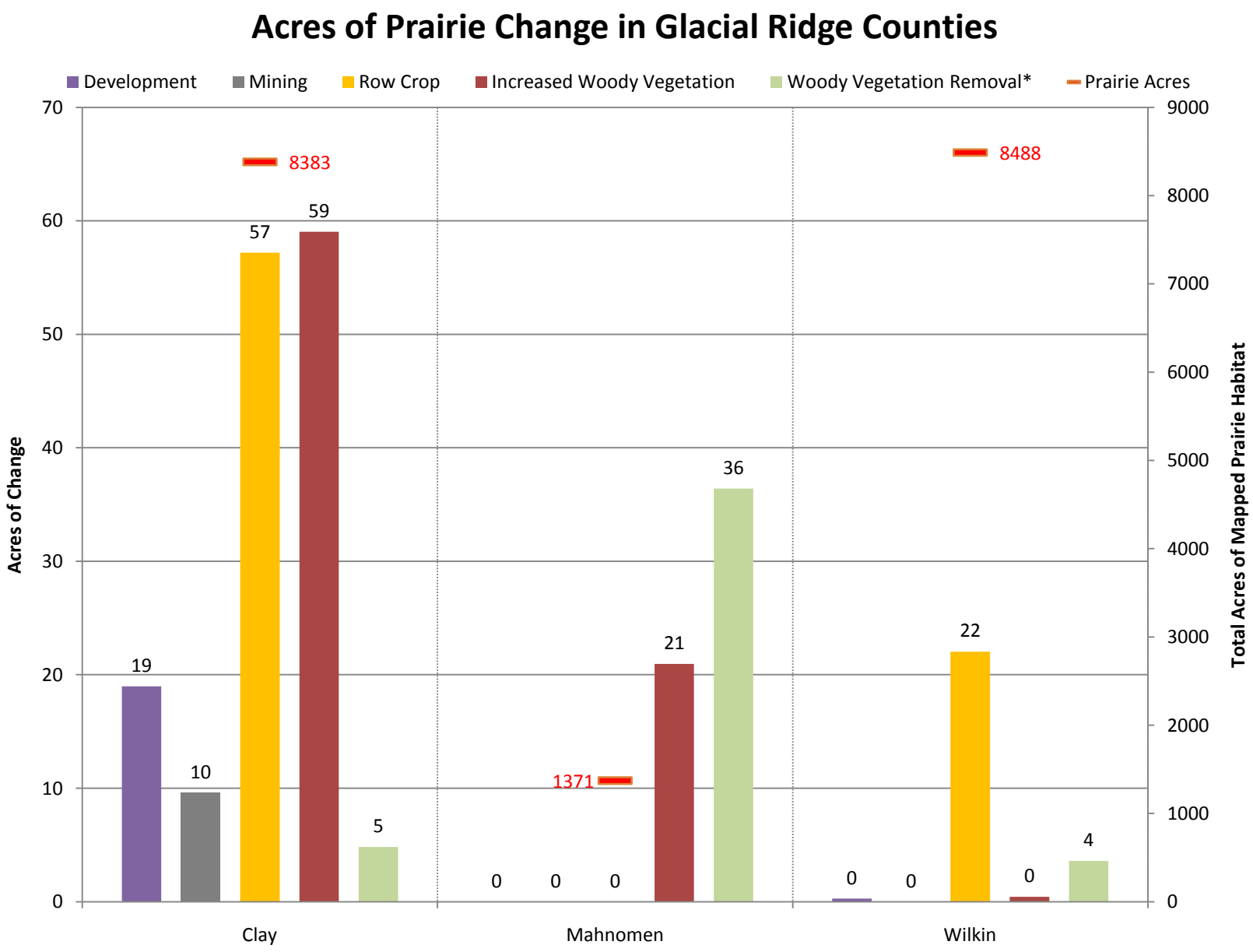


Figure 8 - Bars depict acres of change and are associated with left side of vertical axis, red lines depict total acres and are associated with the right side of the vertical axis. Woody Vegetation Removal also includes a small amount of bare soil to grassland change (<5 acres).

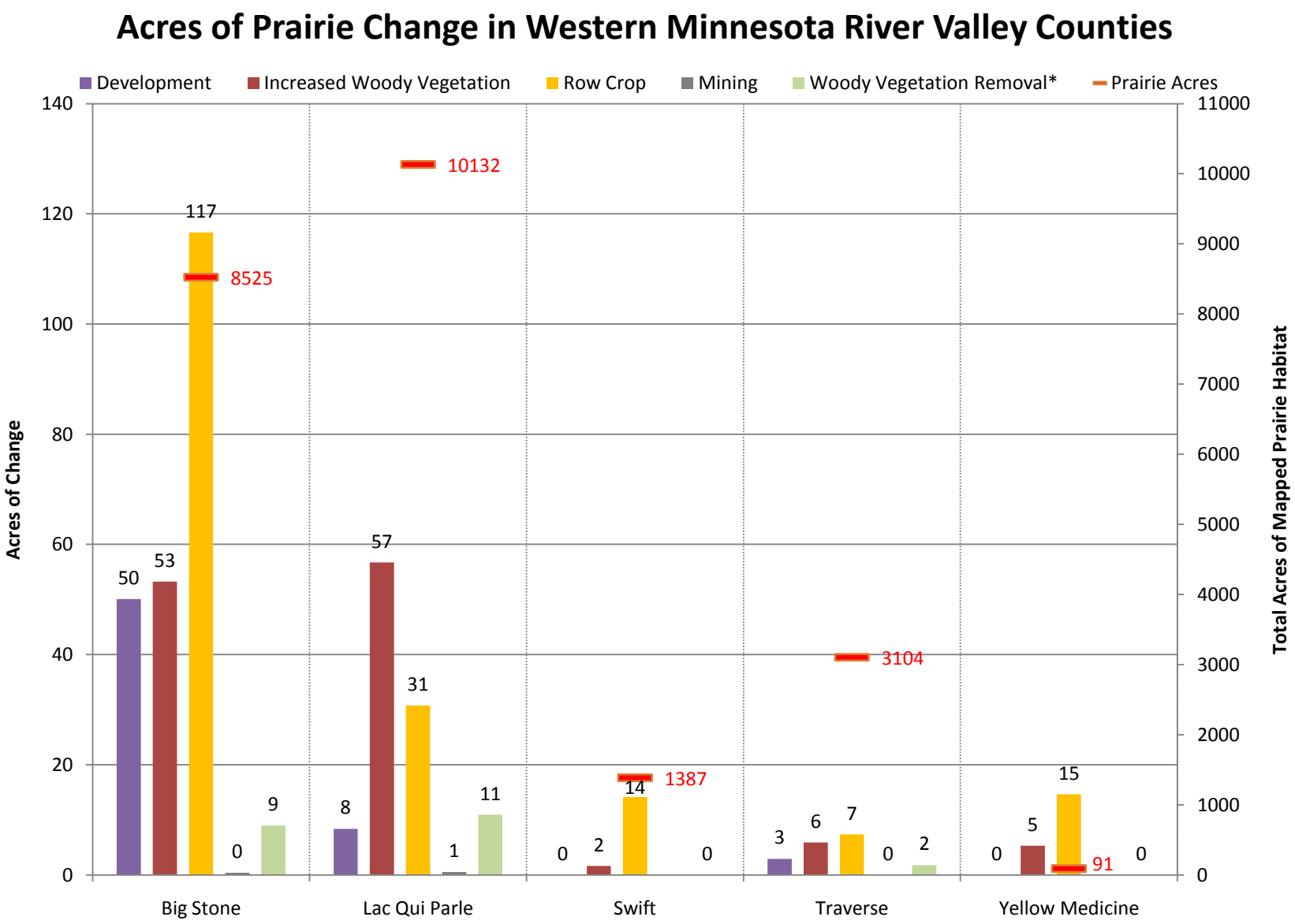


Figure 9 - Bars depict acres of change and are associated with left side of vertical axis, red lines depict total acres and are associated with the right side of the vertical axis. Woody Vegetation Removal also includes a small amount of bare soil to grassland change (<5 acres).

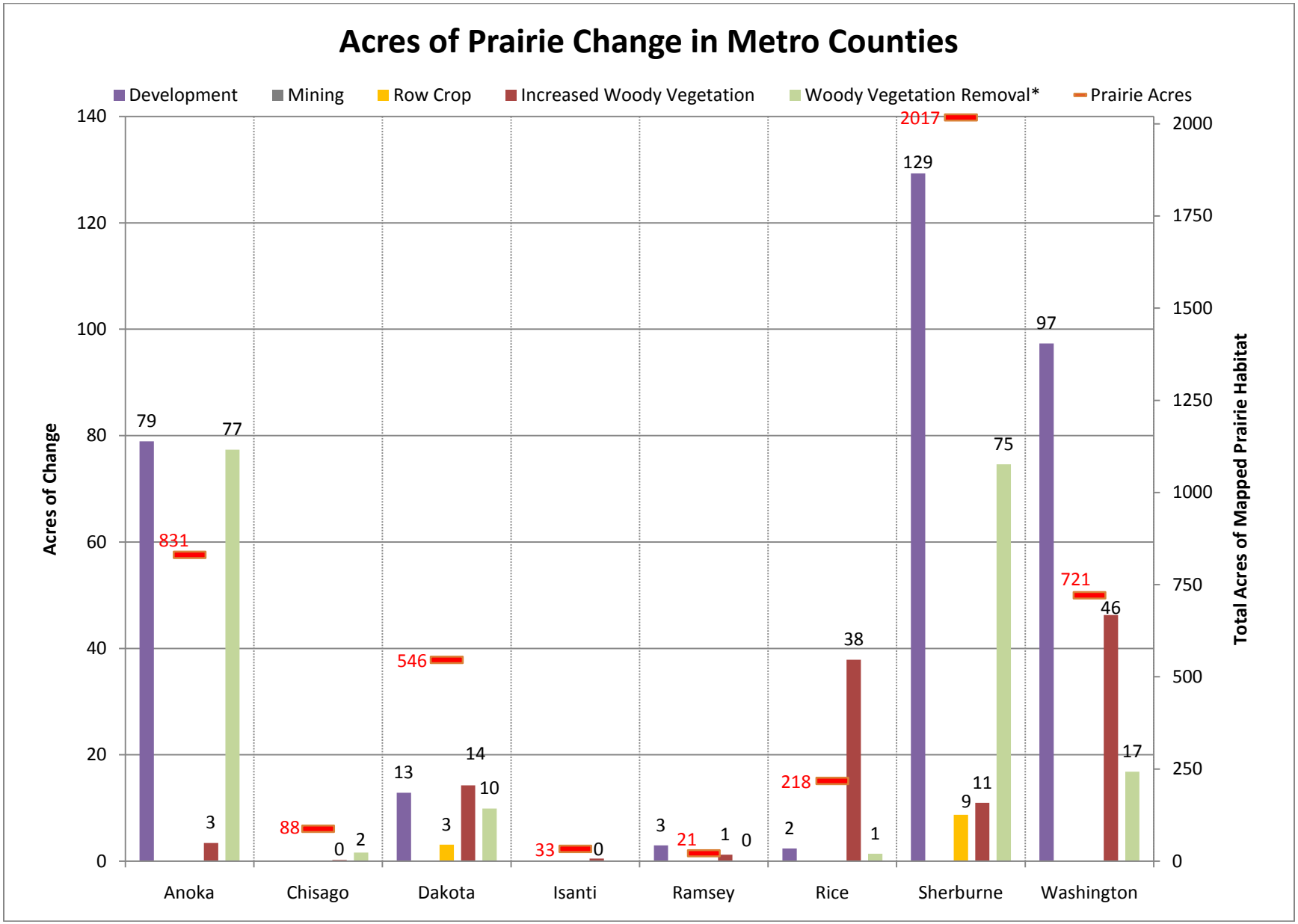

Acres of Prairie Change in Metro Counties
Development
Mining
Row Crop
Increased Woody Vegetation
Woody Vegetation Removal*
Prairie Acres
Acres of Change
Total Acres of Mapped Prairie Habitat
0
20
40
60
80
100
120
140
0
250
500
750
1000
1250
1500
1750
2000
79
3
77
831
88
0
2
13
3
14
10
546
33
0
3
21
1
0
2
218
38
1
129
9
11
75
2017
97
721
46
17
Anoka
Chisago
Dakota
Isanti
Ramsey
Rice
Sherburne
Washington

Figure 10 - Left graph represents total change of prairie habitat that was evaluated for this project. Right graph includes detailed categories of change. "Open Habitat Created" category includes any change that resulted in increased grassland or aquatic habitat. Development category includes roads, residential structures, and other structures.

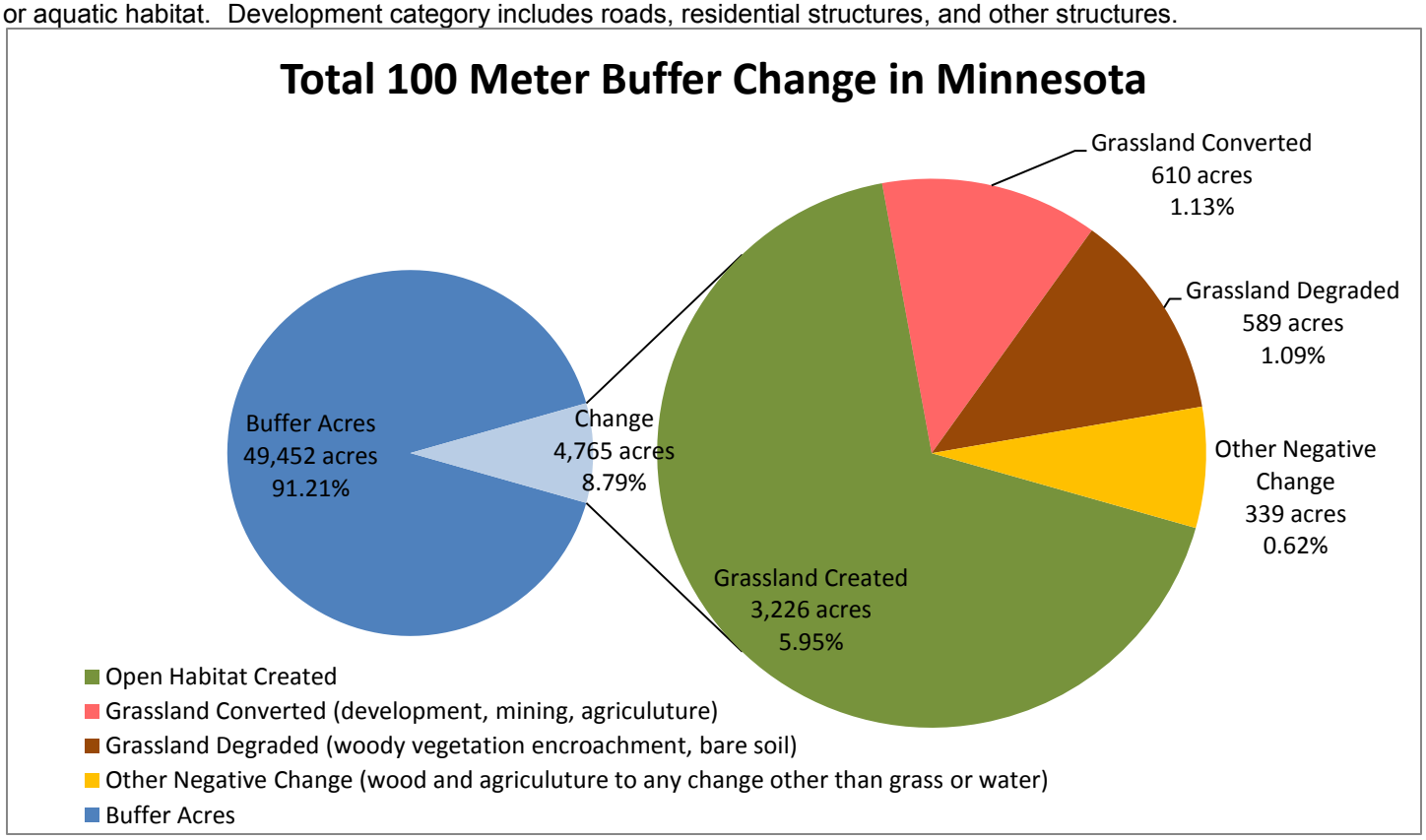


Figure 11 - Left graph represents total change of prairie habitat that was evaluated for this project. Right graph includes detailed categories of change. "Open Habitat Created" category includes any change that resulted in increased grassland or aquatic habitat. Development category includes roads, residential structures, and other structures.

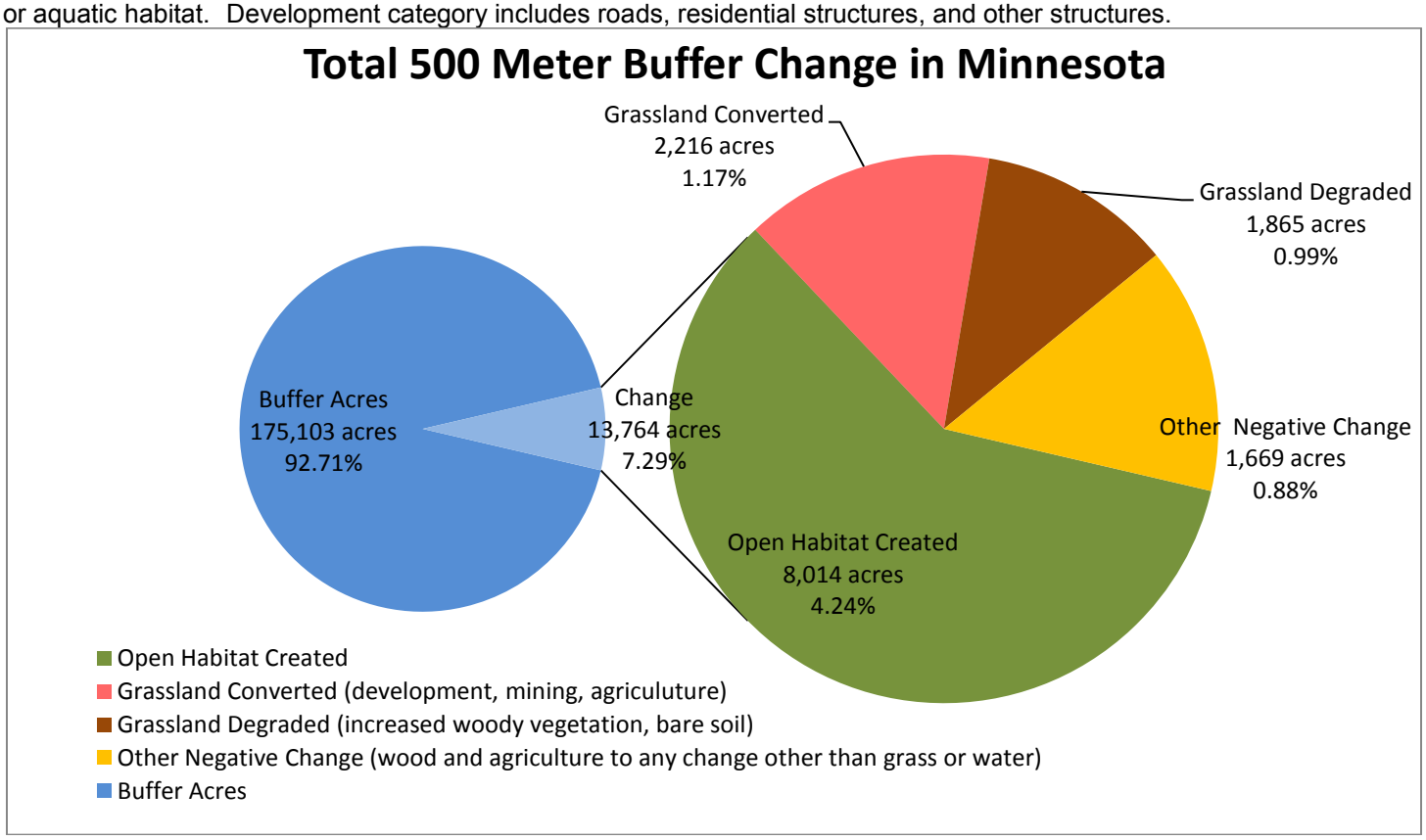


Figure 12 - Bars depict acres of change and are associated with left side of vertical axis, red lines depict total acres and are associated with the right side of the vertical axis. Detailed change categories listed below are discussed in methods.

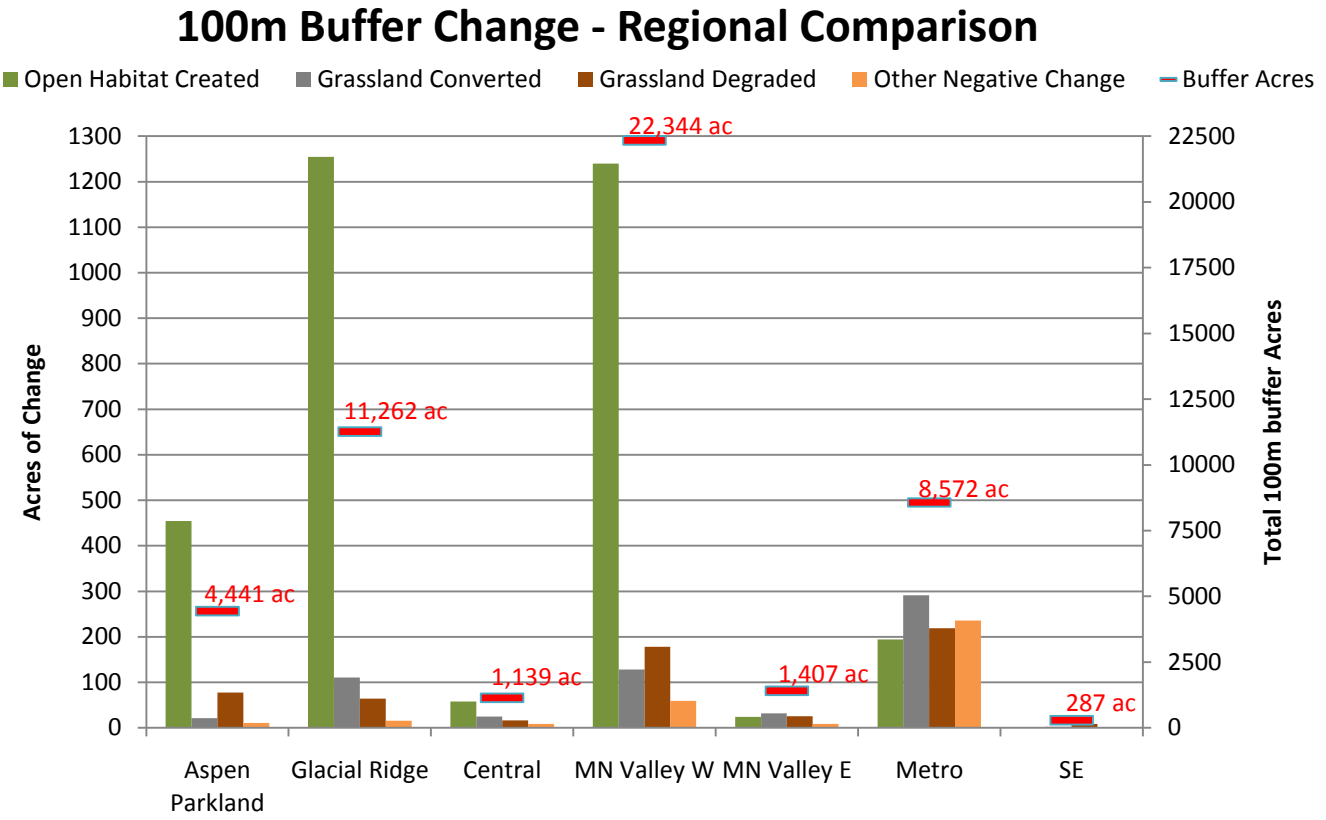


Figure 13 - Bars depict acres of change and are associated with left side of vertical axis, red lines depict total acres and are associated with the right side of the vertical axis. "Detailed change categories listed below are discussed in methods.

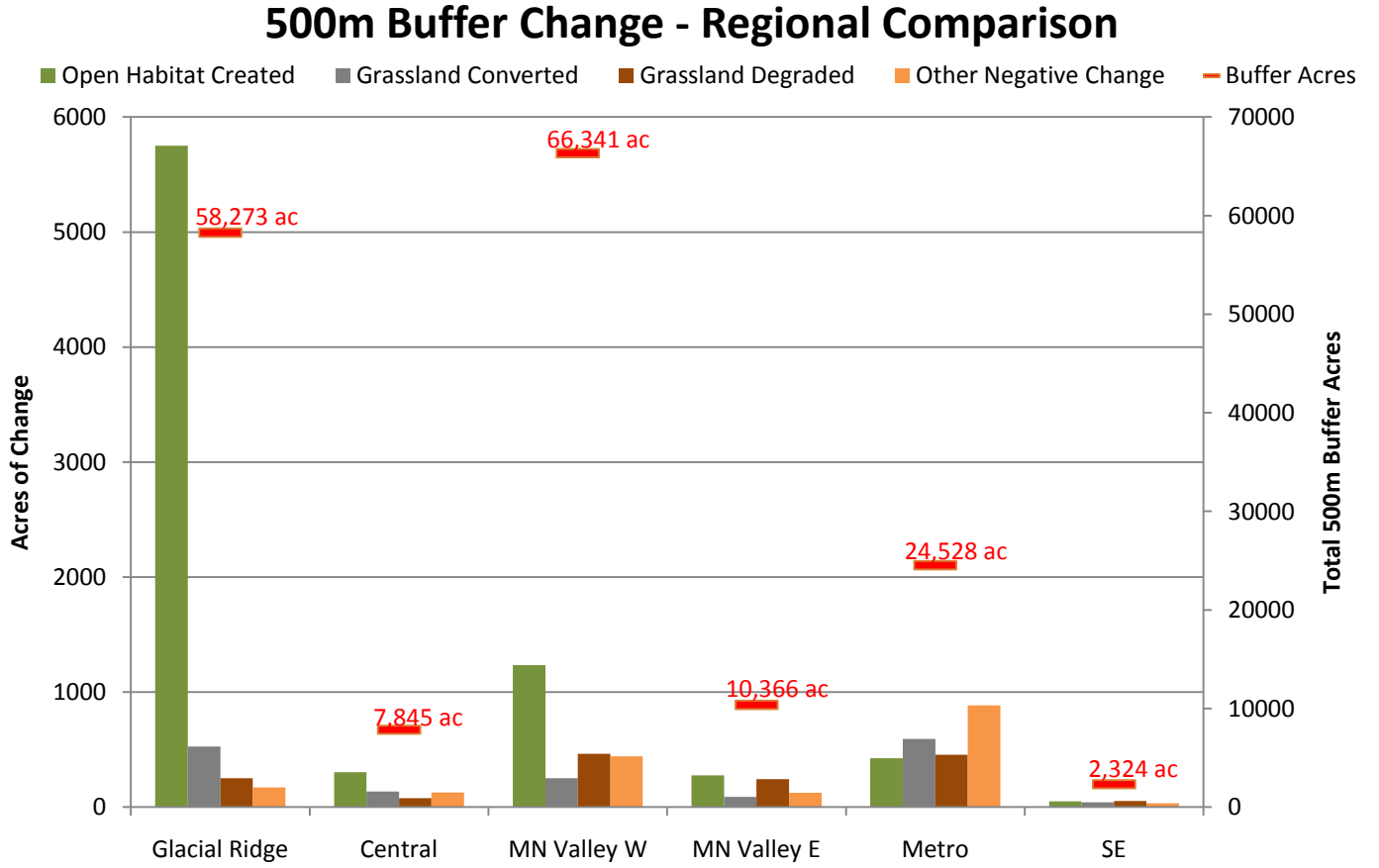


Figure 14 – number of individual prairie sites that were altered or left intact

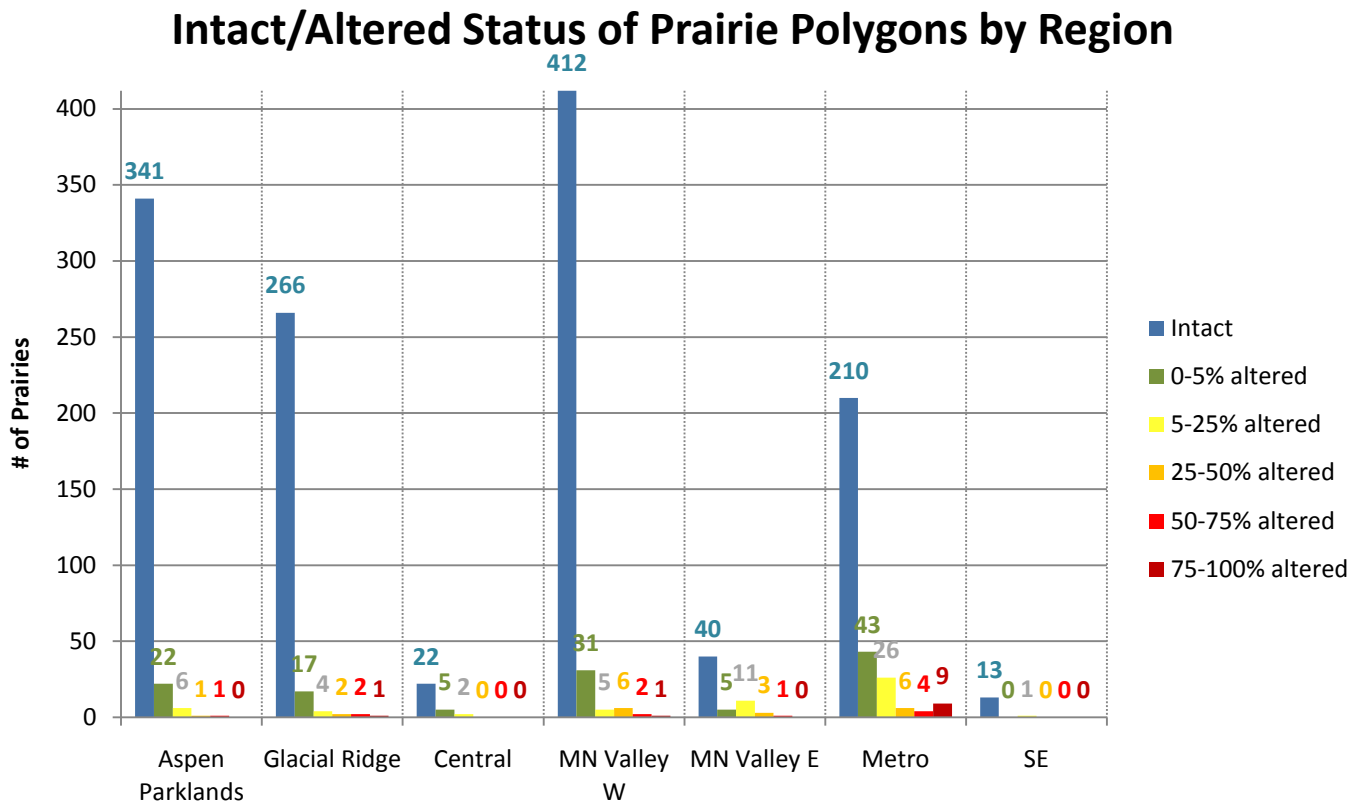


Figure 15 – Protected sites include state, federal and county land, as well as private land listed as CRP, Prairie Bank, or owned by TNC.

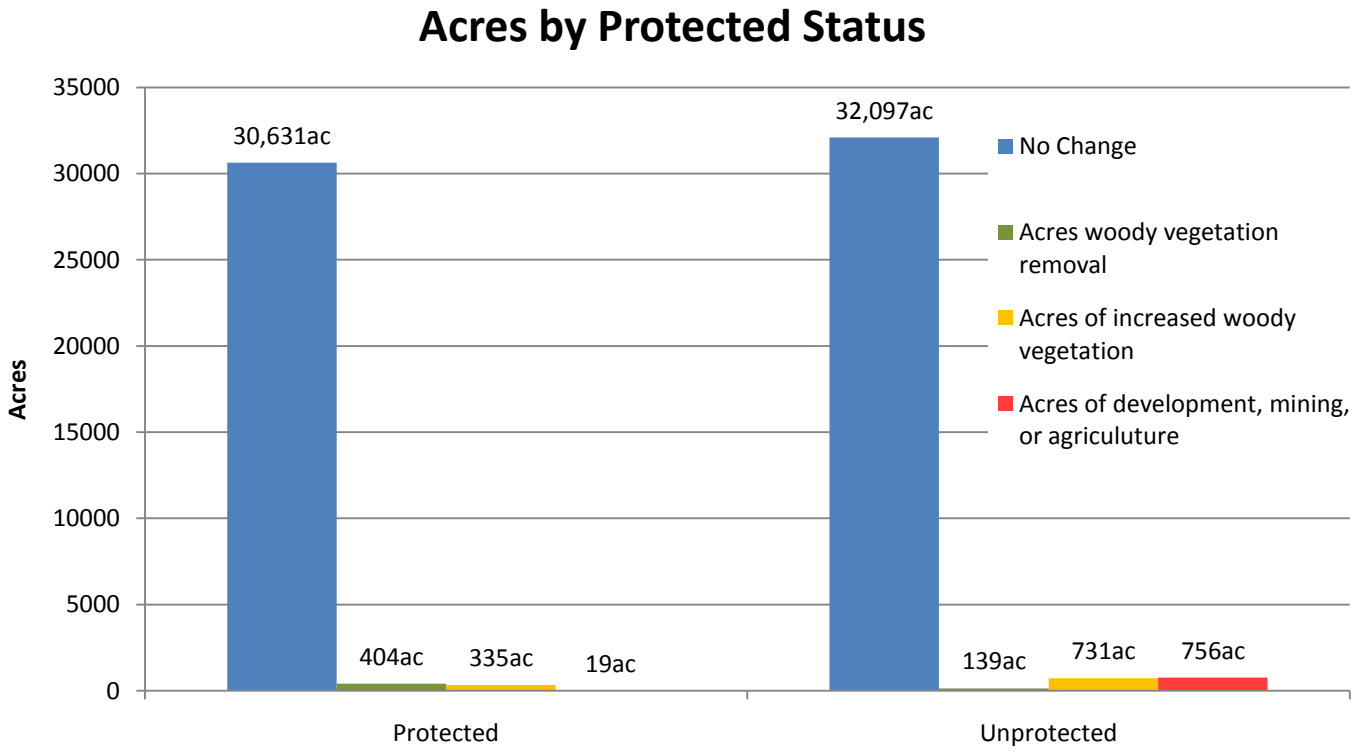
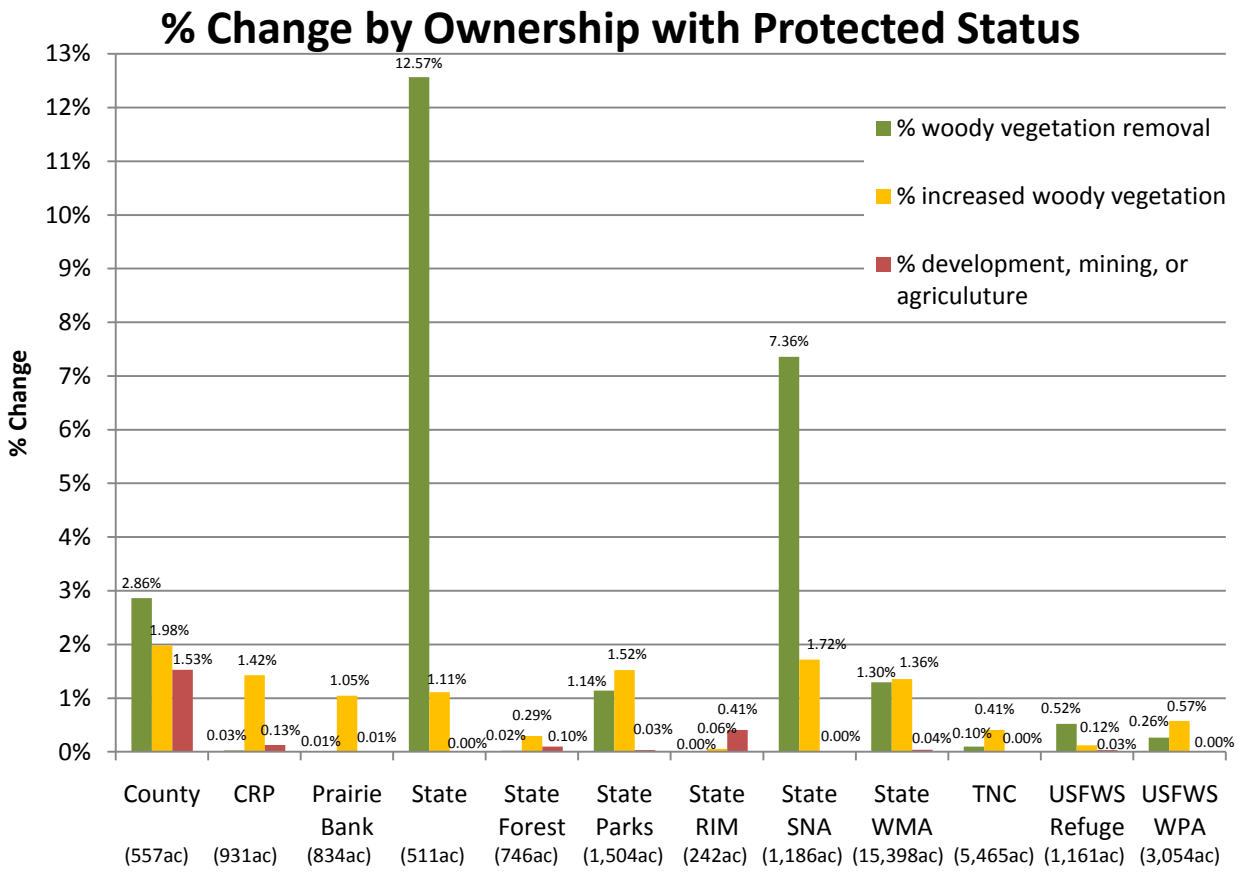


Figure 16 - % of habitat change for prairie sites with protected ownership. % based on total area (listed as acres on x-axis) for each land ownership category. "State" consists of University of Minnesota (U of M), Minnesota Department of Transportation, Minnesota Department of Corrections, Minnesota Department of Military Affairs (MNDMA), and undifferentiated state-owned land. Percent woody vegetation removal under "state" consists of 62 acres from U of M and 2 acres from MNDMA.



Attachment C

Accelerated Prairie Management, Survey, Acquisition and Evaluation
Result 5: Prairie monitoring and evaluation

Final Report to the Legislative-Citizen Commission on Minnesota Resources
July 1, 2008 to June 30, 2010
ML 2008, Chap. 367, Sec. 2, Subd. 3(m)

September 2010

Prepared by Daren Carlson, State Wildlife Action Plan Monitoring Coordinator
Division of Ecological and Water Resources, Minnesota Department of Natural Resources

Cover photo: Lac Qui Parle Wildlife Management Area, Chippewa County, MN by Daniel Wovcha.

Equal opportunity to participate in and benefit from programs of the Minnesota Department of Natural Resources is available to all individuals regardless of race, color, creed, religion, national origin, sex, marital status, status with regard to public assistance, age, sexual orientation, membership or activity in a local commission, or disability. Discrimination inquiries should be sent to MN-DNR, 500 Lafayette Road, St. Paul, MN 55155-4031; or the Equal Opportunity Office, Department of the Interior, Washington, DC 20240.

Funding provided by the Minnesota Environment and Natural Resources Trust Fund as recommended by the Legislative-Citizen Commission on Minnesota Resources and State Wildlife Grants. ©2010. State of Minnesota, Department of Natural Resources

Purpose

This project initiated a long-term monitoring study to track the status and trends of native prairie plant and bird communities in response to two key drivers of change – climate change and fragmentation of habitat. In addition, this study was designed to help inform prairie vegetation protocol development as part of a multi-agency Grassland Adaptive Management Collaborative (GAMC) to test and improve prairie management effectiveness. This project was jointly funded by a Federal State Wildlife Grant and by the Minnesota Environment and Natural Resources Trust Fund (ENRTF) as recommended by the Legislative-Citizen Commission on Minnesota Resources (LCCMR).

Overview

A total of 38 high quality prairie sites, distributed among five focus areas, were monitored for baseline vegetation and bird data over the 2008-2010 field seasons. The sites were identified by the Minnesota County Biological Survey as high quality native prairie, and were stratified according to geography and landscape context. The project was designed in part to address outstanding monitoring protocol questions such as sampling density, transect length, and selection of indicator species.

A total of 683 vegetation transects, 42 relevés, and 1596 bird point counts were completed across the 38 sites, providing a substantial dataset for establishing baselines of bird and plant community conditions, testing and modifying monitoring protocols, and initiating long-term trend monitoring and analysis. Current long-term plans are to monitor a total of 35 sites on a five year rotation (7 sites per year), with five additional sites monitored every year to detect annual variation.

Bird Monitoring: Over the three field seasons of bird surveys, 163 bird species were recorded using standard point count methodology. Fifty-four species were Species in Greatest Conservation Need as identified in the Minnesota's State Wildlife Action Plan (SWAP), 16 were state listed, and 24 were grassland dependent species. Bird community monitoring became the only animal focus for this project. Other prairie animals, such as insects and reptiles, are being studied in separate, but complementary projects.

For all bird species, richness (the number of bird species recorded per point) significantly increased from the southern to northern focus areas, but was not influenced by landscape context (large-embedded vs. small-isolated). The species richness of grassland dependent birds, however, was significantly higher in large-embedded sites in all but one focus area, and also followed the same geographic trend as for all species. Species abundance (the number of bird individuals recorded per point) followed similar patterns as species richness, with a few exceptions detailed in the main report.

After three years of data collection, no trends or patterns of change were detected for abundance of individual bird species per site. This indicates the need for long-term monitoring to determine species trends.

Vegetation Monitoring Collaboration: DNR staff participated in a multi- organization Grassland Adaptive Management Collaborative to develop models, refine protocols, and train field staff.

Vegetation monitoring: The primary purposes of the 2008-2009 field seasons for prairie vegetation monitoring were to test the efficacy of the hierarchical belt transect protocols, developed by the Grassland Adaptive Management Collaborative, as well as to collect baseline data for the long-term prairie monitoring effort. Vegetation monitoring measured four main components: 1) rapid condition assessment (called the plant group score) 2) presence of indicator species; 3) vegetation structure; and 4) plant species composition.

A total of 435 plant species were recorded over the two sampling years. Species richness (number of species per transect) and plant group score was highest in the two northern-most focus areas. Certain individual plant species showed geographic patterns. In particular, Kentucky bluegrass (*Poa pratensis*), a non-native species and the most frequently measured plant overall, increased in both frequency and, more significantly, cover from north to south. The number of indicator species did not show any relationship to geography (focus area distribution) or landscape context (large-embedded vs. small-isolated).

Sensitivity analyses of protocols: Preliminary findings and recommendations from sensitivity analyses of the monitoring protocols:

1) Plant group score, a rapid assessment for evaluating prairie condition, shows a fairly strong relationship to species richness and number of indicator species, although considerable variability in the relationships indicates it should not be used as a sole-measure for prairie condition.

2) The current suite of quality indicators are more likely to be present in Upland Prairie systems than Wet Prairie systems and are rarely present in Wet Meadow systems. The quality indicator list should be modified to include more species typical of the wetter prairie systems.

3) Sampling density (number of transects per acre) for capturing species richness is variable by site. Sampling density could be reduced and still effectively capture quality indicators.

4) Preliminary analyses show that reducing transect length by as much as half (12.5 m or 25 quadrats) will increase sampling speed and likely not substantially alter most of the vegetation measures.

Data management: Development of applications for field entry of bird monitoring data and vegetation indicator species into mobile data recorders enabled efficient and accurate data recording, and saved considerable time and cost by not having to enter hand-written datasheets into a database following the field season.

DNR staff modified a grassland monitoring database developed by the US Fish and Wildlife Service as part of the Grassland Adaptive Management Collaborative to enable entry and storage of the most-detailed protocols while maintaining the database structure. This allowed relatively easy transfer of the core data to the Collaborative (currently managed by the USFWS Morris Wetland District). DNR data are provided to the USFWS, and is also stored a databases on DNR central servers. Data are available to other parties upon request. In order to associate monitoring data trends with management practices, DNR staff are developing an Adaptive Management Spatial Database (AMSD) that allows users to set management objectives, define, track and report on management activities and track and report on biological outcomes (monitoring data).

Introduction

Minnesota's native prairie covered about 18 million acres at the time of the public land surveys (1847-1908); currently less than one percent remains. Recent acceleration of efforts to maintain or restore prairies have accentuated the need for long term data collection, storage and analysis using a consistent set of monitoring protocols to: 1) detect changes and long-term trends (status and trend monitoring) and 2) evaluate the success of prairie management and restoration activities (effectiveness monitoring).

The remaining native prairie habitat continues to face loss from conversion such as agriculture, mining, and development, and additional pressures such as climate change, invasive species, and fragmentation threaten protected prairie in numerous, and often not well understood, ways. Long-term status and trend monitoring provides critical data to help inform how prairie is to be protected and maintained over time as related to anticipated or often unexpected changes due to these key drivers of change.

The results of effectiveness monitoring are crucial for evaluating whether or not management actions are achieving desired outcomes, and subsequently help direct adaptive management decisions.

Related to the loss of prairie habitat, many prairie associated animal species are now rare and continue to show declining trends. Minnesota's State Wildlife Action Plan – Tomorrow's Habitat for the Wild and Rare, identified more prairie associated Species in Greatest Conservation Need than any other habitat in Minnesota (MN DNR 2006). One animal group, grassland birds, have experienced significant declines in the last several decades, both across North America and in Minnesota and more than any other group of birds.

Fragmentation of habitat has two key components – the size of the tract of native prairie and the type of landuse and habitat surrounding a prairie tract, collectively termed landscape context. Numerous studies indicate that prairie species are highly dependent on both the size of native habitat and the type of land surrounding it (e.g. trees, development, etc.).

This project initiated a long-term monitoring study to track the status and trends of native prairie plant and bird communities in response to two key drivers of change – climate change and fragmentation of habitat. In addition, this study was designed to help inform prairie vegetation protocol development as part of a multi-agency Grassland Adaptive Management Collaborative (GAMC) to test and improve prairie management effectiveness.

Grassland Adaptive Management Collaborative

In 2007, grassland managers and scientists formed the Grassland Adaptive Management Collaborative (GAMC), a multi-organization group with participants from the U.S. Fish and Wildlife Service, the U.S. Geological Survey, The Nature Conservancy, and the MN Department of Natural Resources Divisions of Fish and Wildlife, Parks and Trails, and Ecological and Water Resources. The purpose of the group was to develop cooperative, standardized monitoring protocols to more effectively resolve uncertainties about grassland management. A collaborative effort facilitates comparisons of data across ownerships and throughout the tallgrass prairie region of Minnesota. While focused on native prairie, the methods could likely be applied in restored areas.

Several meetings since 2007 resulted in a framework for adaptive grassland management in Minnesota and the Northern Tallgrass Prairie Ecoregion of North Dakota and South Dakota. Generally, the adaptive management process involves defining a problem, identifying potential management alternatives, predicting (modeling) the expected system response to those management alternatives, implementing the management and evaluating the results. The collaborative developed hierarchical monitoring protocols (most-detailed to least-detailed) to sample prairie vegetation, and is collectively storing and sharing vegetation data providing for a larger, more robust dataset. Based on the monitoring data collected, future decisions can be adapted to best meet the goals of the project. The goal of the collaborative is to determine broad plant composition and structural changes over time in response to a suite of land management techniques including grazing, burning, and haying.

As part of this ENRTF funded project, the SWAP monitoring coordinator and other DNR staff participated in the collaborative to develop models, address specific protocol questions (such as sampling density, transect length, and selection of indicator species), and train field staff. Preliminary results are presented below.

Methods

Sites with high quality, native prairie were selected within the Prairie Parkland and Tallgrass Aspen Parkland Provinces in western Minnesota (http://www.dnr.state.mn.us/ecs/index.html). Prairies in eastern Minnesota, such as bluff prairies in the southeast, were excluded In order to limit the project scope and variability in the data. Five focus areas were selected based on concentrations of remaining native prairie identified by MCBS and geographic distribution. Sites were stratified by geographic location (within each of the five focus areas) and landscape context in order to detect long-term changes as a result of climate change and habitat fragmentation (Figures1a & 1b, Table 1). Sites were selected if they were generally either: a) large and embedded within a matrix of grassland, or b) small and isolated [1].

[1] *Large was defined as greater than approximately 50 acres. Small was defined as less than approximately 50 acres. Embedded was defined as more than approximately 50% of a 500 m buffer was grassland or other open native community. Isolated was defined as less than approx. 25% of a 500 m buffer was grassland or other open native community.*

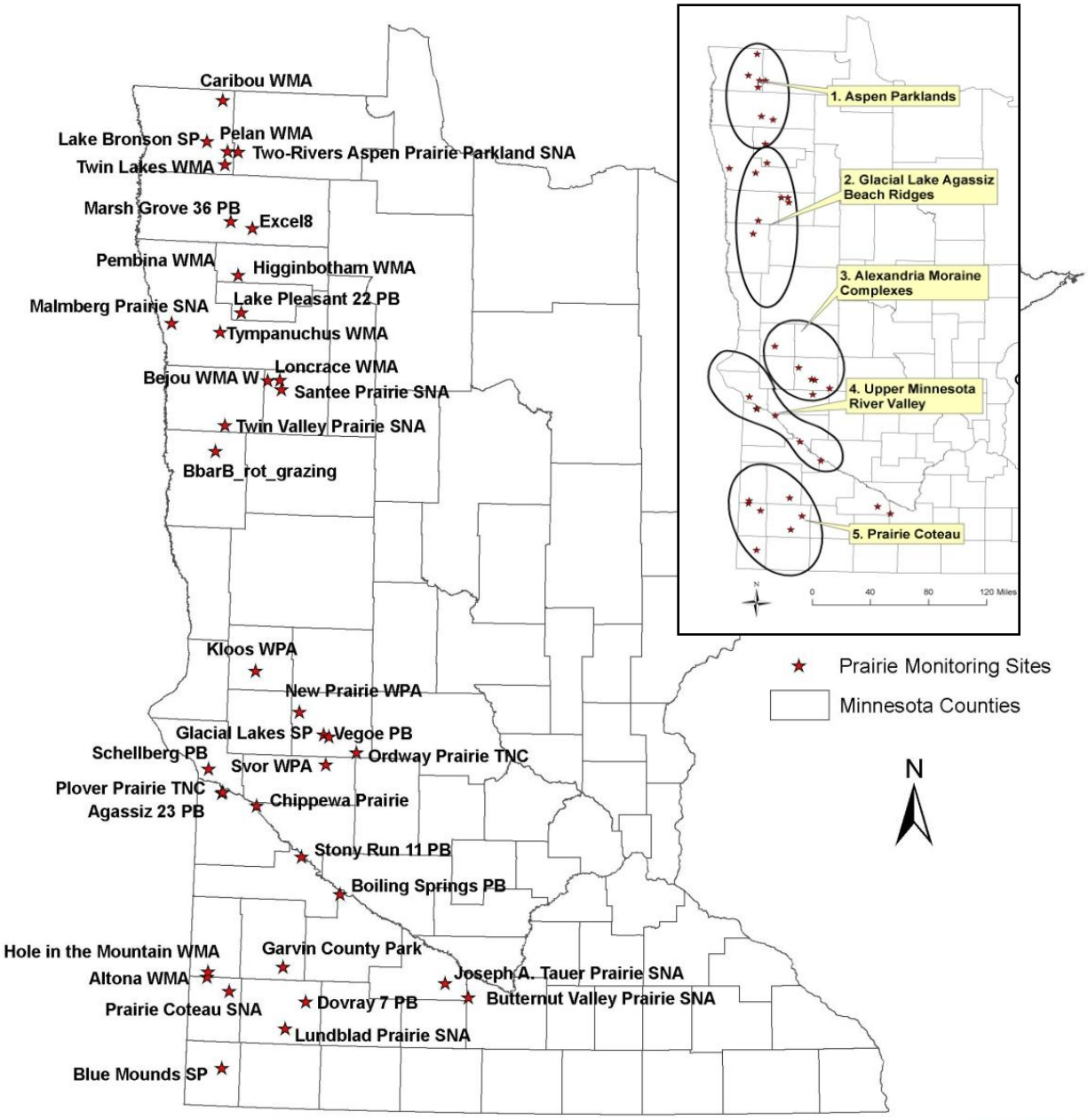
Sites were not stratified to the specifications originally proposed in the Trust Fund work program, because relative size and isolation is variable depending on the landscape, thus affecting the available pool of sites. Three sites (Malmberg Prairie, Butternut Valley SNA, Joseph A. Tauer SNA) were selected outside of the focus areas given their unique small and isolated situations.

Prairie bird monitoring

As part of this initial phase, bird monitoring during the breeding season was conducted at 38 sites in 2008 and 2009. In 2010 twelve sites were resampled, initiating a long-term sampling design (Table 2). Bird monitoring consisted of standard, ten minute point counts repeated three times per season. A minimum of seven point counts (with a few exceptions, see below), spaced a minimum of 200 meters apart were assigned to sites in the office prior to field surveys. Point count locations were first assigned to points previously established by Minnesota County Biological Survey (MCBS) bird surveyors (about 10% of points). When feasible, remaining points were arranged 200 meters apart in a hexagonal grid to match the Iowa MSIM protocols (Manley et al. 2006, Kinkead 2006). Often this was not possible because of the arrangement of the pre-existing MCBS points or because sites were too small or irregularly-shaped to fit a grid of that size. In these cases, plots were located to cover as much of the area as possible while still being 200 meters apart. For exceptionally small sites, only two to five points could be assigned (Table 2). Coordinates for these pre-determined point count locations were downloaded and located in the field using Trimble Nomad GPS data units.

Figure 1a Prairie monitoring sites

Figure 1b Location of focus areas



Prairie monitoring sites as part of the ENRTF funded Accelerated Prairie Project. Sites were monitored for birds and vegetation in 2008 and/or 2009. Twelve of these sites are in the process of being monitored in 2010 - bird monitoring was completed in June 2010 as part of the ENRTF funding.

Table 1 Site summaries

Focus Area	Size/ context[1]	Name	County	Ownshp	Acres	2008 Bird	2009 Bird	2010 Bird	2008 Veg Trans	2008 Releve	2009 Veg trans	2009 Releve
1	LE	Twin Lakes WMA	Kittson	WMA	32		5				12	2
1	LE	Caribou WMA	Kittson	WMA	553		28				40	2
1	LE	Twin Valley Prairie SNA	Norman	SNA	226		10				23	1
1	SI	Pelan WMA	Kittson	WMA	141		7				21	2
1	LE	Marsh Grove 36 PB	Marshall	PB	395		15	15			40	3
1	LE	Excel8	Marshall	DNR - Swamp trust	400		14				40	2
1	LE	Two Rivers Aspen Prairie Parkland SNA	Roseau	SNA	96		7				20	1
1	SI	Higginbotham WMA	Pennington	WMA	130		11	11			13	3
1	SI	Lake Bronson SP	Kittson	SP	32		5	5			6	1
2	LE	B bar B	Clay	PB	271	14						
2	LE	Lake Pleasant 22 PB	Red Lake	PB	18	3	3	3	3	1	3	
2	LE	Santee Prairie SNA	Mahnomen	SNA	22	7			15	1		
2	LE	Tympanuchus WMA	Polk	WMA	24	7		7	6	1		
2	SI	Bejou WMA W	Mahnomen	WMA	7	7			3			
2	SI	Loncrace WMA	Mahnomen	WMA	34	5	5		6	1	6	
2	SI	Malmberg Prairie SNA	Polk	SNA	51	7			10	1		
3	LE	Ordway Prairie	Pope	TNC	278	9	15		21	1	35	1
3	LE	Glacial Lakes SP	Pope	SP	495	14	13				50	2
3	LE	Vegoe PB	Pope	PB	55		7	7			6	1
3	LE	Svor WPA	Swift	WPA	34	7	7		2	1	4	
3	SI	Kloos WPA	Grant	WPA	17	7	7				3	1
3	SI	New Prairie WPA	Pope	WPA	15	4	4	4			3	1
4	LE	Agassiz 23 PB	Lac Qui Parle	PB	64	6			7			
4	LE	Plover prairie	Lac Qui Parle	TNC	201	7		7	13	1		
4	LE	Chippewa Prairie/Lac Qui Parle WMA	Chippewa	TNC/WMA		18	14		100	3	30	2
4	LE	Windsor 13 NE PB	Traverse	PB, partial	159	7			5	1		
4	LE	Schellberg PB	Big Stone	PB	177			10				
4	SI	Boiling Springs PB	Redwood	PB	27	7	7	7	6	1	6	
4	SI	Stony Run 11 PB	Yellow Medicir	PB	11	4	4		3	1	3	
4	SI	Joseph A. Tauer Prairie SNA	Brown	SNA	80		7				8	1
4	SI	Butternut Valley Prairie SNA	Blue Earth	SNA	12		2				2	1
5	LE	Altona WMA	Pipestone	WMA	25	7	7		5		5	
5	LE	Hole in the Mountain	Lincoln	TNC/WMA	148	14	9	14	26		13	
5	LE	Prairie Coteau SNA	Pipestone	SNA	234	7	7		12		12	
5	LE	Blue Mounds SP	Pipestone	SP	131		13	13			13	1
5	SI	Dovray 7 PB	Murray	PB	6	2			3			
5	SI	Garvin County Park	Lyon	County	22	7	7		4		4	
5	SI	Lundblad Prairie SNA	Murray	SNA	17	5	7		8		4	
		Total			**4640**	**182**	**247**	**103**	**258**	**14**	**425**	**28**

[1] LE = large, embedded; SI = Small, isolated

Table 2 Serially alternating design for prairie monitoring project

Year	S_0	S_1 2010	S_2 2011	S_3 2012	S_4 2013	S_5 2014	# sites/yr	Cumulative # of sites
1	5 sites	7 sites					12	12
2	5 sites		7 sites				12	19
3	5 sites			7 sites			12	26
4	5 sites				7 sites		12	33
5	5 sites					7 sites	12	40
6	5 sites	7 sites					12	
7	5 sites		7 sites				12	
8	5 sites			7 sites			12	
9	5 sites				7 sites		12	
10	5 sites					7 sites	12	
11	5 sites	7 sites					12	
12	5 sites		7 sites				12	
13	5 sites			7 sites			12	
14	5 sites				7 sites		12	
15	5 sites					7 sites	12	

40 sites total
S_0 – sites sampled every year, n = 5 (one from each focus area)
S_1 – sites sampled every 5 years starting in year 1 and repeated every 5 years, n=7.
S_2 – sites sampled every 5 years starting in year 2 and repeated every 5 years, n=7.
S_3 – sites sampled every 5 years starting in year 3 and repeated every 5 years, n=7.
S_4 – sites sampled every 5 years starting in year 4 and repeated every 5 years, n=7.
S_5 – sites sampled every 5 years starting in year 5 and repeated every 5 years, n=7.

Bird point counts were conducted on three separate days at each point location at each site during the breeding bird survey period (June 1 through the first week of July) in order to calculate species detectability using Area Occupancy models (MacKenzie et al. 2006). At each point, surveyors recorded all bird species seen or heard during a ten-minute interval, and also recorded estimated distance, sex, and breeding evidence. The full bird field monitoring protocols can be found in Appendix A. Most data were recorded in Trimble mobile handheld units and downloaded into a Microsoft Access database (see Data Management below). Approximately 15% of the data were recorded on data sheets and later entered into the Access database, as there were not enough Trimble units to accommodate all bird surveyors.

Vegetation Monitoring

Vegetation monitoring was conducted mid-July through mid-September in 2008 and 2009. Two methods were used: 1) The belt transect method developed by the Grassland Adaptive Management Collaborative (Appendix B), and 2) relevés as described in the relevé handbook (MN DNR 2007).

The primary purposes of the 2008-2009 field seasons for prairie vegetation monitoring were to test the efficacy of the hierarchical belt transect protocols developed by Grassland Adaptive Management Collaborative (Appendix C) and to collect baseline data to inform the long-term prairie monitoring effort. Protocols were tested using increased sampling density at some sites (1 transect per 5 acres vs. 1 per 10 acres), and conducting relevés.

Location of transect starting points, and random bearings for transect direction, were assigned in the office prior to field survey, at a minimum density of 1 transect per 10 acres. Seventeen of the 38 sites were assigned a transect density of 1 transect per 5 acres to test effective sampling density. Transect starting points were assigned at all bird point count locations that had been previously assigned for the June bird surveys (see above). Since transects generally outnumbered bird points at a given site, additional transects were randomly assigned with a minimum distance of 80 m between transects, using a DNR sampling extension in ArcView 3.3. Transects were designed to allow for sampling of a relatively homogenous prairie system (upland prairie, wet prairie, or wet meadow as defined MN DNR 2005), and the protocols specify procedures for moving transects if they are found in the field to cross into a different system type. For relevés, at sites where relevés had been sampled in the past, the same locations were resampled, otherwise new relevés were located based on the procedures described in the relevé handbook (MN DNR 2007).

Data for the species indicator portion of the protocols were entered directly into Trimble Nomad handheld data units. The bulk of the transect data was collected using paper sheets, and later entered into a Grassland Monitoring Database (see Data Management below).

Data Management

Hand-held applications

An application for field entry of bird monitoring data (using the software Pen Dragon) into Trimble Nomad handheld data recorders was developed by the DNR Management Information Services (MIS) unit. This enabled efficient and accurate data recording, and saved considerable time and cost by not having to enter hand-written datasheets into a database following the field season.

The SWAP Monitoring Coordinator modified the Pen Dragon bird application for recording the plant indicator portion of the habitat monitoring protocols. This application was successfully used by some of the field staff in all vegetation monitoring seasons.

Development of a complete application for the vegetation monitoring was explored, but was not pursued. The cost for development of this application was high given the complexity of the protocols and would need to be custom built. An application will be developed following final protocol development.

A grassland monitoring database was developed by the US Fish and Wildlife Service as part of the Grassland Adaptive Management Collaborative. The original database was developed for the least-detailed level of the hierarchical monitoring protocols (core data). DNR staff modified the database to enable entry and storage of the most-detailed protocols while maintaining the database structure for transfer of the core data to the main Collaborative database (currently managed by the USFWS Morris Wetland

District). Project data are also stored on DNR central servers, and are available upon request.

Adaptive Management Spatial Database

In order to facilitate the use of monitoring information to improve management activities, an Adaptive Management Spatial Database (AMSD) is under development. The Adaptive Management Spatial Database allows users to set management objectives, define, track and report on management activities and track and report on biological outcomes. The intent of AMSD is to increase management effectiveness and efficiencies along with increasing communication to show what we did and how well it worked for future financial and stakeholder support.

The design and development of a spatial database provides standardization of terminology and facilitate flexible, outcome-based reporting by:

- allowing the calculation of habitat management acres in various ways,
- linking habitat management activities to project goals and objectives, and biological responses (monitoring data),
- tracking the status of habitat management projects and/or practices (start and end dates, completion dates),
- linking staff activities and habitat management practices and acres to designated funding strings and financial spreadsheets (program budgets, encumbrances),
- tracking project accomplishments by funding source,
- integrating with other department applications and data sets

Results

Over 2008-2010 field seasons, a total of 683 vegetation transects, 42 relevés, and 1596 bird point counts were completed across the 38 sites (Table 1). The point counts repeated three times in each field season at 532 bird point plots. This level of effort provided a substantial dataset for establishing baselines of bird and plant community conditions across the matrix of sites, testing and modifying monitoring protocols, and initiating long-term trend monitoring and analysis.

Prairie bird monitoring

Staff and contractors completed bird point count surveys during the breeding season at 24 native prairie sites in 2008, 28 sites in 2009, and 12 sites in 2010 for a total of 38 sites overall. Of the 38 sites, 18 sites were sampled 2 of the 3 years and 4 sites were sampled all 3 years (Table 1).

Over the three field seasons of bird surveys, 163 bird species were recorded (121 in 2008, 149 in 2009, and 113 in 2010). 54 of which were Species in Greatest Conservation Need (SGCN), 16 were state listed, and 24 grassland dependent species.

Across all sites, the most commonly recorded bird was the Red-winged blackbird – a generalist species typically associated with wetlands. Seven of the 20 most common species recorded are considered grassland dependent (Table 3, Appendix C).

Table 3 Counts of the 20 most common bird species across all sites

Common Name	Grassland dependent	Total count (all years)	2008	2009	2010
Red-winged Blackbird		1162	526	493	143
Clay-colored Sparrow	Y	1022	353	454	215
Common Yellowthroat		766	243	392	131
Bobolink	Y	599	320	186	93
Yellow Warbler		533	120	322	91
Common Grackle		513	226	284	3
Sedge Wren	Y	498	186	222	90
American Goldfinch		478	152	266	60
Grasshopper Sparrow	Y	459	214	148	97
Brown-headed Cowbird		455	156	266	33
Savannah Sparrow	Y	379	136	164	79
Song Sparrow		359	109	182	68
Tree Swallow		347	115	213	19
Canada Goose		343	178	165	0
Western Meadowlark	Y	283	131	70	82
Mallard		218	123	91	4
Alder Flycatcher		211	21	138	52
Swamp Sparrow		196	64	92	40
Cedar Waxwing		157	17	133	7
Le Conte's Sparrow	Y	150	31	98	21

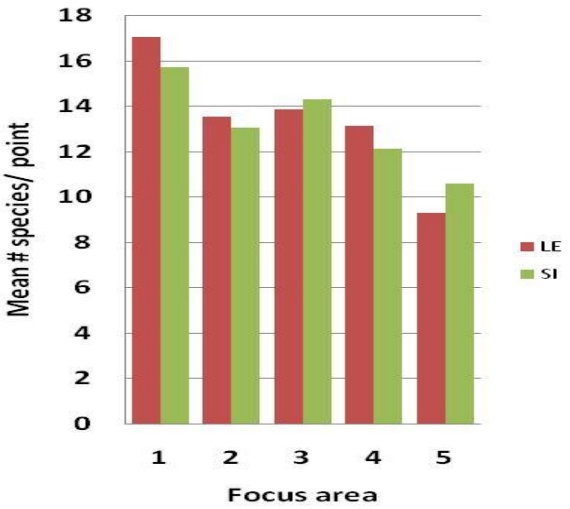
Analysis of bird communities

Species richness (number of bird species per point count averaged by site and across years) varied significantly ($p = 0.003$) by focus area, but not by landscape context. In general, the number of bird species per point count decreased from north (focus area 1) to south (focus area 5, Figure 2a).

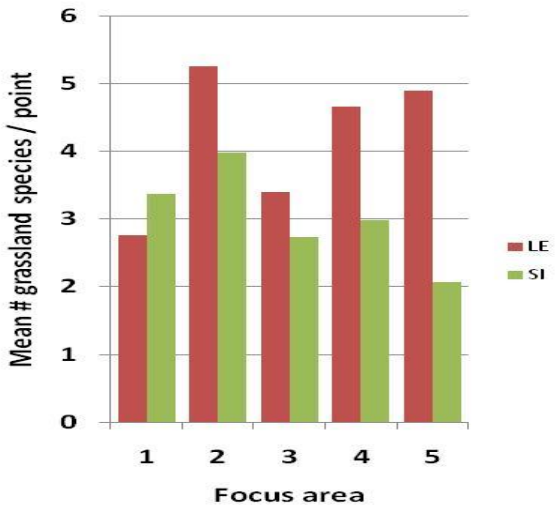
However, the number of grassland dependent bird species was significantly influenced by landscape context ($p=0.0034$), as well as focus area ($p = 0.080$) and their interaction ($p=0.063$). Large, embedded sites had more grassland species per point count in all regions, except for the northern focus area 1 where the pattern was reversed (figure 2b). Focus area 1 also had the lowest mean number of grassland bird species per point of all focus areas.

Figure 2 Mean number of bird species per point by focus area and landscape context (LE = large embedded, SI = small isolated)

2a) All species



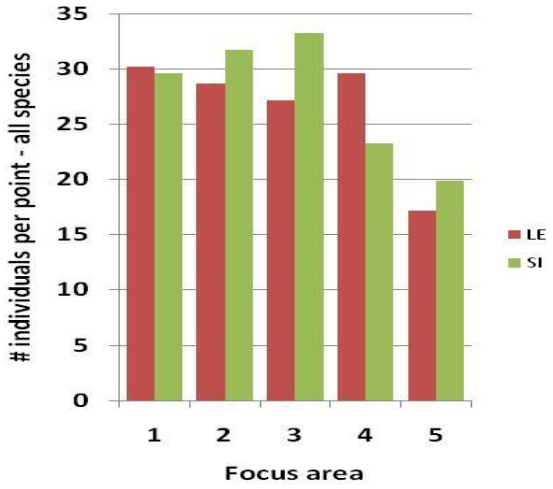
2b) Grassland dependent species



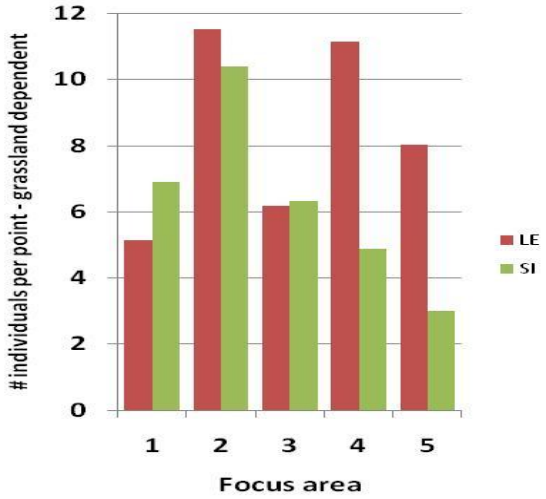
Species abundance (the number of bird individuals per point) followed similar patterns as species richness. Total number of individuals per point for all bird species was significant for focus area (p=0.0012), and not landscape context. This result was driven primarily by the southern-most focus area (focus area 5) which had about half the mean individuals per point than the other focus areas (Figure 3a). For grassland dependent bird species, focus area (p=0.038), landscape context (p=0.049), and their interaction (p=0.0099) all significantly influenced the number of individuals per point, with mixed responses. In the two southern-most focus areas, mean abundances of grassland bird species on large-embedded sites were than two-times those on small isolated sites (Figure 3b). This trend was reversed in the northern-most focus area where abundance at small-isolated sites was slightly higher than at large-embedded sites.

Figure 3 Mean number of individual birds per point by focus area and landscape context (LE = large embedded, SI = small isolated)

3a) All species



3b) Grassland dependent species



Examples of individual bird species trend data are available from the four sites that were sampled all three years. Since typically species numbers vary greatly on an annual basis due to population fluctuations, weather, observers, etc., a dataset from a period longer than three years is needed to determine trends related to climate change and habitat fragmentation. It will also be important to include other data such as weather and climate, the vegetation, management activities to further explain trend patterns. Sample data are presented below as an example of the type of information that will be available as this long-term monitoring project continues over time.

The four sites sampled in all three years are located in four of the five focus areas and evenly split between the two size-context categories (Table 4). Four grassland associated bird species are presented; bobolink (*Dolichonyx oryzivorus*), Clay-colored sparrow (*Spizella pallida*), Savanna Sparrow (*Passerculus sandwichensis*), and Western Meadowlark *(Sturnella neglecta)*.

Table 4 Sites that have been sampled for birds in all three years

Site Name	Focus area	Size, Context	Number of sample points
Lake Pleasant 22 NPB	2	Large, Embedded (LE)	3
New Prairie WPA	3	Small, Isolated (SI)	4
Boiling Springs NPB	4	Small, Isolated (SI)	7
Hole in the mountain TNC/WMA	5	Large, Embedded (LE)	14

The Bobolink was the second most abundant grassland bird species and fourth most abundant of all bird species across all sites (Table 3). Of the four sites examined for trends, it was recorded at all but New Prairie WPA, with the highest numbers in the southern two sites (Figure 4a). Preliminary trends are mixed. Abundance increased substantially at Boiling Springs Native Prairie Bank (NPB), remained steady at Hole in the Mountain WMA/TNC preserve, and decreased to zero detected at Lake Pleasant NPB.

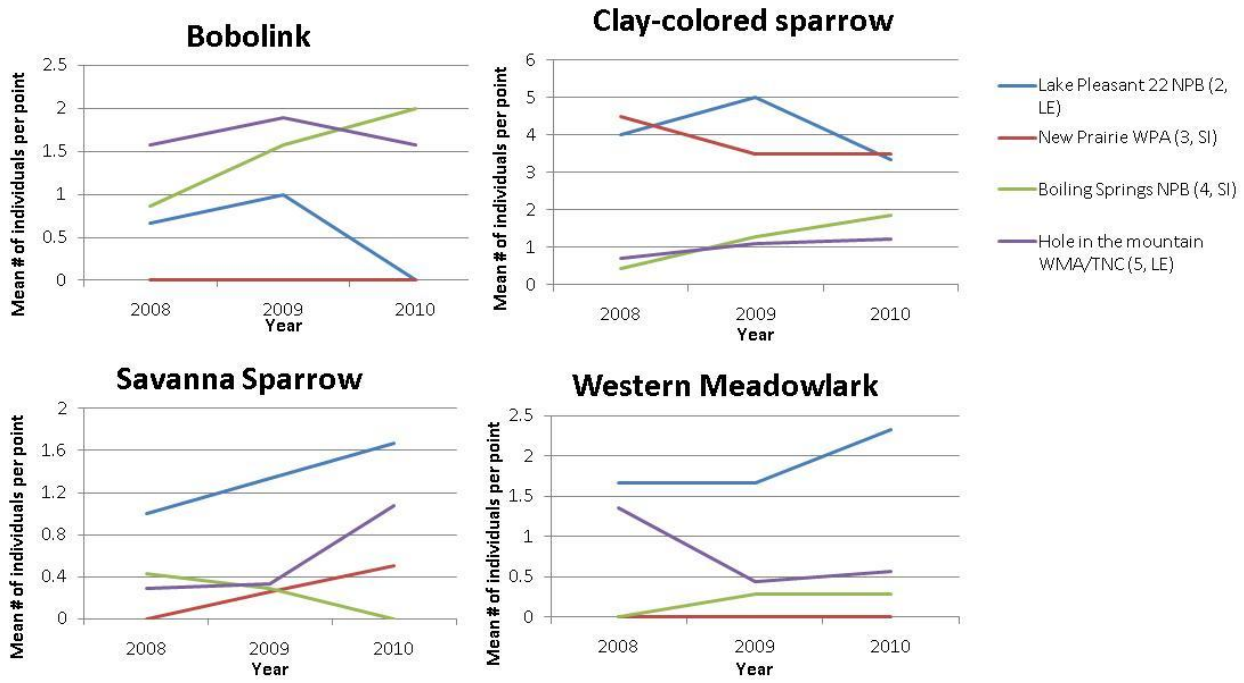
The Clay-colored Sparrow was the most abundant grassland bird and the second most abundant of all bird species across all sites (Table 3). Its abundance was much higher in the two northern sites (Lake Pleasant 22 NPB, New Prairie WPA) than at the two southern sites (Boiling Springs NPB, Hole in the Mountain WMA/TNC). Preliminary trends reveal minor increasing abundances at the southern sites and steady to declining numbers at the northern sites (Figure 4b).

The Savanna Sparrow was the sixth most abundant grassland bird and the 11th most abundant of all bird species across all sites (Table 3). Preliminary trend data show its abundance decreasing at Boiling Springs, with slight to moderate increases at the other sites. It was most abundant at Lake Pleasant Native Prairie Bank (Figure 4c).

The Western Meadowlark was the sixth most common grassland bird species (Table 3). It was present in three of the four sites, and most abundant at Lake Pleasant 22.

Preliminary abundance trends were mixed, with increases at Lake Pleasant 22 and Boiling Springs, and a substantial decrease from the first year at Hole in the Mountain (Figure 4d).

Figure 4 Preliminary trend data for the a) Bobolink (*Dolichonyx oryzivorus*), b) *Clay-colored Sparrow (*Spizella pallida*)*, c) *Savannah Sparrow (*Passerculus sandwichensis*),* and d) Western Meadowlark (*Sturnella neglecta*)



Vegetation Monitoring

Staff and contractors completed vegetation transects and relevés at 20 sites in 2008 and 28 sites in 2009 for a total of 36 sites overall (12 sites were sampled in both 2008 and 2009). A total of 683 transects (258 in 2008 and 425 in 2009) and 42 relevés (28 in 2008 and 14 in 2009) were completed over the two field seasons. In 2009, 20 transects were sampled twice by two different field crews to test repeatability.

Analyses presented for these two field seasons provide summary baseline information of differences between sites and strata (geographic location - focus area and landscape context), preliminary tests of the efficacy of sampling protocols for long-term monitoring, preliminary tests of remaining protocol questions such as transect length, sampling density, and sampling frequency. Full sensitivity analyses, including analysis of relevé data, will be completed following the 2010 field season and are not included in this report.

The transect protocols measure four main components: 1) rapid condition assessment called the plant group score 2) presence of indicator species; 3) vegetation structure; and 4) plant species composition. Summaries of these for components and their interrelationships are discussed in separate sections below.

1) Rapid condition assessments – plant group score

The plant group score is based on the relative amount of invasive species, presence of woody plants, and relative amounts grasses and forbs (Appendix B). A score is assigned to each of the 50 quadrats along the 25 m transect, summed for the entire transect, and averaged among all transects at a site. Plant group score, along with structure and a subset of the indicator species, represent the data that are collected at the most basic level of the protocols. These data are collected by all participants within the Grassland Adaptive Management Collaborative and pooled into a common dataset.

The range of possible plant group scores is from -185 to 185, with the bulk of the score determined by dominance of invasive vs. native plant species (Table 5). A higher score indicates better condition, although this score only incorporates plant composition as broad categories. There is a strong relationship between mean plant group score per transect and number of native species per transect and number of quality plant indicators per transect (see sensitivity analysis below).

Table 5 Plant group score breakdown. Each quadrat along a transect is scored based on its condition in A, B, and C below. Each transect is then averaged, and a site is averaged between transects. For example, if a quadrat is >75% native, >50% herbaceous, and a 25-75% grass-forb, then the score is 150+25+10 = 185. The maximum possible.

A) Native vs. invasive		B) Herbaceous vs. woody		C) Grass vs. forb	
Category	**Score**	**Category**	**Score**	**Category**	**Score**
Native >75%	150	Herbaceous >50%	25	Grass >75%	0
Native 50-75%	50	Low shrub >50%	0	Grass-Forb25-75%	10
Invasive 50-75%	-50	Tall shrub >50	25	Forb>75%	-10
Invasive > 75%	-150				

The mean plant group score per site ranged from -114 at Kloos WPA, a small-isolated site in focus area 3 to 180 at Lake Pleasant 22 NPB, a large-embedded site in focus area 2 (Appendix D). Plant group score was significant for focus area ($p<0.0001$), and the interaction between focus-area and size-context ($p=0.0074$), but not size-context alone ($p=0.79$). The two northern-most areas (Focus areas 1 and 2) had significantly higher plant group scores than the other areas with the exception of small-isolated sites in focus area 4 (Figure 5). Plant group scores by size-context was not statistically significant, although some differences were significant in specific focus areas. In particular, small-isolated sites were higher than large-embedded sites in focus area 4, with a reverse trend in focus area 3 (Figure 5).

2) Presence of indicator species

Indicator species fall into five categories: 1) Tier1 quality indicators, 25 plant species; 2) Tier 2 quality indicators, 30 plant species; 3) Tier 1 invasive indicators, 36 plant species; 4) Tier 2 invasive indicators, 36 plant species; and 5) Disturbance increasers, 13 plant species. Disturbance increasers are native plants generally associated with grassland sites overly-disturbed by grazing, soil disturbance, etc. While the invasive and

disturbance increaser indicators will be important for assessing management actions and detecting trends over time, this report focuses on the Tier 1 and Tier 2 quality indicators.

The mean number of quality indicator species (Tier 1 and Tier 2, 55 species total) per transect ranged from zero at Agassiz 23 NPB, a large-embedded site in focus area 4, to 10.5 at Lundblad Prairie SNA, a small-isolated site in focus area 5 (Appendix D) . Mean numbers were highly variable between focus areas and size-context, with no discernable patterns present (Figure 6). One possible explanation is due to the fact that the presence of indicator species is highly dependent upon the system type being sampled (see sensitivity analysis below).

Figure 5 Mean plant group score per transect vs. focus area and landscape context

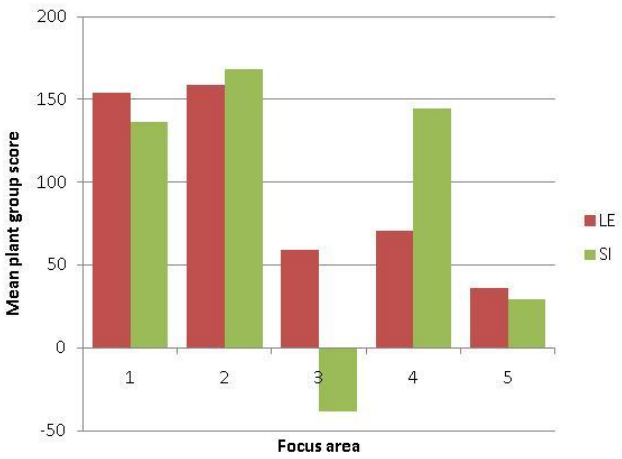
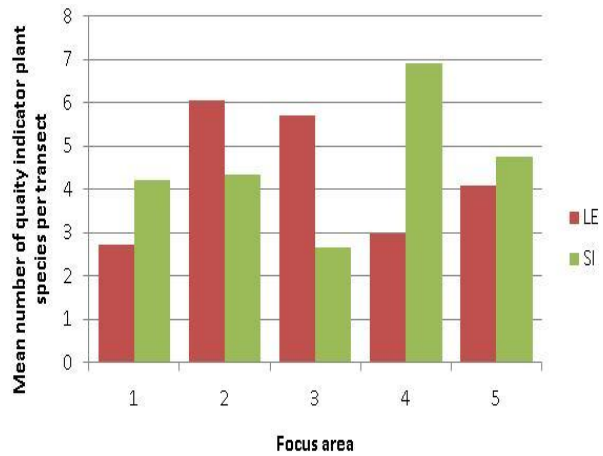


Figure 6 Mean number of quality indicators per transect vs. focus area and landscape context



3) Vegetation structure

Vegetation structure was characterized using Visual Obstruction Readings (VOR) at the beginning of each transect, and litter depth at every 5th quadrat along a transect (see Appendix B for more information).

Management objectives as part of the Adaptive Management Collaborative are to maintain a variety of vegetation VOR readings (measured as the coefficient of variation) at a site, as a variety of structures is important to maximize habitat quality for a suite of species. Target litter depths are around 5-7 cm. Both VOR and litter depth are highly dependent upon the intensity and time since management, as well as type of prairie (dry vs. mesic vs. wet).

The coefficient of variation of VOR readings showed no relationship to mean plant group score per site (Figure 7). Litter depth tended to be higher in wet meadow and wet prairie systems, and showed little relationship to prairie quality as measured by plant group score (Table 6).

Figure 7 coefficient of variation (CV) of visual obstruction reading (VOR) vs mean plant group score per site

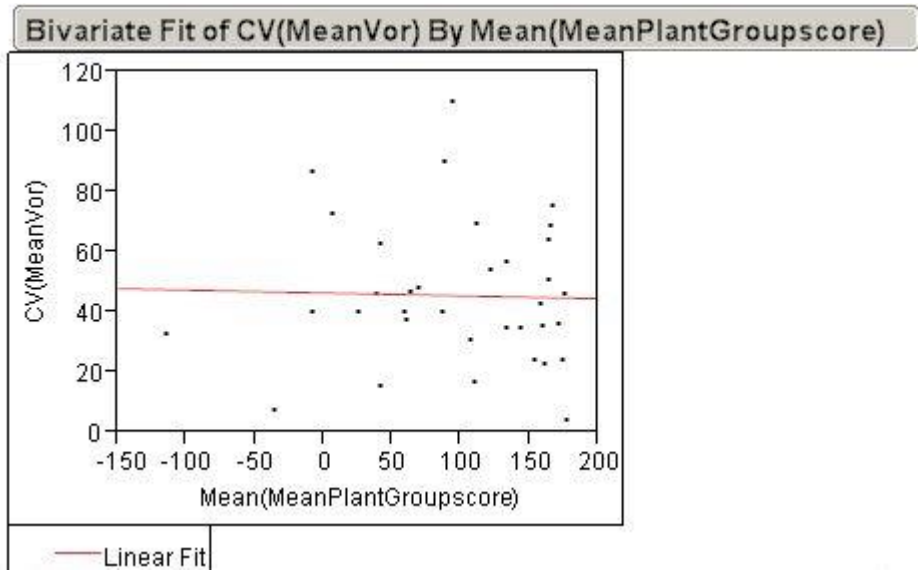


Table 6 Mean Litter depth – summarized by "Transect quality" and system type for all focus areas.

"Quality" (Plant Group Score)	System Type	N	Mean Litter Depth	Std Err Litter Depth
<-50 "Worst"	WP	10	5.46	1.02
	UP	40	3.19	0.41
	WM	1	2.30	
-50to100 "medium"	WP	25	2.92	0.48
	UP	167	3.09	0.18
	WM	3	6.22	1.02
100+ "Best"	WP	150	3.07	0.17
	UP	153	1.75	0.18
	WM	83	6.10	0.53

4) Plant species composition and diversity

A total of 435 plant species were recorded over the two sampling years. Across all transects sampled, the most frequently occurring species was Kentucky bluegrass (*Poa pratensis*, 59% of all quadrats), followed by Big Bluestem (*Andropogon gerardii*, 26%), Smooth brome (*Bromus inermis*, 17%), Indian grass (*Sorghastrum nutans*, 10%), and Side-oats grama (*Bouteloua curtipendula*, 9.9%, Table 7). Kentucky bluegrass was twice as frequent, and had 1.5 times more total cover than big bluestem, the next most common plant species. These patterns differed by focus area. For example, the frequency and mean percent cover of Kentucky bluegrass increased from north to south (Figure 8). While the frequency of Kentucky bluegrass peaked at almost 80% in focus areas 3, 4, and 5, the mean percent cover continued to increase from near 15% in focus area 3 to over 30% in focus area 5. Cover and frequency of Kentucky bluegrass was not influenced by landscape context (not pictured).

The other primary prairie invasive species, Smooth brome (*Bromus inermis*), was the third most frequent and abundant species overall, but also varied considerably by focus area (Table 7, Figure 9). Smooth brome was almost non-existent in the northern two focus areas (1 and 2), peaked at nearly 50 percent frequency in focus area 3, and leveled-off around 20 percent in the southern areas (4 and 5). Mean percent cover followed similar patterns.

Table 7 Most frequent species across all sites and 683 transects

Scientific Name	Common Name	Native	Mean % cover	Frequency
Poa pratensis	Kentucky bluegrass	I	15.5	58.98%
Andropogon gerardii	Big bluestem	N	9.0	25.55%
Bromus inermis	Smooth Brome	I	5.3	17.27%
Sorghastrum nutans	Indian Grass	N	3.3	10.41%
Bouteloua curtipendula	Side-oats grama	N	2.9	9.87%
Stipa spartea	Porcupine grass	N	2.8	9.87%
Solidago canadensis	Canada goldenrod	N	2.4	9.12%
Solidago missouriensis	Missouri goldenrod	N	1.7	6.27%
Schizachyrium scoparium	Little bluestem	N	1.7	5.60%
Populus tremuloides	Quaking aspen	N	1.6	4.13%

Figure 8 Frequency and average cover of Kentucky bluegrass by focus area

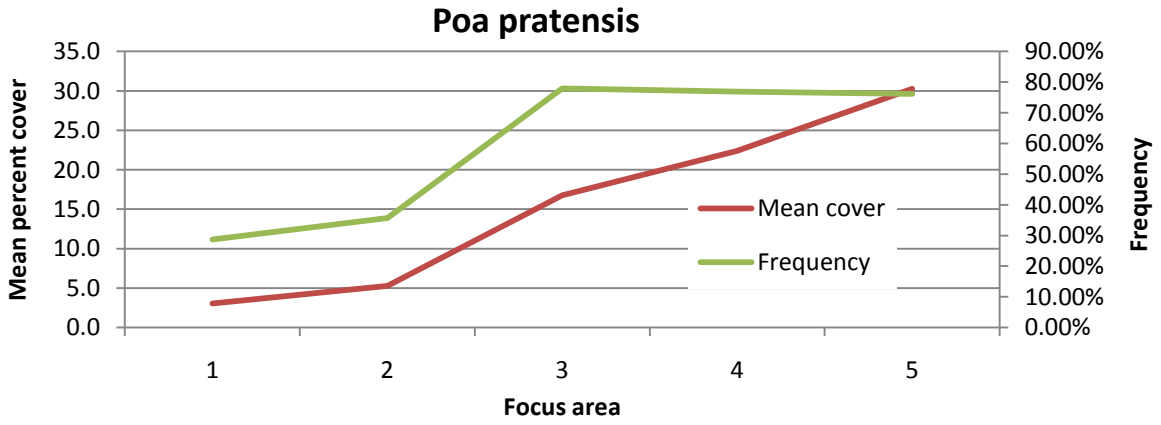
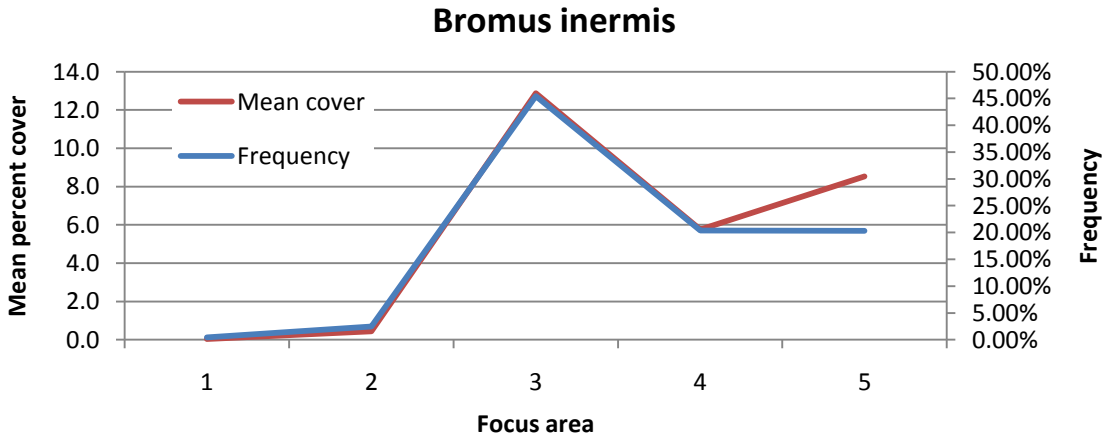
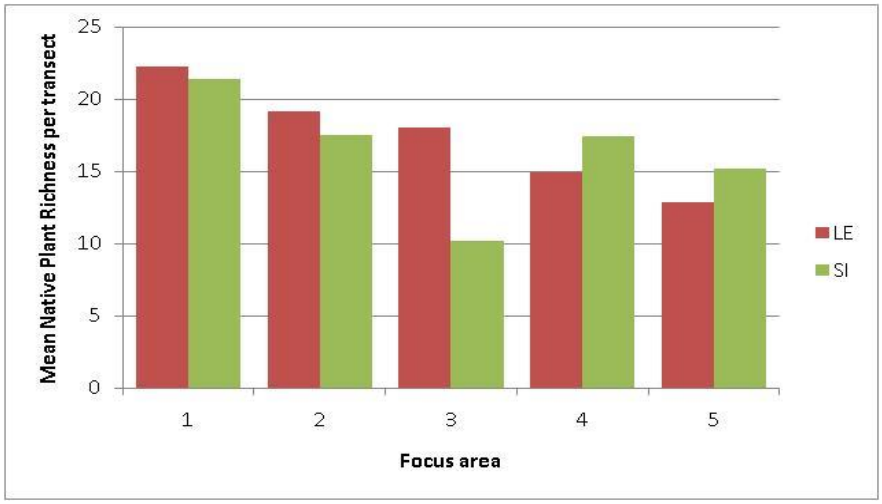


Figure 9 Frequency and average cover of Smooth brome by focus area



Mean richness (number of native species per transect) ranged from 7 at Kloos WPA, a small-isolated site in focus area three, to 25.9 at Higginbotham WMA, a small-isolated site in focus area one (Appendix D). Mean richness was significantly influenced by focus area (p=0.0026), but not by landscape context (p=0.87). Species richness tended to be higher in the two northern-most focus areas (1 and 2) and lower in the southern focus areas (Figure 10).

Figure 10 Mean number of native species per transect vs. focus area and landscape context



Sensitivity analysis and protocol recommendations for the grassland management collaborative

Sensitivity analyses of the protocols will be completed following the 2010 field season (provided by funds other than ENRTF). Preliminary results are discussed below.

Indicator species: The current suite of quality indicators are dependent on the system type (Upland Prairie, Wet Prairie, Wet Meadow). They are more likely to be present in Upland Prairie systems than Wet Prairie systems, and are rarely present in Wet Meadow systems (Table 8). The indicator list should be modified to include plants more characteristic of wetter prairie systems.

Table 8 Tier 1 quality indicators – summarized by plant group score and system for focus areas 2,3,4,5 (Focus area 1 did not have enough indicators for analysis).

"Quality" (Plant Group Score)	System Type	Median # Indicators	N	Mean Proportion	Std Err of proportion
<-50 "Worst"	WP	0	10	0.016	0.007
	UP	1.5	36	0.081	0.014
	WM	0	1	0.000	
-50to100 "medium"	WP	2	19	0.080	0.018
	UP	4	163	0.171	0.009
	WM	0	3	0.013	0.013
100+ "Best"	WP	4	54	0.167	0.009
	UP	6	134	0.253	0.009
	WM	0	15	0.019	0.013

Plant group score: Plant group score showed a substantial association with species richness and with the number of quality indicators (Figures 11, 12), suggesting this rapid assessment may be a good method for determining prairie quality, with the following caveats. This project focused on high quality prairie, and it is important to include poorer quality prairie sites from the larger pool of sites within the Grassland Adaptive Management Collaborative in such an analysis in order to get a broader spectrum of prairie quality. While a relationship exists between plant group score and species richness and with the number of indicators, considerable variability in the data remains, suggesting that additional species level information may be necessary. A more detailed species-level sampling on a less-frequent rotation (e.g. every 5 or 10 years) is suggested in order to fully assess prairie plant community condition in response to management and other drivers of change.

Figure 11 Number of native plant species per transect vs. mean plant group score per transect

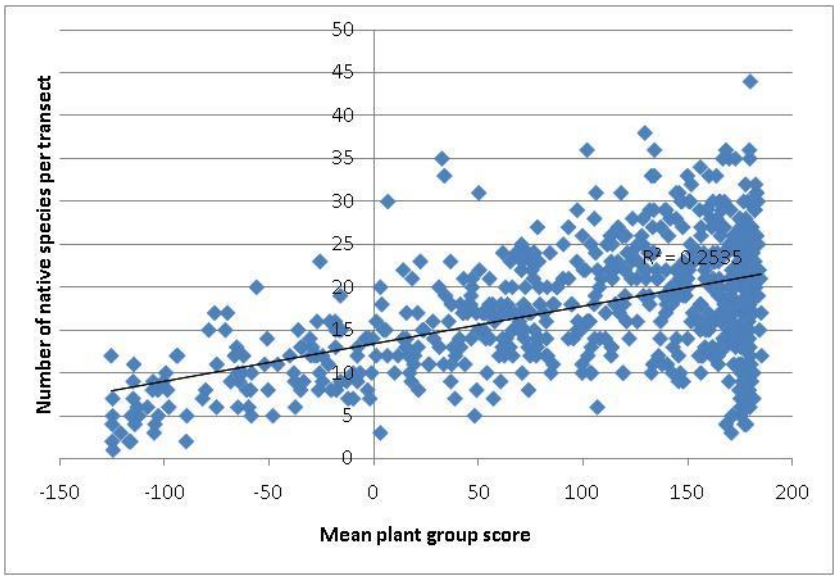
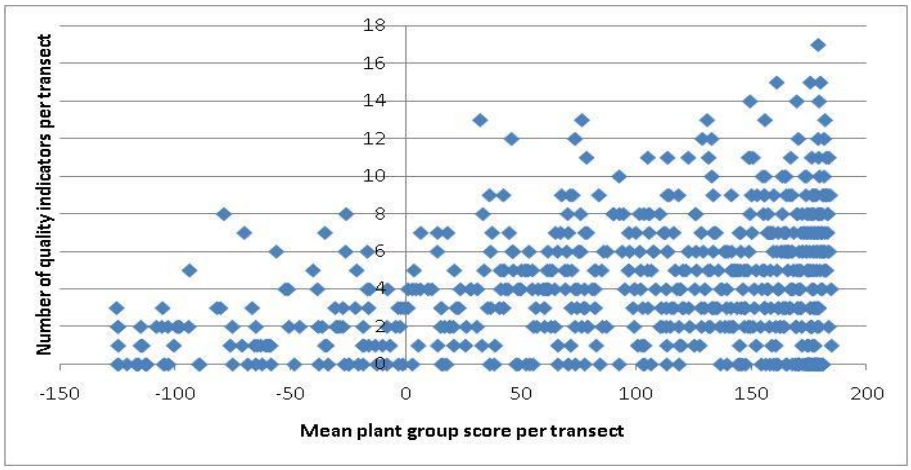


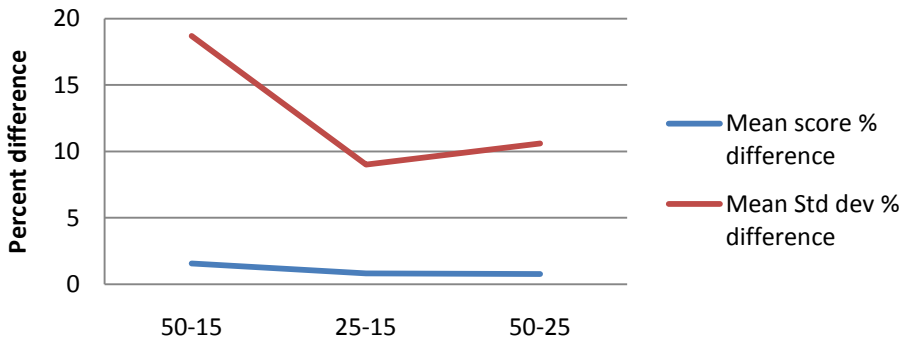
Figure 12 Number of quality indicator plant species per transect vs. mean plant group score per transect



Transect length (number of quadrats per transect):
Transects are currently 25 meters long by 0.1 meters wide and consist of 50 half-meter long quadrats. Along the same 25 meters, a 3 meter wide belt is used for additional detection of indicator species. The following preliminary analyses test whether a shorter transect with fewer quadrats could provide the same accuracy while resulting in less effort for data collection. Shorter transects could also allow for more transects to be sampled per site with the same amount of effort, providing more statistical power for the site overall. Preliminary analyses of plant group score, species indicators, and plant composition are discussed below.

For mean plant group score per transect, reducing the number of quadrats per transect from 50 (25 m transect length) to as low as 15 (7.5 m transect length) results in a mean difference of less than two-percent per transect (Figure 13). However, the variation in difference is nearly 20 percent when reducing to 15 plots, and about 10 percent when reducing to 25 plots.

Figure 13 Plant group score vs. number of quadrats



50-15 = comparison of average plant group score using 50 plots vs. 15 plots, 25-15 = 25 plots vs. 15 plots, 50-25 = 50 plots vs. 25 plots.

For number of indicators per transect, reducing the number of quadrats from 50 to 20 decreased the mean number of indicators by nearly 35-40% for all indicators except for Tier 1 Invasives, which saw a decrease of 20% (Figure 14). The rate of decrease is generally higher going from 50 quadrats to 30 quadrats, than from 30 quadrats to 20 quadrats. However, a much larger rate of gain in number of indicators, especially for Quality Tier 1 indicators, is realized by adding the additional 3m belt along the transect (Figure 14). The data do not exist to examine 3m belt transects shorter than 25 m since the data was collected along the entire 25 m length.

Mean number of species per transect ranged from 12 when a transect was 7.5 m long with 15 quadrats to 20 when a transect was 25 m long with 50 quadrats (Figure 15). The rate of increase in species count is slightly higher going from 30 to 50 quadrats than when going from 15 to 30 quadrats, suggesting a longer transect crosses more variation in the plant community.

Figure 14 Mean number of indicators per transect vs. number of quadrats

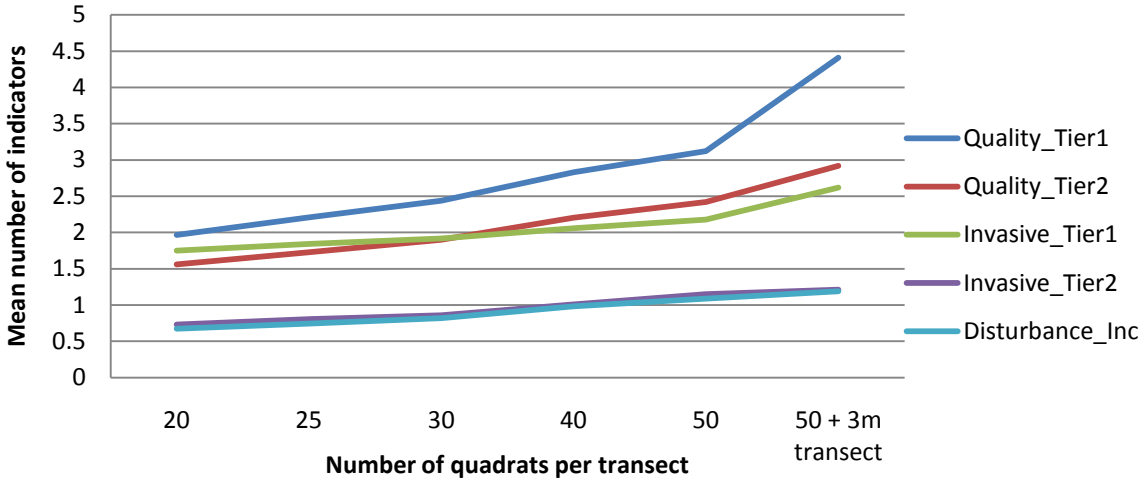
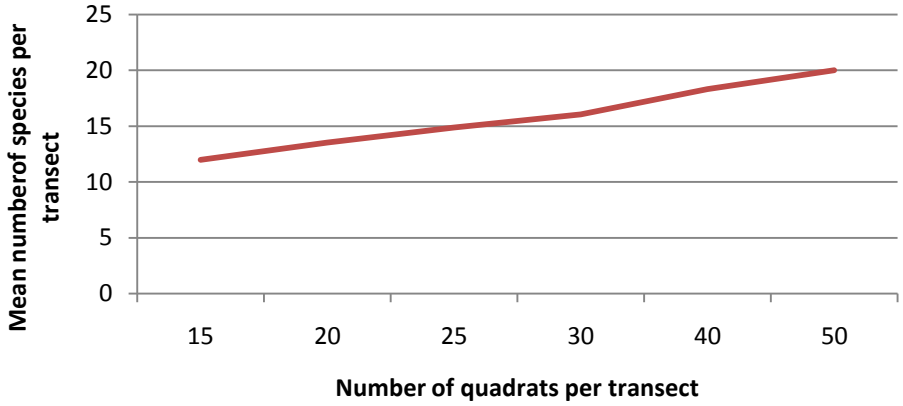


Figure 15 Mean number of species per transect vs number of quadrats per transect



Sampling density

The recommended sampling density is one transect per 10 acres of a site. This recommendation is from the original Grant et al. (2004) study in North Dakota, and it has not been tested if this density applies for sites in Minnesota. Ultimately, analyses will be completed to determine the number of transects to achieve a certain level of power for detecting change after the 2010 data are entered into the database. Preliminary patterns in sampling density for three sites where the sampling density was increased to 1 transect per 5 acres are presented below.

Three sites, Boiling Springs Native Prairie Bank, Two-Rivers Aspen Prairie Parkland SNA, and Ordway Prairie TNC Preserve were examined using the species accumulation curve in Pc-Ord 5.0 (McCune & Mefford, 2006). Boiling Springs is small-isolated site in focus area 4, and is 27 acres in size with 6 transects samped. Two-Rivers Aspen Prairie Parkland SNA is a large-embedded site in focus area 1 and is 96 acres in size with 20 transects. Ordway Prairie TNC preserve is a large-embedded site in focus area 3 and is 380 acres in size with 52 transects.

The species accumulation curve for Boiling Springs shows a very slight decrease in the number of species per transect at 3 transects (1 transect per 9 acres, called subplots in Figure 16), but the number of species is still increasing beyond 6 transects. Two-Rivers Aspen Prairie Parkland SNA shows a leveling-off in the species accumulation curve at about 15 transects (1 per 7.5 acres, Figure 17). The species accumulation curve for Ordway Prairie TNC preserve shows a decrease in the accumulation rate at about 20 transects (1 transect per 20 acres), but shows little sign of leveling off at 52 transects (1 transect per 7 acres, Figure 18). However, at Ordway Prairie, the species accumulation curve for quality tier 1 indicators shows a strong leveling off at about 15 transects (1 transect per 25 acres, Figure 19). Species accumulation curves for indicator species have yet to be completed at other sites or for other indicator groups.

Figure 16 Species accumulation curve for Boiling Springs NPB

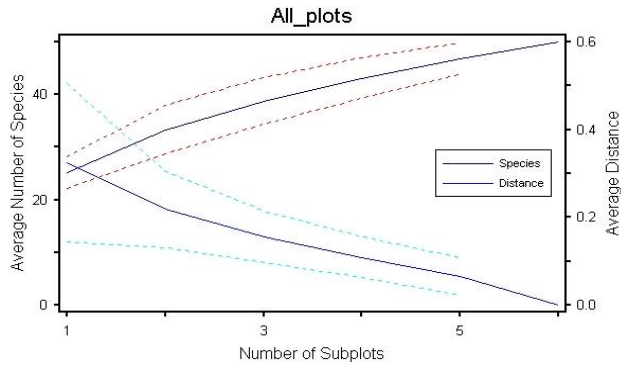


Figure 17 Species accumulation curve for Two-Rivers Aspen Prairie Parkland SNA

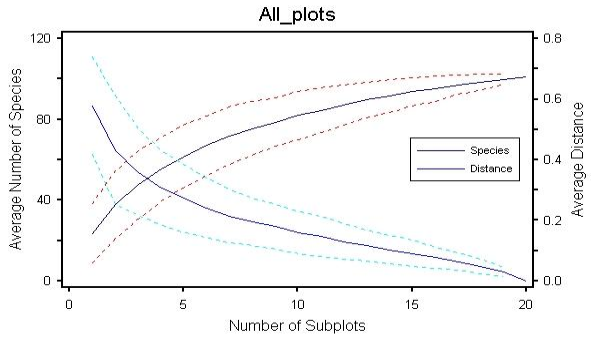


Figure 18 Species accumulation curve for Ordway Prairie TNC preserve, All species

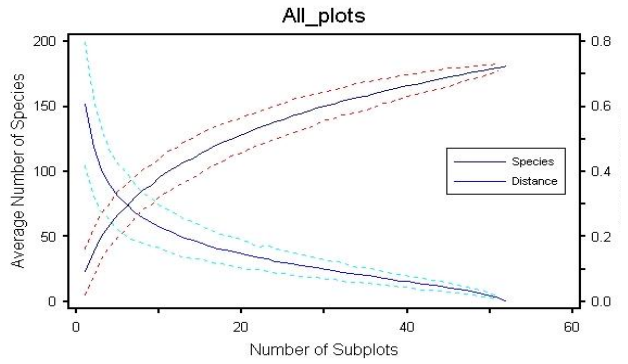
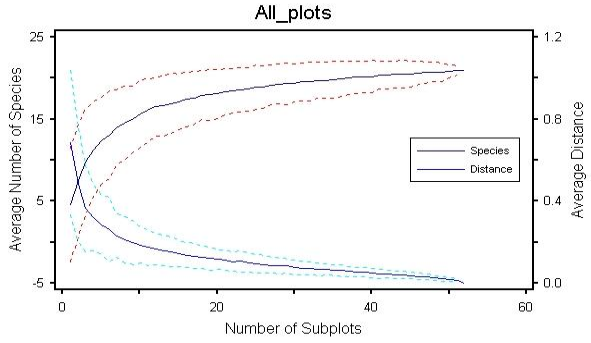


Figure 19 Species accumulation curve for Ordway Prairie TNC preserve, Quality Tier1 Indicators only



Conclusions

This project provided substantial data to help test and refine prairie monitoring protocols and establish baseline ecological information on remnant native prairie in western Minnesota. Analysis of the baseline information indicates that some regional and landscape differences in plant and bird communities exist. However, additional years of data are required to determine if the ecological trends are significant, especially in the context of climate change.

The 38 sites monitored as part of this project exceeded the originally proposed number of sites. However, bird community monitoring became the only animal focus for this project. Other prairie animals, such as insects and reptiles, are being studied in separate, but complementary projects.

Current long-term plans are to monitor a total of 40 sites using a serially alternating design with 5 sites monitored every year to detect annual variation, and 35 sites monitored every five years (7 sites per year), for a total of 12 sites monitored per year (Table 2).

References

Grant, T.A., E.M. Madden, R.K. Murphy, K.A. Smith, & M.P. Nenneman. 2004. Monitoring Native Prairie Vegetation: The Belt Transect Method. Ecological Restoration. 22:2 pp. 106-112.

Kinkead, K. 2006. Iowa Multiple Species Inventory and Monitoring Program Technical Manual. Iowa Department of Natural Resources.

Mackenzie, D.I, J.D. Nichols, J.A Royle, K.H. Pollock, L.L. Bailey, and J.E. Hines. 2006. Occupancy Estimation and Modeling. Academic Press. Burlington, MA.

Manley, P.N., B. Van Horne, J.K. Roth, W.J. Zielinski, M.M. McKenzie, T.J. Weller, F.W. Weckerly, and C. Vojta. 2006. Multiple Species Inventory and Monitoring. USDA Forest General Technical Report W0-73.

McCune, B. and M. J. Mefford. 2006. PC-ORD. Multivariate Analysis of Ecological Data. Version 5. MjM Software, Gleneden Beach, Oregon, U.S.A.

Minnesota Dept. of Natural Resources (MN DNR) 2005. Field Guide to the Native Plant Communities of Minnesota: The Prairie Parkland and Tallgrass Aspens Parklands Provinces. Ecological Land Classification Program, Minnesota County Biological Survey, and Natural Heritage and Nongame Research Program. MNDNR St. Paul, MN.

Minnesota Dept. of Natural Resources (MN DNR) 2006. Tomorrow's Habitat for the Wild and Rare: An Action Plan for Minnesota Wildlife, Comprehensive Wildlife Conservation Strategy. Division of Ecological Services, Minnesota Dept. of Natural Resources.

Minnesota Department of Natural Resources (MNDNR). 2007. *A handbook for collecting vegetation plot data in Minnesota: The relevé method.* Minnesota County Biological Survey, Minnesota Natural Heritage and Nongame Research Program, and Ecological Land Classification Program. Biological Report 92. St. Paul: Minnesota Department of Natural Resources.
http://www.dnr.state.mn.us/eco/mcbs/vegetation_sampling.html

Appendix A: Bird Monitoring protocols **June 2009**

Survey points:
Point locations are pre-assigned prior to fieldwork and will be located using a GPS unit. In general, points are at least 200m apart, although there may be a few exceptions in small sites. Each site should have 7 points, except again for exceptionally small sites.

Survey Frequency:
Each site will be surveyed 3 times, with a minimum of 3 days in between repeat surveys. If possible, have at least one repeat survey completed by a different individual.

Time of day:
- point counts should be conducted from 15 minutes before sunrise to approximately 4.5 hours after sunrise (about 0930 hrs). End point counts a little earlier or later depending on bird activity.

General data recording:
-Record the coordinates in UTM or Lat-long, area name, site id, point#, date, observer name, and waypoint if recording the location into a GIS
- Record start time (if using datasheet), approximate temperature in 10 F intervals, wind speed category, and sky code (see definitions below).

Bird data recording:
- record all birds heard or seen during a ten-minute interval, noting those first detected in the first 5 minutes and those first detected in the last 5 minutes. If using a data recorder, it should record the elapsed time for you so you do not need to make note of the time interval.
- Record the estimated distance the bird is from the point in one of four categories: 0-25m, 25-50 50-100m, > 100m. If the bird is flying over, mark it as FO instead of a distance.
- for each individual, indicate the sex as male, female, unknown. It can be assumed that a singing bird is a male.
- Record breeding evidence using codes provided on datasheet or on data unit.

- Tally individual numbers of birds up to 10. For larger groups of birds of the same sex and species use categories or 10-25 and 25+.

- if a bird is known/suspected to be in a habitat different than upland prairie/grassland, record in the "miscellaneous" column with the code DH, and note the habitat. It is very important to make sure that birds recorded at a given point are actually within the habitat being surveyed. For example, if you are sampling a deciduous forest, you know that a loon heard in the distance is certainly not in the forest. Unfortunately, this determination is often difficult. If the observer is at least 150m from the habitat edge, then the distance to the bird in question is probably the best guide (if bird is more than 150m it may be outside the habitat). Particularly troublesome are flyovers that cannot be seen. For example, if an observer suspects that a crow heard in the distance is flying, then it should be counted as a flyover. Birds commonly heard flying include: gulls, terns, corvids, waxwings, Icterids (blackbirds, etc.), and Fringillids (finches).

Site/locality information:
- Point locations are preassigned, but if you have to move a point for some reason, take a GPS reading; write (accurately) coordinates on datasheet <u>and</u> save position on GPS unit.

Rare species:
- for <u>all</u> state-listed or rare species, record exact GPS coordinates (or estimated bearing and distance from point count location).

Points to remember:
- do not count the same individual more than once (e.g., the same pair of sandhill cranes may be audible at 5 consecutive points. Only count it once).

- Species abbreviations are okay, but make sure they are recognizable and unique (e.g., "S. Sparrow" could be Song, Swamp, or Savannah; or "sharptail" could be sparrow or grouse).

- if you use standardized 4-letter common name codes, make sure you know the correct ones (for example: BANS=Bank Swallow, BARS=Barn Swallow – not BASW for either spp.).

Weather constraints:
- do not conduct point counts when wind or rain are obviously negatively affecting bird activity, or your ability to detect birds.
- Do not survey is the wind speed is 25 mph or greater (ideally surveys should only be done in winds less than 6 mph).Light rain or mist may be okay unless nothing seems to be singing. It may often be worth waiting out heavier rain if it appears that it might stop shortly, particularly if you have already walked/driven a long distance to get to a site.

Code definitions:

Temperature

30 (30-40 F)
40 (40-50 F)
50 (50-60 F)
60 (60-70 F)
70 (70-80 F)
80 (80-90 F)
90 (90-100 F)
100 (go home!)

Wind speed (<1, 1-3, 4-7, 8-12, 13-18, 19-24 mph)

Sky codes

0 Clear or a few Clouds
1 Partly cloudy (scattered) or variable sky
2 Cloudy (broken) or overcast
4 Fog or smoke
5 Drizzle or light rain
7 Snow
8 Showers

- Breeding evidence code

ne -- nest with eggs or young
nb -- adult building nest/ carrying nest material
an -- adult on nest
dd -- distraction display, mobbing
uy -- unfledged young away from nest
cf -- carrying food, fecal sac
ac -- adult entering nest cavity/hole
fj -- flying juvenile away from nest
IB -- any other territorial or nesting behavior (not listed above) suggesting bird is nesting nearby.

Appendix B
GRASSLAND MONITORING TEAM
STANDARDIZED MONITORING PROTOCOL

MN DNR Version (DRAFT)
06 July 2009

Background and Objectives

Grassland management goals in Minnesota, North Dakota, and South Dakota often include preservation or restoration of the historical native condition and providing habitat for wildlife. As endangered or declining ecosystems, remnants of tallgrass prairie are also intrinsically important to preserve. Remnant and restored prairies in the northern Great Plains are threatened by encroaching invasive species, particularly cool-season introduced grasses and woody vegetation. The main focus of grassland management efforts is on protecting or enhancing the competitive ability of native plants. However, because we typically operate without clear objectives for prairie management and with little or no evaluation of management effects, there are considerable uncertainties about the most appropriate management tools and prescriptions.

In 2007, a multi-agency group of grassland managers and scientists formed the Grassland Monitoring Team (GMT). The group felt that a cooperative, standardized monitoring effort would improve our effectiveness at resolving uncertainties about grassland management. A collaborative effort will facilitate comparisons of data across ownerships and throughout the tallgrass prairie region of Minnesota. Our effort is focused on native prairie, but the methods could likely also be applied in restored areas.

In November 2007, several representatives from this group participated in a workshop with prairie ecologists and experts in adaptive management and modeling. At this workshop, we developed a rough framework for adaptive grassland management in Minnesota and the Northern Tallgrass Prairie Ecoregion of North Dakota and South Dakota. Generally, the adaptive management process involves defining a problem, defining potential management alternatives, predicting (modeling) the expected system response to those management alternatives, implementing the management and evaluating the results. Based on the monitoring data collected, future decisions can be adapted to best meet the goals of the project.

Our goal is to determine broad plant composition and structural changes over time in response to a suite of land management techniques including grazing, burning, and haying.

The partners in this project have overlapping goals, but it should be noted that each of us has some specific goals that are not addressed with this effort. Within the context of this project, the following objectives apply across all ownerships and participants.

- Maintain or increase the percentage cover of native prairie vegetation relative to invasive/exotic vegetation.
- Minimize the percentage cover of invasive/exotic vegetation, with particular attention to a short list of species (see list).
- Maintain the structural diversity of native grassland ecosystems.
- MN DNR objective: Maintain high quality native prairie plant communities over time*.

*The MNDNR-SWAP has an additional objective to maintain high quality plant communities, therefore we are committed to collect information on community composition.

Sampling Design

The population of interest for this project is remnant tallgrass prairie in Minnesota as well as eastern North Dakota and South Dakota . The subset available for sampling (study sites) is a field of native prairie that will undergo one consistent treatment at any given point in time. Study sites can include federal, state or private properties, and are under the management of a project partner. Study sites can optionally be organized into management units (e.g., a county, management district, or landscape).

Sample units are permanent transects, distributed randomly in the study site at a density of one transect per 10 acres. The transects are 25-m long and 0.1-m wide, with 50 0.5-m long quadrats along a transect (Grant et al. 2005). A list of potential transects are established in the office, then field checked to ensure they meet the study criteria. We will use a random point generator tool to establish transect starting points. Each point should be at least 25-m from the edge of the study site and at least 50-m from another point. Exclude areas that are obviously in a wetland or heavily wooded area, are more than 75% nonvegetated (e.g., rock pile), or that cross between systems (i.e., upland grassland, lowland grassland, and wet meadow). Create enough points to have 1 per 10 acres plus a few extra in case you have to reject some during the field check. Use Excel or other software to generate a random compass bearing for the transect. If during the field check the transect as assigned will violate rejection criteria, follow the "Procedures for moving a transect" detailed below. **For those working in the Aspen Parklands, please note the section below.**

Sites will be sampled at least once every three years (in some cases more frequently), from July through September. This time period was chosen because it is a period during which the greatest number of tallgrass prairie plants can be identified.

Procedures for moving a transect:

1. Flip the bearing of the transect 180 degrees. For example, if the initial transect bearing was 85 degrees, try running the transect 265 degrees. If the transect is still not within the target community after shifting the transect bearing 180 degrees, try the +90 degree bearing, then the +270 degree bearing.

2. If the 4 directions (in step 1) do not work, move the transect starting point 25 m from the initial starting point along the original bearing assignment. For example, if the 265 degree bearing (from the 180 degree flip) still falls in a non-target community, move the starting point 25 m in the 85 degree direction.

3. If step 2 is still unsuccessful, repeat step 1 at 25 m from the initial point (180 degree flip, +90, +270). For example, if 25 m from the initial starting point along the 85 degree bearing is within a non-target community, try moving 25 m out in a 85+180 = 265 degree bearing, then 85+90 = 175 degree bearing, then a 85+270 = 355 degree bearing.

4. If moving 25 m along the 4 bearings still falls within a non-target community, repeat step 3, but move 50 m.

5. If still unsuccessful after trying to move the starting point 50 m. A new random location will need to be assigned – contact the DNR monitoring coordinator.

Notes on target communities:

While the MNDNR-SWAP monitoring project is targeting upland prairie systems, many of the areas are naturally heterogeneous and will contain wetter depressions. Only move the transect if the area is clearly more of a wetland community. Do not move the transect if it includes areas that have shrubs as a result of lack of management (woody encroachment). Shrub swamps should be considered a different community and warrants moving the transect. Forested areas with >50% cover and than should be considered a different community and warrant moving the transect. Individual trees should not warrant moving the transect.

Aspen Parklands modifications

The Aspen Parklands province presents unique challenges since systems and plant communities are naturally heterogeneous rejection criteria likely require modifications from those detailed above. For example, it may be difficult to effectively locate a transect that does not cross between systems. Current guidelines for this region will be that the transect must fall within 75% of a particular system type, although this may need to be modified as field work commences. In addition, since stands of forest (primarily aspen) both occur naturally and are more likely as a result of lack of management in the Aspen Parklands, forested areas should not be excluded. Finally, the procedures for moving a transect may need to be modified in that they are more targeted to fall within a particular system type.

Field Methods

Field season prep, Sequence of events during season, Details of measurements with forms, Post collection processing, end of season procedures

The protocol is hierarchical in terms of effort expended on acquiring detail on composition of the plant community. All participants will collect the same basic structural information. Options A, B, and C represent different levels of detail on plant community composition data. Subsequently complex options incorporate all features of the simpler options, so that the most basic set of data will be collected at every site.

Typical series of events at a transect:

1. Use GPS to navigate to the transect starting point.
2. Collect VOR readings. We recommend doing this before anything else, because activity of observers can disturb the vegetation cover.
3. Run out a 25-m cloth tape, staking it at both ends to prevent shifting during data collection.
4. If using a two-person team, we find that an efficient approach is to have one person identify and call out the plant codes and invasive species present in each quadrat. The other person acts as the data recorder and also measures litter depth (and optionally, plant height) as the team moves along the transect.
5. When you come to the end of the transect, walk slowly along either side of the tape looking for the indicator species within the wider transect buffer. The buffer is 1.5 m (a Robel pole length) on either side of the standard belt transect, making it 25 m X 3 m.

Equipment needed:
Compass, GPS, VOR pole (standardized VOR poles were provided to each team at the beginning of the 2007 field season by the USFWS – Glacial Ridge/Rydel National Wildlife Refuges), meter stick, rebar/stakes, meter tape, map and list of azimuths/coordinates, datasheets (with extra), scratch paper, pencils, personal gear, photo guide and camera if doing photopoints

Structure

Visual Obstruction Reading (VOR). At the beginning of the transect, take a set of VOR readings from the four cardinal directions (e.g., N, E, S, W) using a VOR (Robel) pole. The VOR pole has alternating decimeters clearly marked along the length of the pole (Robel et al. 1970). The observer will take VORs at a height of 1 m and a distance of 4 m from the pole. Record the lowest half-decimeter mark visible on the pole (i.e., not completely obscured by vegetation). It is recommended that you record VOR before doing anything else that may disturb the vegetation structure at the site (e.g., running out the transect).

Litter Depth. Using a meter stick, record litter depth to the nearest cm at 5-m intervals along the transect (5, 10, 15, 20, 25 m). Place the bottom of the meter stick on the ground and make sure that it is flush with the soil surface. The litter measurement is the height of the litter layer – that is, the layer lying horizontal (not leaning, not standing, etc.).

Vegetation Height (optional). Using a meter stick, record plant height to the nearest cm at 5-m intervals along the transect.

Composition

Plant groups. Record a plant group code for each quadrat along the belt transect, using the hierarchical list of plant groups provided (Appendix **). This list has been carefully designed to allow roll up into various levels. It is not species dependent, which allows the methods to be used in any grassland system regardless of the main invasives of concern.

Plant codes represent a spectrum that spans from Native to Invasive (mostly exotic) and everything in between. The plant codes represent a hierarchical tree, which functions as a dichotomous key. Arrival at the final code for an individual plot involves making four sets of independent decisions:

- Native (Natives>50% cover) vs. Invasive (Invasives>50% cover)
- All Native vs. Mostly Native OR Mostly Invasive vs. All Invasive
- Herbaceous vs. Low Shrub vs. Tall Shrub
- Graminoid vs. Graminoid-Forb vs. Forb

Some general tips about assigning plant groups:

- The decision about whether a plot is native vs. invasive-dominated is determined based on all plants present within the plot, whether herbaceous or shrub.
- Use foliar, as opposed to canopy cover, to make plant code determinations. ***Foliar cover*** "subtracts out" the "blank" spaces while ***canopy cover*** "fills in the gaps" between leaves, branches, etc.
- Assign 900 code ("Other," for bare ground, animal mounds, rock pile, etc.) if >75% of the plot is unvegetated.
- If >25% of the plot is vegetated, use relative percentages within the vegetated portion of the plot to make plant code determinations.
- To distinguish between low and tall shrub, use current height not the potential height of the species
- In determining native/invasive composition, use the list of Tier 1 and 2 invasive species provided. Note that some of these invasive species are actually native to parts of the region.
- Remember that the four classes (native/invasive; all native (invasive)/mostly native (invasive); herbaceous/low shrub/tall shrub; grass/grass-forb/forb) are independent decisions. Therefore, you should include woody species when making the native/invasive decision. The only exception is that grass/forb ignores woody components.
- Include dwarf shrubs (e.g., prairie rose, lead plant) in with the Low Shrub category.

Option A	Option B	Option C
Numeric code only	Numeric code	Numeric code

Invasive Species. Use the Tier 1 (and when appropriate, Tier 2) list of invasive species provided (Appendix *). This list was developed by Robert Dana (MBCS, 2008) and includes *****

	Option A	Option B	Option C
Quadrat level	Record all Tier 1 invasives present, regardless of cover. Circle "Dominant" invasive(s), those dominating >50% of the plot, where applicable	Record all Tier 1 invasives present, regardless of cover. Circle "Dominant" invasive(s), those dominating >50% of the plot, where applicable	Record all Tier 1 and Tier 2 invasives present, regardless of cover. Circle "Dominant" invasive(s), those dominating >50% of the plot, where applicable
Transect level (25m x 3m buffer centered on the standard belt transect)	Use checklist to record presence of Tier 1 invasives (optional??)	Use checklist to record presence of Tier 1 and/or Tier 2 (optional) invasives	Use checklist to record presence of Tier 1 and Tier 2 invasives

Quality indicators. Use the Tier 1 (and when appropriate, Tier 2) list of quality indicator species. The list was developed by Robert Dana and Fred Harris (MCBS, 2008) and includes conservative species that are sensitive to grazing and easily identified.

	Option A	Option B	Option C
Quadrat level	n/a	n/a	Record all Tier 1 quality indicators present, regardless of cover
Transect level (25m x 3m buffer centered on the standard belt transect)	Record presence of Tier 1 quality indicators	Record presence of Tier 1 and/or or Tier 2 (optional) quality indicators	Record presence of Tier 1 or Tier 2 quality indicators not already recorded in quadrats

Other species. Additional information can be collected about species composition within each quadrat.

Option A	Option B	Option C
n/a	Record dominant native species from a select list (optional)	Record any species with >10% absolute cover of quadrat, and indicate whether it is >50% or <50%.

One option for participants using either Option A or B might be to collaborate with partners to do a thorough Option C survey at more infrequent intervals, e.g., every 10 years.

Data handling, analysis, and reporting

Metadata procedures, Overview of database design, Data entry, verification, editing, routine summaries and analyses, reporting schedule, report format (summary table and figure examples), methods for long term trend analysis, data archive procedures

The FWS Biological Monitoring Team has developed an Access database for this project. In addition to data entry capabilities, the relational database also has a couple of simple reporting functions that enable quick analysis of entered data at the end of each field season. Any updates to the database will be provided on the BMT website (http://www.fws.gov/bmt/database_gmd.htm)

Personnel requirements and training

Roles and responsibilities, Qualifications, Training procedures

Project coordinators are responsible for organizing training sessions, facilitating communication among the group members, disseminating any changes to the protocol or database, and working with a statistician to analyze data.

In addition, provide a consistent plant guide – complete with species that frequently are mistaken for each other- is recommended for all the indicator species (both for grazing sensitive species and for invasives). It would be helpful if flowering times on indicator species list could be provided.

Field office staff will be responsible for choosing study sites in their work area, assigning transects, data collection, data entry, ensuring data accuracy, and sending their data to the project coordinators.

The protocol was designed to be used by field staff or seasonal employees with a working knowledge of tallgrass prairie plant species common in Minnesota. A training session will be provided as needed each year in early July. Following the session, we will hold periodic quality assurance checks in the field by double-sampling a set of transects. This will be done fairly early in the season to allow time to correct inconsistencies among observers. We recommend that quality-assurance checks be held in conjunction with additional training in species identification.

Table 1. Invasive species lists.

Tier 1Invasives

Code	Common Name	Scientifc Name
ACENEG	Boxelder	*Acer negundo*
AGRCRI	Crested Wheatgrass	*Agropyron cristatum*
AGRGIG	Redtop	*Agrostis gigantea/stolonifera*
ARTABS	Absinthe Sagewort	*Artemisia absinthemum*
BROANN	Annual Bromes	*B. japonicus, tectorum, secalinus*
BROINE	Smooth Brome	*Bromus inermis*
CARACA	Plumeless Thistle	*Carduus acanthoides*
CARNUT	Musk Thistle	*Carduus nutans*
CENMAC	Spotted Knapweed	*Centaurea maculosa*
CHRLEU	Ox-eye Daisy	*Chrysanthemum leucanthemum*
CIRCAN	Canada Thistle	*Cirsium arvense*
CIRVUL	Bull Thistle	*Cirsium vulgare*
CORVAR	Crown-vetch	*Coronilla varia*
DAUCAR	Queen Anne's Lace	*Daucus carota*
ELAANG	Russian Olive	*Elaeagnus angustifolia*
ELYREP	Quack-grass	*Elytrigia repens*
EUPESU	Leafy Spurge	*Euphorbia esula*
FRAPEN	Green Ash	*Fraxinus pennsylvanica*
LINVUL	Butter-and-eggs	*Linaria vulgaris*
LONTAT	Tartarian Honeysuckle	*Lonicera tatarica*
LOTCOR	Birdsfoot Trefoil	*Lotus corniculatus*
MEDSAT	Alfalfa	*Medicago sativa*
MELISP	Sweet Clovers	*Melilotus alba & officinalis*
PASSAT	Parsnip	*Pastinaca sativa*
PHAARU	Reed Canary-grass	*Phalaris arundinacea*
PHLPRA	Timothy	*Phleum pratense*
POACPX	Canada and Kentucky Bluegrass	*Poa compressa, pratensis*
POPDEL	Cottonwood	*Populus deltoides*
RHACAT	Common Buckthorn	*Rhamnus cathartica*
RHAFRA	Glossy Buckthorn	*Rhamnus frangula*
ROBPSE	Black Locust	*Robinia pseudo-acacia*
SONARV	Sow-thistle	*Sonchus arvensis*
TRIPRA	Red & Alsike clovers	*Trifolium pratense, hybridum*
TRIREP	White Clover	*Trifolium repens*
ULMAME	American Elm	*Ulmus americana*
ULMPUM	Siberian Elm	*Ulmus pumila*

Tier 2 Invasives

Code	Common Name	Scientifc Name
AMABLI	Prostrate Pigweed	*Amaranthus blitoides*
ARCMIN	Burdock	*Arctium minus*
BERINC	Hoary Alyssum	*Berteroa incana*
CALSEP	Hedge Bindweed	*Calystegia sepium*
CARARB	Siberian Pea-tree	*Caragana arborescens*
CHERUB	Alkali Blite	*Chenopodium rubrum*

CONARV	Field Bindweed	*Convolvulus arvensis*
CRETEC	Hawk's Beard	*Crepis tectorum*
DACGLO	Orchard Grass	*Dactylis glomerata*
ERUGAL	Dog-mustard	*Erucastrum gallicum*
FESELA	Meadow and Tall Fescues	*Festuca pratensis & elatior*
GRISQU	Curly-top Gum Weed	*Grindelia squarrosa*
KOCSCO	Summer-cypress	*Kochia scoparia*
LAPPSP	Stickseeds	*Lappula redowski & squarrosa*
MEDLUP	Black Medick	*Medicago lupulina*
MORALB	White Mulberry	*Morus alba*
NEPCAT	Catnip	*Nepeta cataria*
PINSYL	Scotch Pine	*Pinus sylvestris*
PLANSP	Common & American Plantains	*Plantago major & rugellii*
POLPER	Lady's Thumb	*Polygonum persicaria*
POTARN	Silvery Cinquefoil	*Potentilla argentea*
POTREC	Sulphur-flowered Cinquefoil	*Potentilla recta*
PUCDIS	European Alkali-grass	*Puccinellia distans*
RUMACE	Sheep Sorrel	*Rumex acetosella*
RUMSPP	Dock	*Rumex patientia, crispus, stenophyllus*
SALALB	White Willow	*Salix alba*
SALTRA	Russian Thistle	*Salsola tragus*
SAPOFF	Bouncing Bet	*Saponaria officinalis*
SETASP	Foxtails	*Setaria glauca, viridis, faberi*
SILCSE	a campion	*Silene cserei*
SILVUL	Bladder-campion	*Silene vulgaris*
SINARV	Charlock	*Sinapis arvensis*
SISALT	Tumble Mustard	*Sisymbrium altissimum*
TAROFF	Dandelion	*Taraxacum officinale*
VERTHA	Common Mullein	*Verbascum thaspus*
XANSTR	Cocklebur	*Xanthium strumarium*

Table 2. Native indicator species.

Tier 1 Quality Indicators

Code	Common Name(s)	Scientific Name
AMOCAN	Leadplant	*Amorpha canescens*
ANEPAT	Pasque Flower	*Anemone patens*
ASTCRA	Ground Plum, Buffalo-bean	*Astragalus crassicarpus*
ASTSER	Silky Aster	*Aster sericeus*
CALSER	Toothed Evening Primrose	*Calylophus serrulatus*
CORPAL	Bird's Foot Coreopsis	*Coreopsis palmata*
DALCAN	White Prairie Clover	*Dalea candida*
DALPUR	Purple Prairie Clover	*Dalea purpurea*
ECHPAL	Narrow-leaved Purple Coneflower	*Echinacea pallida var. angustifolia*
HELAUT	Sneezeweed	*Helenium autumnale*
HEURIC	Alum Root	*Heuchera richardsonii*
LIAASP	Rough Blazing Star	*Liatris aspera*
LIALIG	Northern Plains Blazing Star	*Liatris ligulistylis*
LIAPUN	Dotted Blazing Star	*Liatris punctata*
LIAPYC	Great Blazing Star	*Liatris pycnostachya*
LILPHI	Wood Lily	*Lilium philadelphicum*
LYSQUA	Prairie Loosestrife	*Lysimachia quadriflora*
PEDESC	Prairie Turnip	*Pediomelum esculentum*
PHLPIL	Prairie Phlox	*Phlox pilosa*
POTARGU	Tall Cinquefoil	*Potentilla arguta*
PRERAC	Smooth Rattlesnakeroot	*Prenanthes racemosa*
TRABRA	Bracted Spiderwort	*Tradescantia bracteata*
ZIGELE	White Camas	*Zigadenus elegans*
ZIZAPT	Heart-leaved Alexanders	*Zizia aptera*
ZIZAUR	Golden Alexanders	*Zizia aurea*

Tier 2 Quality Indicators

Code	Common Name(s)	Scientific Name
AGOGLA	Glaucus False Dandelion	*Agoseris glauca*
AMONAN	Fragrant False Indigo	*Amorpha nana*
ASCOVA	Oval-leaved Milkweed	*Asclepias ovalifolia*
ASCSPE	Showy Milkweed	*Asclepias speciosa*
ASCTUB	Butterfly Weed	*Asclepias tuberosa*
ASTADS	Prairie Milk Vetch	*Astragalus adsurgens*
ASTLAE	Smooth Blue Aster	*Aster laevis*
ASTNOV	New England Aster	*Aster novae-angliae*
ASTOBL	Aromatic Aster	*Aster oblongifolius*
ASTOOL	Sky-blue Aster	*Aster oolentangiensis*
ASTUMB	Flat-topped Aster	*Aster umbellatus*
CARFIL	Thread-leaved Sedge	*Carex filifolia*
CASSES	Downy Paintbrush	*Castelleja sessiliflora*
DELVIR	Prairie Larkspur	*Delphinium virescens*
GAIARI	Blanket Flower	*Gaillardia aristata*
GENPUB	Downy Gentian	*Gentiana puberulenta*

LATVEN	Veiny Pea	*Lathyrus venosus*
LIACYL	Few-headed Blazing Star	*Liatris cylindracea*
LYTALA	Winged Loosestrife	*Lythrum alatum*
MUHCUS	Plains Muhly	*Muhlenbergia cuspidata*
PANLEI	Leiberg's Panic Grass	*Panicum leibergii*
PEDLAN	Swamp Lousewort	*Pedicularis lanceolata*
SILLAC	Compass Plant	*Silphium laciniatum*
SOLPTA	White Aster-like Goldenrod	*Solidago ptarmicoides*
SOLRID	Riddell's Goldenrod	*Solidago riddellii*
SOLSPE	Showy Goldenrod	*Solidago speciosa*
SORNUT	Indian Grass	*Sorghastrum nutans*
SPOHET	Prairie Dropseed	*Sporobolus heterolepis*
THADAS	Tall Meadow-rue	*Thalictrum dasycarpum*
VERVIR	Culver's Root	*Veronicastrum virginicum*

Native Plant System Level Descriptions
(Excerpts from Minnesota Department of Natural Resources (MNDNR). 2005. Field guide to the native plant communities of Minnesota: the Prairie Parkland and Tallgrass Aspen Parklands Provinces. Ecological Land Classification Program, Minnesota County Biological Survey, and Natural Heritage and Nongame Research Program. MNDNR St. Paul, MN.)

Upland Grass
*Upland Prairie (UP) communities are herbaceous plant communities dominated by graminoid species, with a species-rich forb component that can approach codominance with the graminoids. The tall grass big bluestem (*Andropogon gerardii*) and the midheight grasses prairie dropseed (*Sporobolus heterolepis*) and little bluestem (*Schizachyrium scoparium*) are the most important graminoids. Indian grass (*Sorghastrum nutans*), a tall grass, and porcupine grass (*Stipa spartea*) and side-oats grama (*Bouteloua curtipendula*), both midheight grasses, are the most important associated graminoids. Sedges (*Carex *spp.) are sometimes common in UP communities but are typically a minor graminoid component. The most common and widespread woody species are the low semi-shrubs leadplant (*Amorpha canescens*) and prairie rose (*Rosa arkansana*), and the tall shrub wolfberry (*Symphoricarpos occidentalis*). Purple prairie clover (*Dalea purpurea*), heath aster (*Aster ericoides*) and stiff goldenrod (*Solidago rigida*) are common forbs. The main vegetation layer in UP communities is usually less than 40in (1m) high, although some forbs and the flowering stalks of the tall grasses exceed this height as the growing season progresses.*

Lowland Grass
Northern Wet Prairie: Grass-dominated but forb-rich herbaceous communities, often with a strong shrub component, on somewhat poorly drained to poorly drained loam soils formed in glaciolacustrine sediments, unsorted glacial till, or less frequently outwash deposits. Present primarily on level to very gently sloping sites. Flooded for brief periods at most; upper part of rooting zone is not saturated for most of growing season. Drought stress is infrequent, usually brief, and not severe. Fires were very frequent historically.

Southern Wet Prairie: Grass-dominated but forb-rich herbaceous communities on poorly drained to very poorly drained loam soils formed in lacustrine sediments, unsorted glacial till, or less frequently outwash deposits. Typically in slight depressions, sometimes on very gentle slopes. Flooded for brief periods at most; upper part of rooting zone is not saturated for most of growing season, but saturation usually persists in lower zone for much of season.

Wet Meadow
Northern Wet Meadow/Carr: *Open wetlands dominated by dense cover of broad-leaved graminoids or tall shrubs. Present on mineral to sapric peat soils in basins and along streams.*
Southern Basin Wet Meadow/Carr: *Open wetlands dominated by dense cover of broad-leaved sedges. Typically present in small, closed, shallow basins isolated from groundwater inputs.*
Prairie Wet Meadow/Carr: Open wetlands dominated by a dense cover of graminoids. Present in small, shallow depressions in the western and southern parts of the state.

Appendix C: Total individual bird counts

Common Name	Grassland dependent	Total count (all years)	Count of individuals 2008	2009	2010
Red-winged Blackbird		1162	526	493	143
Clay-colored Sparrow	Y	1022	353	454	215
Common Yellowthroat		766	243	392	131
Bobolink	Y	599	320	186	93
Yellow Warbler		533	120	322	91
Common Grackle		513	226	284	3
Sedge Wren	Y	498	186	222	90
American Goldfinch		478	152	266	60
Grasshopper Sparrow	Y	459	214	148	97
Brown-headed Cowbird		455	156	266	33
Savannah Sparrow	Y	379	136	164	79
Song Sparrow		359	109	182	68
Tree Swallow		347	115	213	19
Canada Goose		343	178	165	0
Western Meadowlark	Y	283	131	70	82
Mallard		218	123	91	4
Alder Flycatcher		211	21	138	52
Swamp Sparrow		196	64	92	40
Cedar Waxwing		157	17	133	7
Le Conte's Sparrow	Y	150	31	98	21
Eastern Kingbird		148	53	79	16
Brewer's Blackbird		144	22	114	8
Gray Catbird		142	42	78	22
Marsh Wren		138	41	81	16
House Wren		137	29	94	14
Wilson's Snipe		129	25	89	15
Field Sparrow		128	41	70	17
Mourning Dove		120	54	64	2
Ring-necked pheasant	Y	120	86	28	6
American Robin		110	26	74	10
Barn Swallow		105	46	53	6
Double-crested Cormorant		93	39	54	
American White Pelican		89	21	67	1
Least Flycatcher		88	19	64	5
Upland Sandpiper	Y	83	44	36	3
Unknown		70	29	34	7
Dickcissel	Y	68	2	39	27
American Crow		65	3	51	11
Veery		63	3	50	10
Killdeer	Y	58	24	27	7
Vesper Sparrow	Y	58	11	40	7
Cliff Swallow		53	43	10	
Unknown sparrow		52	21	30	1
Start		51	44	7	
Marbled Godwit	Y	50	32	18	
Willow Flycatcher		49	34	13	2

Common Name	Grassland dependent	Total count (all years)	Count of individuals 2008	2009	2010
Blue-winged Teal		46	36	10	
Red-eyed Vireo		45	4	31	10
Warbling Vireo		44	5	32	7
Brown Thrasher		43	17	19	7
European Starling		41	28	13	
Northern Harrier	Y	41	15	22	4
Yellow-headed Blackbird		40	21	19	
Eastern Towhee		36	3	33	
Rose-breasted Grosbeak		36	6	29	1
Unknown blackbird, finch, grosbeak		35	34	1	
Great Crested Flycatcher		34	11	19	4
American Redstart		33	1	13	19
Turkey Vulture		31	6	23	2
Chipping Sparrow		30	5	18	7
Unknown woodpecker, swallow		28	27	1	
Black-capped Chickadee		27	8	14	5
Baltimore Oriole		26	5	20	1
Blue Jay		26	11	15	
Northern Flicker		25	11	13	1
Orchard Oriole		25	7	14	4
Sandhill Crane		25	1	24	
Ring-billed Gull		23	13	10	
Indigo Bunting		22	6	15	1
Eastern Bluebird		21	4	15	2
Red-tailed Hawk		21	6	15	
Eastern Wood-Pewee		20	4	15	1
Yellow Rail		20	1	19	
Great Egret		19	8	11	
Unknown duck, grebe, etc		19	16	3	
Bank Swallow		18	6	11	1
Yellow-bellied Sapsucker		17	4	12	1
Black Tern		16	12	4	
Black-billed Cuckoo		16	3	13	
Wood Duck		16	2	14	
Great Blue Heron		15	4	11	
Nashville Warbler		15		15	
Northern Rough-winged Swallow		15	4	11	
Northern Cardinal		14	3	9	2
Unknown rail, sandpiper		14	3	11	
Chestnut-sided Warbler		13		13	
Eastern Meadowlark	Y	13	2	8	3
Sora		13	8	5	
Western Kingbird		13	2	11	
American Bittern		12	5	7	
Common Nighthawk		12	4	8	
Unknown blackbird		12		12	

Common Name	Grassland dependent	Total count (all years)	Count of individuals 2008	2009	2010
Common Tern		10		10	
Greater Prairie-Chicken	Y	10	7	3	
Horned Lark	Y	10	7	3	
Common Loon		9	3	6	
Forster's Tern		9	2	5	2
Hairy Woodpecker		9	2	7	
Ovenbird		9	2	7	
Rock Dove		9	2	7	
Unknown grouse		9			9
Yellow-throated Vireo		9	1	8	
Red-bellied Woodpecker		8	1	7	
Yellow-billed Cuckoo		8	5	3	
Belted Kingfisher		7	3	4	
Black-and-white Warbler		7		7	
Blue Grosbeak		7		4	3
Short-eared Owl	Y	7		7	
Unknown grouse, gull, tern		7	7		
Unknown swallow		7		6	1
Cooper's Hawk		6	2	4	
Downy Woodpecker		6	2	4	
Gadwall		6	6		
Henslow's Sparrow	Y	6	4	1	1
Unknown Gull		6		6	
Franklin's Gull		5		5	
Northern Shoveler		5	5		
Ruby-throated Hummingbird		5	3	2	
Sharp-tailed Grouse	Y	5	1	3	1
Unknown woodpecker		5		5	
Wood Thrush		5		2	3
American Kestrel		4		3	1
Black-billed Magpie		4		4	
Eastern Phoebe		4		3	1
Herring Gull		4	4		
Olive-sided Flycatcher		4		4	
Purple Martin		4	1	3	
Unknown flycatcher, vireo, wren, warbler		4	4		
Hooded Merganser		3	1	2	
Lark Sparrow	Y	3		3	
Pine Siskin		3		3	
Scarlet Tanager		3		3	
Unknown Duck		3		3	
Unknown flycatcher		3		3	
Unknown Misc		3		3	
Unknown wren		3		3	
Virginia Rail		3	1	2	
White-breasted Nuthatch		3	2	1	

Common Name	Grassland dependent	Total count (all years)	Count of individuals 2008	2009	2010
Bald Eagle		2		2	
Black-crowned Night-Heron		2		2	
Broad-winged Hawk		2		2	
Common Moorhen		2	2		
Nelson's Sharp-tailed Sparrow		2		2	
Osprey		2		2	
Sharp-shinned Hawk		2		2	
Spotted Towhee		2		2	
Wild turkey		2	2		
American Woodcock		1		1	
Baird's Sparrow	Y	1	1		
Blackpoll Warbler		1		1	
Blue-gray Gnatcatcher		1		1	
Bonaparte's Gull		1	1		
Canvasback		1		1	
Caspian Tern		1		1	
Chestnut-collared Longspur	Y	1	1		
Common Raven		1		1	
Greater Yellowlegs		1	1		
Green Heron		1	1		
House Finch		1		1	
House Sparrow		1	1		
Loggerhead Shrike		1		1	
Pied-billed Grebe		1		1	
Semipalmated Plover		1			1
Swainson's Hawk	Y	1		1	
Unknown Hawk		1		1	
Unknown thrush		1		1	
Unknown thrush, corvid		1		1	
Wilson's Phalarope	Y	1		1	
Wilson's Warbler		1		1	
Winter Wren		1		1	

Appendix D Vegetation summaries by site and year

Unit_Name	Focus area	Acres	Size-Context	Sampling Year	# of transects	Mean plant group score	Mean # quality indicators/ transect	Mean Richness /transect
Agassiz 23	4	63.75	L-E	2008	7	62.31	0.00	10.86
Altona WMA	5	24.99	L-E	2008	5	-23.10	1.80	9.80
Altona WMA	5	24.99	L-E	2009	5	6.72	4.40	14.00
Bejou WMA W	2		S-I	2008	3	49.67	4.33	14.00
Blue Mounds State Park	5	130.76	L-E	2009	13	-8.17	2.08	10.54
Boiling Springs Prairie	4	27.09	S-I	2008	6	134.70	8.00	24.50
Boiling Springs Prairie	4	27.09	S-I	2009	6	173.10	10.33	20.67
Butternut Valley Prairie SNA	4	11.67	S-I	2009	2	177.00	9.00	21.50
Caribou WMA	1	552.9	L-E	2009	40	132.71	2.43	23.35
Chippewa Prairie	4	1328.02	L-E	2008	101	45.18	3.94	16.43
Chippewa Prairie	4	1328.02	L-E	2009	30	112.77	7.03	19.40
Dovray 7	5	6.02	S-I	2008	3	-36.87	3.33	13.67
Excel8	1	400.48	L-I	2009	46	164.08	1.13	14.96
Garvin County Park	5	22.12	S-I	2008	4	-40.53	2.25	8.50
Garvin County Park	5	22.12	S-I	2009	4	6.25	3.75	13.00
Glacial Lakes State Park	3	494.57	L-E	2009	50	40.75	4.00	13.58
Higginbotham_WMA	1	130.65	S-I	2009	16	162.89	4.44	25.88
Hole in the mountain	5	147.14	L-E	2008	25	78.78	4.12	12.36
Hole in the mountain	5	147.14	L-E	2009	13	69.19	7.15	16.46
Joseph A. Tauer Prairie SNA	4	79.8	S-I	2009	8	121.80	4.75	13.63
Kloos WPA	3	16.54	S-I	2009	3	-114.53	2.00	7.00
Lake Bronson State Park	1	31.94	S-I	2009	6	109.15	4.00	17.00
Lake Pleasant 22	2	18.23	L-E	2008	3	170.30	6.33	18.67
Lake Pleasant 22	2	18.23	L-E	2009	3	180.37	6.00	22.67
Loncrace WMA	2	34.15	S-I	2008	6	175.77	4.67	17.17
Loncrace WMA	2	34.15	S-I	2009	6	155.72	5.17	20.67
Lundblad Prairie SNA	5	17.38	S-I	2008	9	107.38	3.89	17.22
Lundblad Prairie SNA	5	17.38	S-I	2009	4	109.03	10.50	23.75
Malmberg Prairie SNA	2	50.96	S-I	2008	10	173.65	3.20	14.70
Marsh Grove 36	1	395.16	L-I	2009	39	157.24	4.28	24.92
New Prairie WPA	3	15.24	S-I	2009	3	37.80	3.33	13.33
Ordway Prairie	3	379.51	L-E	2008	21	78.84	7.43	24.76
Ordway Prairie	3	379.51	L-E	2009	30	98.65	6.40	18.03
Pelan WMA	1	141.11	L-E	2009	12	143.34	3.00	25.75
Plover Prairie	4	200.95	L-E	2008	13	107.27	1.31	12.46
Prairie Coteau SNA	5	244.09	L-E	2008	12	44.62	3.42	12.00
Prairie Coteau SNA	5	244.09	L-E	2009	13	85.98	5.69	14.62
Santee Prairie SNA	2	21.87	L-E	2008	15	170.55	6.93	18.13
Stony Run 11	4	9.43	S-I	2008	3	107.27	4.33	13.33

Unit_Name	Focus area	Acres	Size-Context	Sampling Year	# of transects	Mean plant group score	Mean # quality indicators/ transect	Mean Richness /transect
Stony Run 11	4	9.43	S-I	2009	4	154.75	5.00	11.25
Svor WPA	3	54.87	L-E	2008	2	19.90	5.00	16.50
Svor WPA	3	54.87	L-E	2009	4	77.90	7.00	20.50
Twin Lakes WMA	1	31.79	L-E	2009	11	164.77	3.64	21.91
Twin Valley Prairie SNA	2	226.75	L-E	2009	23	111.05	4.39	17.22
Two-Rivers Aspen Prairie Parkland SNA	1	96.43	L-I	2009	20	159.88	1.95	22.90
Tympanuchus WMA	2	24.14	L-E	2008	6	159.92	6.67	19.33
Vegoe PB	3	49.39	L-E	2009	6	40.52	4.50	15.17
Windsor 13 NE	4	159.09	L-E	2008	5	25.34	2.60	15.40

2008 Project Abstract
For the Period Ending June 30, 2010

PROJECT TITLE: Prairie Ecosystem Restoration Project
PROJECT MANAGER: Rich Perrine
AFFILIATION: Martin Soil and Water Conservation District
MAILING ADDRESS: 923 North State Street, Suite 110
CITY/STATE/ZIP: Fairmont, MN 56031
PHONE: (507) 235-6680
E-MAIL: Richard.perrine@mn.nacdnet.net
WEBSITE: [If applicable] www.martinswcd.net
FUNDING SOURCE: Environment and Natural Resources Trust Fund
LEGAL CITATION: M.L. 2008, Chp. 367, Sec. 2, Subd. 3(n)

APPROPRIATION AMOUNT: $80,000

Overall Project Outcome and Results

31 prairie remnant owners gave written permission to collect native plant materials from their property. 18 Township Boards gave permission for the collection of native plant materials from township road right-of-ways. The Martin County Board of Commissioners granted permission to collect native plant materials from county road right-of-ways and native populations within county parks.

MCIA inspected nearly 700 acres on 28 collection sites and 578 acres on 23 planting sites. MCIA was contracted to perform site inspections, identification and verification of native species in order for the seeds collected to maintain their “Yellow Tag” eligibility.

Two interns hired in 2008 to assist with project implementation, secured permission and started the seed collection. In June, 2009 four interns were hired and they immediately went to work learning plant and seed identification and seed stratification requirements. Daily tasks included identifying and monitoring prairie remnants and sites with local ecotype native species, planting trays, using GPS to mark species locations, placing no mow and/or no spray signs in selected ditches, shelling and cataloguing seed types and amounts collected. Of the 104 different local ecotype native species collected, we consider at least 34 species to be at-risk for further decline.

As time ran out for the planting phase of the project, seed, rootstocks and cuttings from 104 native plant species had been collected from 40 local remnant populations. These remnants, ranged from less than an acre to over 100 acres in size, totaling almost 800 acres. Of these, only about 25 acres could be considered high quality, and almost no acres were without some impact from invasive species. Reed Canary grass, Smooth Brome and Kentucky bluegrass are major grass invaders found on nearly every site, along with Canada thistle. Sweet Clover and Buckthorn are starting to dominate areas as well. No chemicals were used or recommended within the higher quality portions of the remnants. Hand pulling seemed somewhat effective on low level Sweet Clover infestations. Stripping buds and Collecting seed heads from thistles was used primarily to reduce seed contamination as was done with smooth brome before collecting native seed in those areas.

In order to reduce the risk of entire collection sites from being sprayed or mowed, Canada thistle had to be kept from maturing past the bud stage. Hand pulling seemed to produce the least impact to the native plants.

With conversion of land to other uses, if given an opportunity to collect native plants, we learned to prioritize species to remove and salvage them in priority order in the time available, because once converted, there is not a single plant left on the site! Every year we seem to lose a site with remnant native plant populations.

Letters describing the project were sent to perpetual easement owners, inviting them to participate. With the wonderful response, we were able to plant on 758 acres of the 1,589 acres where permission was granted. Two landowners had significant acreage which allowed us to plant 15 smaller plantings within various landscape positions on their easements.

32.27 lbs of seed and about 3,000 propagated plants were then transferred to suitable locations on 1,589 acres of land protected by perpetual conservation easements. Planting sites were selected where niches remained between existing plants and where invasive species were absent. Species with a small seed supply were planted in plots of only a few square feet, while seed from many species were broadcast over much larger areas of 100 acres or more with a Vicon seeder mounted on an ATV. Seed supplies ranged from less than a gram to several lbs. for some of the more common species and those having a good seed year. Plantings were strategically located to expand over time, allowing many of the species to move into their preferred niches and increase diversity over the 1,589 acres of easement area.

Increasing the plant diversity will improve the natural functions, replace some of our rapidly declining native prairie habitats and provide a better habitat for our insects, birds, and mammals. Plant materials from these areas are to be made available as foundation seed sources, with their origination tracked in accordance to MN Crop Improvement Association's (MCIA) "Yellow Tag" program guidelines.

Project Results Use and Dissemination

Articles were published in Martin SWCD's Conservation Update and several radio spots were aired discussing this project and updating county residents on the projects progress. We also set up information booths at the annual County Fair, Corn and Soybean Days, Spring Expo, and talked about the project at our rain garden seminars and weed management workshops. An interpretive planting around the foundation of the Martin County Courthouse features the project which is referenced on a bronze plaque.

Trust Fund 2008 Work Program Final Report

Date of Report: August 10, 2010
Final Report
Date of Work program Approval: June 10, 2008
Project Completion Date: June 30, 2010

I. PROJECT TITLE: Prairie Ecosystem Restoration Project

Project Manager: Rich Perrine
Affiliation: Martin SWCD
Mailing Address: 923 North State Street, Suite 110
City / State / Zip : Fairmont, MN 56031
Telephone Number: (507) 235-6680
E-mail Address: richard.perrine@mn.nacdnet.net
FAX Number: (507) 235-8171
Web Page address: www.martinswcd.net

Location: On cooperator's perpetual conservation easements, within Martin County and the portions of adjacent counties located within approximately 25 miles of the center of Martin County.

Total Trust Fund Project Budget:	**Trust Fund Appropriation:**	**$80,000.00**
	Minus Amount Spent:	**$80,000.00**
	Equal Balance:	**$ 0.00**

Legal Citation: M.L. 2008, Chp. 367, Sec. 2, Subd. 3(n) .

Appropriation Language: $80,000 is from the trust fund to the Board of Water and Soil Resources for an agreement with the Martin County Soil and Water Conservation District to collect and propagate local ecotype native plant materials from prairie remnants for establishment on lands with perpetual conservation protection in Martin County. If the Martin County Soil and Water Conservation District sells seeds or plants that were collected or propagated using money from this appropriation, the net proceeds of the sale must be repaid to the trust fund.

II. and III. FINAL PROJECT SUMMARY.

31 prairie remnant owners gave written permission to collect native plant materials from their property. 18 Township Boards gave permission for the collection of native plant materials from township road right-of-ways. The Martin County Board of Commissioners granted permission to collect native plant materials from county road right-of-ways and native populations within county parks.

MCIA inspected nearly 700 acres on 28 collection sites and 578 acres on 23 planting sites. MCIA was contracted to perform site inspections, identification and verification of native species in order for the seeds collected to maintain their “Yellow Tag” eligibility.

Two interns hired in 2008 to assist with project implementation, secured permission and started the seed collection. In June, 2009 four interns were hired and they immediately went to work learning plant and seed identification and seed stratification requirements. Daily tasks included identifying and monitoring prairie remnants and sites with local ecotype native species, planting trays, using GPS to mark species locations, placing no mow and/or no spray signs in selected ditches, shelling and cataloguing seed types and amounts collected. Of the 104 different local ecotype native species collected, we consider at least 34 species to be at-risk for further decline.

As time ran out for the planting phase of the project, seed, rootstocks and cuttings from 104 native plant species had been collected from 40 local remnant populations. These remnants, ranged from less than an acre to over 100 acres in size, totaling almost 800 acres. Of these, only about 25 acres could be considered high quality, and almost no acres were without some impact from invasive species. Reed Canary grass, Smooth Brome and Kentucky bluegrass are major grass invaders found on nearly every site, along with Canada thistle. Sweet Clover and Buckthorn are starting to dominate areas as well. No chemicals were used or recommended within the higher quality portions of the remnants. Hand pulling seemed somewhat effective on low level Sweet Clover infestations. Stripping buds and Collecting seed heads from thistles was used primarily to reduce seed contamination as was done with smooth brome before collecting native seed in those areas.

In order to reduce the risk of entire collection sites from being sprayed or mowed, Canada thistle had to be kept from maturing past the bud stage. Hand pulling seemed to produce the least impact to the native plants.

With conversion of land to other uses, if given an opportunity to collect native plants, we learned to prioritize species to remove and salvage them in priority order in the time available, because once converted, there is not a single plant left on the site! Every year we seem to lose a site with remnant native plant populations.

Letters describing the project were sent to perpetual easement owners, inviting them to participate. With the wonderful response, we were able to plant on 758 acres of the 1,589 acres where permission was granted. Two landowners had significant acreage which allowed us to plant 15 smaller plantings within various landscape positions on their easements.

32.27 lbs of seed and about 3,000 propagated plants were then transferred to suitable locations on 1,589 acres of land protected by perpetual conservation easements. Planting sites were selected where niches remained between existing plants and where invasive species were absent. Species with a small seed supply were planted in plots of only a few square feet, while seed from many species were

broadcast over much larger areas of 100 acres or more with a Vicon seeder mounted on an ATV. Seed supplies ranged from less than a gram to several lbs. for some of the more common species and those having a good seed year. Plantings were strategically located to expand over time, allowing many of the species to move into their preferred niches and increase diversity over the 1,589 acres of easement area.

Increasing the plant diversity will improve the natural functions, replace some of our rapidly declining native prairie habitats and provide a better habitat for our insects, birds, and mammals. Plant materials from these areas are to be made available as foundation seed sources, with their origination tracked in accordance to MN Crop Improvement Association's (MCIA) "Yellow Tag" program guidelines.

Articles were published in Martin SWCD's Conservation Update and several radio spots were aired discussing this project and updating county residents on the projects progress. We also set up information booths at the annual County Fair, Corn and Soybean Days, Spring Expo, and talked about the project at our rain garden seminars and weed management workshops. An interpretive planting around the foundation of the Martin County Courthouse features the project which is referenced on a bronze plaque.

IV. OUTLINE OF PROJECT RESULTS*:*

Result 1: Collect Native Plant Materials

Description: Prairie remnants will be inventoried. Permission to collect native plant materials will be secured and agreements will be completed. (Landowners who request compensation will be paid for the value of the seed harvested on their property). Prairie Remnants will be monitored. Native plant material, usually seed but sometimes root or shoot cuttings and plants will be collected from the prairie remnants. The Minnesota Crop Improvement Association (MCIA) will provide prairie remnant inspections.

Summary Budget Information for Result 1:	**Trust Fund Budget:**	**$30,000.00**
	Amount Spent:	**$30,000.00**
	Balance:	**$ 0.00**

Deliverable	**Completion Date**	**Budget**	**Status**
1. Secure Access/Agreements	**12-31-2009**	**$2,000.00**	**100%**
2. Inventory, Collect Seed	**06-30-2010**	**$12,000.00**	**100%**
3. Pay Land Owners	**06-30-2010**	**$7,000.00**	**100%**
4. MCIA Inspection	**06-30-2010**	**$9,000.00**	**100%**

Completion Date: 06-30-2010

Final Report Summary: August 10, 2010

Written agreements granting permission to collect native plant materials were secured from 31 landowners. Collaboration with the State's Ecologist who is conducting the Minnesota County Biological Survey helped us locate additional prairie remnants and potential prairie remnant sites to look for local ecotype native species. Eighteen Township Boards returned written permission for collection of native plant materials within their township road right-of-ways. A contract developed with the MN Crop Improvement Association (MCIA) provided for the inspection and inventory of 28 native prairie sites and 23 easement sites.

A renewed permit from the DNR was acquired to collect, propagate, and plant three threatened or endangered species. After the accidental mowing of Sullivant's Milkweed (State Threatened), on one of our right-of-way sites, signs requesting no mowing or spraying with Minnesota Trust Fund recognition were posted with great success on selected ditches. These signs also included our phone number with instructions to call if any invasive/noxious weeds were visible within our project area.

Collaboration with the Martin County Biological Survey has resulted in efficiency with landowner contacts and has helped produce some significant finds in the field. The Small White Ladyslipper was found on one of the inventory trips and the Tuberous Indian Plantain was found on three privately owned parcels.

21 sites were monitored closely and seeds from 104 local ecotype plant species were collected, with 61 of those species coming from multiple properties to provide genetic variation for these local ecotypes.

GPS was used to place location waypoints on plant species at two large private property sites with more than 30 different plant species. Waypoints can be used again for relocation and collection of seed in the future.

$7,000 in compensation was provided to private landowners for allowing the collection of 32.27 lbs of seed from their property. Collection site spreadsheets were updated with species, date collected, and weight for calculating compensation.

Seeds were collected into late November. Cool summer temperatures slowed maturation. Drought conditions and insect predation impacted seed production of some species. Dry conditions helped keep feet dry, but prevented Carex species from filling seed and holes in seed pods were evidence of insect damage.

Time limited our spring 2010 seed collection to only a few species that were ready to pick by mid-May due to the enormous response from 18 easement owners to plant our collected seed on their properties and the preparation needed for planting.

Result 2: Propagate Native Plants

Description: Purchase containers and ingredients for growing medium. Prepare trays, seeds and cuttings. Start plants under grow lights. Move plants to a greenhouse, a nursery plot or plant directly into easement protected sites.

Summary Budget Information for Result 2: **Trust Fund Budget: $34,000**
Amount Spent: $34,000
Balance: $ 0

Deliverable	Completion Date	Budget	Status
1. Purchase materials	06-30-2010	$5,000.00	100%
2. Propagate plants	06-30-2010	$29,000.00	100%

Completion Date: 06-30-2010

Final Report Summary: August 10, 2010

Planting trays, inserts and growing medium ingredients were purchased. The special tray inserts and tubes with deep planting cells will allow the development of deep root systems. (The procedure used for propagation came from the Iowa Ecotype Project, University of Northern Iowa.) Plants started in these tube/cone shaped cells transplant with roots deeper in the ground which should result in better access to soil moisture as the soils dry out. Over 3,000 tubes were planted with seed. Successful germination rate of planted seeds is about 85% to 90% for grasses and a few of the forbs. Many forbs had about 50% to 60% germination rate. Some seeds such as the Prairie Blazing Star, Prairie Turnip, Ground Plum, and Pasque Flower had 0 to 10% germination rate.

Hoary Puccoon cuttings were collected and transplanted to large tubes that had been seeded with Sideoats Grama, Porcupine Grass, and Big Blue Stem.
We had zero success with the Hoary Puccoon cuttings growing with the grass seedlings but we did have some success with germination of Hoary and Fringed Puccoon seeds with established grasses. Early plantings of Monkey flower required thinning and were transplanted to larger tubes in the process.

In 2009 seed trays were housed in a nursery for most of the summer, but by late October, were moved to the SWCD's shed to harden off for winter. In 2010, we leased space in what was once a pharmacy and it had limited windows for fresh air ventilation. Use of the furnace fan to provide air movement helped but the high humidity levels caused mold spores to develop. The Prairie Turnip is notoriously susceptible to damp-off, a type of mold that is already a part of the seed. We removed the Prairie Turnip to a protected outdoor area but the plant would grow to its second leaf stage and then die out. We placed the plant trays into a water bath in order for the plants to soak up water from the bottom which is a recommended means of keeping the seeds/seedlings hydrated without soaking the surface, but it did not make a difference with the Prairie Turnip. All the grasses had 90% or better germination and growth. One forb species that was picked in 2008, Prairie Blazing Star, had 0% germination. We do not have a hypothesis as to why none of the seed from this species reached maturity, but undeveloped seed seems to be common with blazing star species.

A refrigerator was acquired as an in-kind contribution for the project and was used extensively for seed storage and stratification.

Result 3: Establish Plants on Easements

Description: Select suitable sites on protected easements for each species being planted. Prepare site by providing mechanical and/or chemical weed control if needed and achieve proper soil conditions for the species being planted. Plant and/or transplant local ecotype native plants directly into existing stands or into prepared areas. Continue weed control until seedlings and transplants become established, water as needed.

Summary Budget Information for Result 3:	**Trust Fund Budget:**	**$16,000.00**
	Amount Spent:	**$16,000.00**
	Balance:	**$ 0.00**

Deliverable	**Completion Date**	**Budget**	**Status**
1. Select Sites	**05-15-2010**	**$1,000.00**	**100%**
2. Prepare, Seed/Transplant	**06-30-2010**	**$10,000.00**	**100%**
3. Site Maintenance	**06-30-2010**	**$5,000.00**	**100%**

Completion Date: 06-30-2010

Final Report Summary: August 10, 2010

Letters were sent to all Martin County CREP and RIM easement owners explaining the project and invited them to participate by allowing us to plant the collected seeds and plant materials on their property. We had an overwhelming response from our residents, with18 landowners providing 23 sites and 1589 acres, which were inspected by MCIA prior to planting. Dormant seeding during the winter of 2009/2010 was not done due to late seed collection being required after unexpected snow fell in early October, delaying collection until warmer weather returned in November. As soon as collection was completed in November, snow fell again but we did not have enough seed cleaned to get out on the sites.

Two people went out to each site, conducted a plant inventory, site evaluation and determined soil type by using the Web Soil Survey on the USDA's Natural Resource Conservation Service web site. We also checked the CREP and RIM files for the species that were already seeded on to the easements, to avoid planting species already growing on the site

Prior to planting, the easement sites were assessed for suitability. Heavy Spring 2010 rain, produced populations of grasses and weeds that were overwhelming in areas, preventing the planting of all of the acreage available. Weedy areas were avoided when selecting planting sites. Very little chemical control was used, with Roundup and 2-4D being used primarily adjacent to planting areas to slow encroachment.

Easement owners were encouraged to only use mechanical weed control in the future and to contact the SWCD for help with selection of chemicals, timing and location of applications and then for use only when absolutely necessary.

Follow-up monitoring will be provided for all planting sites with weed control and maintenance strategies communicated with the landowners and operators as issues arise.

Seeds were mixed with vermiculite and hand seeders were used on smaller sites and at sites that were difficult to get to with the Vicon seeder. The project ended with 758 acres planted with additional species, using 32.27 lbs. of seed and approximately 3,000 transplants.

Coordinating planting permission, researching the species that were already planted on their 23 sites, and identifying suitable planting areas took three weeks to complete. Seeding was completed on June 28, 2010.

V. TOTAL TRUST FUND PROJECT BUDGET:

Staff or Contract Services: $75,000
Equipment: $0.00 All equipment will be provided in-kind
Development: $0.00
Restoration: $0.00 On at least 30 selected sites, approximately 1,000 acres.
Acquisition, including easements: $0.00 Within approximately 2,500 acres or more of existing perpetual conservation easements, under private ownership.
Other: $5,000.00 for supplies, primarily growing medium and containers, needed for plant propagation.

TOTAL TRUST FUND PROJECT BUDGET: $80,000.00

Explanation of Capital Expenditures Greater Than $3,500: None

VI. OTHER FUNDS & PARTNERS:

A. Project Partners: Martin Soil and Water Conservation District: $80,000.

Fox Lake Conservation League, Tim Eisenmenger; Watonwan Pheasants, Everett Garlsich; Fox Lake Association, Mark Stoffel; MN Department of Natural Resources Wildlife Manager, Randy Markl; and Ecological Services, Jason Garms; U. S. Fish and Wildlife Service Private Lands, Gerry Shimek; and many prairie remnant and easement owners providing in-kind.

B. Other Funds Proposed to be Spent during the Project Period:

C. Past Spending: $10,000 of in-kind time, mileage, supplies and equipment will be used for this project in the two years prior to July 1, 2008. Maintenance of existing

plant materials and preparation for an increased workload for the two-year LCCMR funded project period will continue through July 1, 2008.

D. Time: Work needed to establish plants on protected sites will continue beyond the two years funded through the LCCMR. Work started prior to the LCCMR funded portion of the project will be continued and completed. Work with additional species that cannot be completed within the LCCMR funded project timeframe will continue until the plants can be established on protected easement sites. Additional in-kind, local funding and grant funding will be secured if needed to complete any unfinished work.

VII. DISSEMINATION: Information will be documented in conservation plans for participating landowners. Copies of the plans will be provided to the BWSR Central Office in St. Paul to be included in cooperator files there. Project progress and results will be posted on the SWCD web site. The project will be featured in the Martin SWCD annual publication, the "Conservation Update" in January of 2008, 2009, 2010 and 2011.

Final Report Summary: August 10, 2010

Articles outlining the project and project progress were written for the Conservation Update published twice a year. These articles generated interest within the community and we received a few calls from citizens wanting to volunteer. We also posted these articles on our web site www.martinswcd.net . One of the local radio stations provides about 5-10 minutes of air time per week where this office discusses all of our projects and programs that are available to eligible landowners. We spoke about this project at least quarterly. We provided a planting and an interpretive display around the foundation of the county courthouse to showcase the project of local ecotype native plants. Boy Scout Troop 55 from Truman, MN made aluminum stakes to mount laser etched plant labels which were well received by the public. A bronze plaque features the project and recognizes the LCCMR and the Environment and Natural Resources Trust Fund.

VIII. REPORTING REQUIREMENTS:
Periodic work program progress reports will be submitted not later than January 31, 2009, July 31, 2009, January 31, 2010 . A final work program report and associated products will be submitted between June 30 and August 1, 2010 as requested by the LCCMR

IX. RESEARCH PROJECTS: This project does not involve a research component. Propagation techniques used in this project were acquired through training provided by the Tallgrass Prairie Center, University of Northern Iowa, Cedar Falls, IA and the Iowa Ecotype Project.

J:\SHARE\WORKFILE\ML2008\Work Program Information\2008WPTemplateblank.doc

Attachment A: Budget Detail for 2008 Projects

Project Title: Prairie Ecosystem Restoration Project

Project Manager Name: Rich Perrine

Trust Fund Appropriation: $80,000

2008 Trust Fund Budget	**Result 1 Budget 05/13/10**	**Amount Spent** *(06/30/10)*	**Balance** 06-30-2010		**Result 2 Budget 05/13/10**	**Amount Spent** *(06/30/10)*	**Balance** 06-30-2010	**Result 3 Budget 05/13/10**	**Amount Spent** *(06/30/10)*	**Balance** 06-30-2010	**Total Budget 05/13/10**	**Total Balance 06/30/10**
	Collect Native Plant Materials				Propagate Native Plants			Establish Plants on Easements				
BUDGET ITEM			0				0			0		
PERSONNEL: wages and benefits One new full time staff person doing all aspects of project work, with the assistance of 4 to 5 seasonal workers during busy times, working with native plant materials.	12,180	12,180	0		28,600	28,600	0	15,000	15,000	0	55,780	0
Contracts			0				0			0		
Agreements with prairie remnant owners to donate or receive payment for plant materials collected from their property. Agreements with easement owners outlining their responsibilities and the procedures for the planting and maintenance of local ecotype plants on their property.	7,000	7,000	0				0			0	7,000	0
The Minnesota Crop Improvement Association will provide field certification of prairie remnants. Inspection fee: $50.00 per hour. Planting sites will be documented, to allow for the development of "Yellow Tag Seed".	9,000	9,000	0				0			0	9,000	0
Other Supplies: Plant trays, inserts, growing medium ingredients, innoculants, rooting hormone, plant food.			0		5,000	5,000	0			0	5,000	0
Travel expenses in Minnesota Travel to, from and between sites for monitoring, seed collection, propagation, planting and maintenance activities.	1,820	1,820	0		400	400	0	1,000	1,000	0	3,220	0
COLUMN TOTAL	**$30,000**	**$30,000**	**$0**		**$34,000**	**$34,000**	**$0**	**$16,000**	**$16,000**	**$0**	**$80,000**	**0**

2008 Project Abstract
For the Period Ending June 30, 2010

PROJECT TITLE:	Best Practices for Native Prairie Management
PROJECT MANAGER:	Michelle J. Snider
AFFILIATION:	Minnesota Recreation and Park Association
MAILING ADDRESS:	200 Charles Street NE
CITY / STATE / ZIP:	Fridley, MN 55432
PHONE:	763.571.1305 x100
E-MAIL:	snider@mnrecpark.org
WEBSITE:	mnrpa.org / bestpracticesmn.org
FUNDING SOURCE:	Environment and Natural Resources Trust Fund
LEGAL CITATION:	ML 2008, [Chap. 367], Sec.[2], Subd.3 (0).
APPROPRIATION AMOUNT:	$45,000

Overall Project Outcomes and Results
The 2004 LCMR Parks Study and the 2003–2008 State Comprehensive Outdoor Recreation Plan (SCORP) recommended better coordination among Minnesota's outdoor recreation providers. This project addressed these recommendations by engaging public and private outdoor recreation leaders to transform better coordination into shared knowledge and practices.

Two native prairie demonstration projects will identify best management practices and maintenance methodologies as the sites continue to mature. The first native prairie demonstration area is located within Cedar Creek Ecosystem Science Reserve in East Bethel, Minnesota. One-half of the area was mowed, and one-half was burned prior to seeding. This 23-acre demonstration area features five treatments: burn/broadcast seed; burn/drill seed; mow/broadcast seed; mow/drill seed; and forb plantings.

The second native prairie demonstration project is located within two city parks in Hutchinson, Minnesota. The two areas' objectives were to restore turf back to native prairie, and to further an oak savanna restoration. This approximately 10-acre demonstration area (total acreage within the two sites) features four treatments: drill seed near lowland river area; broadcast seed near high-ground river area; hand-seed; and over-seeding of a continued restoration project.

Three regional workshops were conducted to exchange information and techniques used during the demonstrations, and overall native prairie best practices. The first regional workshop focused on native prairie impacts, research, and reconnecting children to nature. Session content included biodiversity and its impacts on prairie ecosystems; bioenergy; climate; productivity and resistance to drought, disease, and pests; and reconnecting children with the native environment by teaching them the value of the native prairies, lands, and waterways.

The second regional workshop was designed to gather a cross-section of professionals to discuss strategies and solutions for best practices in native prairie management. Session content included best practices in native prairie management from numerous perspectives: engineering, wildlife, natural resources, park resources, and water resources. Workshop presenters also provided information on partnerships, stormwater program and vegetation, prairie maintenance, prairie seed installation, and forestry inventories.

The third regional workshop centered on small and large suburban native prairie areas. Session content included prairie and native plant/tree protection and restoration; and agricultural development that has been one of the largest sources of local habitat removal with current efforts to restore these prairies to their original native habitats. Workshop presenters also provided information on efforts to convert 600 acres of former agricultural land to native prairie and wetland.

Projects Results Use and Dissemination

The two demonstration areas were components of two of the regional workshops to share the site preparation, seed selection, and methodology information with participants. Project results have been provided within the Minnesota Recreation and Park Association's 2009 annual report, and Minnesota's state report during National Recreation and Park Association meetings.

Additionally, project updates are included on the Minnesota Recreation and Park Association's website and the best practices website. Further project results dissemination will be shared during Minnesota Recreation and Park Association educational conferences and trainings.

Trust Fund 2008 Work Program Final Report

Date of Report: June 30, 2010
Final Report
Date of Work Program Approval: June 10, 2008
Project Completion Date: June 30, 2010

I. PROJECT TITLE: Best Practices for Native Prairie Management

Project Manager: Michelle J. Snider
Affiliation: Minnesota Recreation and Park Association
Mailing Address: 200 Charles Street NE
City / State / Zip : Fridley, MN 55432
Telephone Number: 763.571.1305 x100
E-mail Address: snider@mnrecpark.org
FAX Number: 763.571.5204
Web Page address: mnrpa.org / bestpracticesmn.org

Location: Twin Cities Metro Area and Out-State Minnesota

Total Trust Fund Project Budget:	**Trust Fund Appropriation:**	**$**	**45,000.00**
	Minus Amount Spent:	**$**	**33,863.91**
	Equal Balance:	**$**	**11,136.09**

Legal Citation: ML 2008, [Chap. 367], Sec.[2], Subd.3 (0).

Appropriation Language: $45,000 is from the trust fund to the commissioner of natural resources for an agreement with the Minnesota Recreation and Park Association to provide information on best practices for native prairie management through field demonstrations, regional workshops, and the Web.

II. and III. FINAL PROJECT SUMMARY

The 2004 LCMR Parks Study and the 2003–2008 State Comprehensive Outdoor Recreation Plan (SCORP) recommended better coordination among Minnesota's outdoor recreation providers. This project addressed these recommendations by engaging public and private outdoor recreation leaders to transform better coordination into shared knowledge and practices.

Two native prairie demonstration projects will identify best management practices and maintenance methodologies as the sites continue to mature. The first native prairie demonstration area is located within Cedar Creek Ecosystem Science Reserve in East Bethel, Minnesota. One-half of the area was mowed, and one-half was burned prior to seeding. This 23-acre demonstration area features five treatments: burn/broadcast seed; burn/drill seed; mow/broadcast seed; mow/drill seed; and forb plantings.

The second native prairie demonstration project is located within two city parks in Hutchinson, Minnesota. The two areas' objectives were to restore turf back to native prairie, and to further an oak savanna restoration. This approximately 10-acre demonstration area (total acreage within the two sites) features four treatments: drill seed near lowland river area; broadcast seed near high-ground river area; hand-seed; and over-seeding of a continued restoration project.

Three regional workshops were conducted to exchange information and techniques used during the demonstrations, and overall native prairie best practices. The first regional workshop focused on native prairie impacts, research, and reconnecting children to nature. Session content included biodiversity and its impacts on prairie ecosystems; bioenergy; climate; productivity and resistance to drought, disease, and pests; and reconnecting children with the native environment by teaching them the value of the native prairies, lands, and waterways.

The second regional workshop was designed to gather a cross-section of professionals to discuss strategies and solutions for best practices in native prairie management. Session content included best practices in native prairie management from numerous perspectives: engineering, wildlife, natural resources, park resources, and water resources. Workshop presenters also provided information on partnerships, stormwater program and vegetation, prairie maintenance, prairie seed installation, and forestry inventories.

The third regional workshop centered on small and large suburban native prairie areas. Session content included prairie and native plant/tree protection and restoration; and agricultural development that has been one of the largest sources of local habitat removal with current efforts to restore these prairies to their original native habitats. Workshop presenters also provided information on efforts to convert 600 acres of former agricultural land to native prairie and wetland.

Projects Results Use and Dissemination

The two demonstration areas were components of two of the regional workshops to share the site preparation, seed selection, and methodology information with participants. Project results have been provided within the Minnesota Recreation and Park Association's 2009 annual report, and Minnesota's state report during National Recreation and Park Association meetings.

Additionally, project updates are included on the Minnesota Recreation and Park Association's website and the best practices website. Further project results dissemination will be shared during Minnesota Recreation and Park Association educational conferences and trainings.

IV. OUTLINE OF PROJECT RESULTS*:*

Result 1: *Best Practices Native Prairie Demonstrations*

Description: Two native prairie demonstration projects will be held to identify best management practices in both metro/urban and out-state/more rural environments. Thus, one demonstration project will be held in Anoka County. Another demonstration project will be held in the prairie biome of southwest or northwest Minnesota. The project team will convene member agencies and partners to select specific areas upon which to enhance existing prairie restoration efforts. Land will not be purchased; rather member agencies or partners' land will be used for these projects. The demonstrations will focus on a comprehensive site analysis to identify the target plant community, site preparation (may include burning and mowing), seeding and planting. A high diversity mix of over 20 species of native grasses, sedges, and forbs, of local eco-type origin, will be selected for seeding and planting. Further, project goals are to expand current restoration efforts and to enhance the biological diversity and ecological function of the sites. For example, a current restoration project may be supplemented by overseeding the area. Additionally, interpretative signs will be implemented to describe the processes underway. Mowing and burning will be considered as disturbance regime factors and will be effectively used at targeted times throughout the restoration process. These demonstration projects will become educational sites to inform land users and land managers of the native prairie restoration taking place in the area. This information will also be disseminated to land managers and outdoor recreation professionals throughout the State of Minnesota.

Potential demonstration topics could include biodiversity and its impacts on prairie ecosystems, bioenergy, climate, disease effects, water quality, wildlife, soil fertility, carbon cycle, and disturbance regimes. Experts would be sought on special topics to expand the arena of knowledge to program participants. Demonstration methods and results will be compared based on geographical regions within the northern tallgrass biome. The outcome is to provide land managers and recreation professionals platforms for gaining the most current information for native prairie management and maintenance methodologies. The demonstrations will reach approximately 200 to 300 participants.

Summary Budget Information for Result 1:	**Trust Fund Budget:**	**$ 30,000.00**
	Amount Spent:	**$ 29,656.01**
	Balance:	**$ 343.99**

Deliverable	**Completion Date**	**Budget**	**Status**
1. Metro Demonstration	**May 26, 2009**	**$15,690.65**	**Completed**
2. Out-State Demonstration	**Mid-November, 2009**	**$13,965.36**	**Completed**
3. Location Comparison	**December 31, 2009**	**0**	**Completed**

Completion Date: December 31, 2009

Final Report Summary:
The metro demonstration project has been moved to 2009 when weather more conducive to native prairie plantings exists. This project will be held in Anoka County at the Cedar Creek Ecosystem Science Reserve.

The grant project's first native prairie demonstration area was seeded beginning on May 26, 2009 at Cedar Creek Ecosystem Science Reserve in East Bethel, Minnesota, which is located in Anoka County. The total area is 23 acres. One-half of the area was mowed, and one-half was burned prior to the seeding. Both broadcast and drill seeding took place, with forb plantings following along the natural trail. Anoka County Parks provided in-kind services. This 23-acre demonstration area features five treatments to further monitor for best practices in management: burn/broadcast seed; burn/drill seed; mow/broadcast seed; mow/drill seed; and forb plantings.

Initial planning has begun for the grant project's second demonstration area, which will be held in the fall of 2009 in Hutchinson, Minnesota.

The grant project's second native prairie demonstration project was seeded in mid-November 2009 within two City of Hutchinson park areas in Hutchinson, Minnesota. In-kind services were provided by Hutchinson Parks and Recreation.

The first park was selected as a site to restore turf areas back to native prairie plantings. This park's seeding and methodologies were divided into two areas: a 1.6-acre primarily lowland area and a one-acre high-ground area.

The park's 1.6 acres of primarily lowland area includes approximately 700 feet of river frontage that periodically floods and holds some water for days after rain events. This site was selected to act as a buffer between Hutchinson Parks and Recreation's high-maintenance athletic fields and the Crow River. This site's seed mixtures were selected because of the almost continuous wet nature of the site. Drill seeding was the method of sowing the seed. Hutchinson Parks and Recreation staff selected this methodology as they felt drill seeding would provide the best chance of not having the seed washed away during the periodic floods.

The park's one-acre of high-ground area has good drainage. Being a well drained site with often dry periods in the summer, prairie grass and native wildflower mixtures were selected. Broadcast seeding was used in this area. Native prairie flower seed was then hand-sowed. Mulch was added to the park area plantings to help prevent erosion and retain soil moisture. Hutchinson Parks and Recreation will install a recreational path within the next year along the river near these planting areas. The plantings will add recreational and educational value to the park area. Additionally, these plantings enabled Hutchinson Parks and Recreation to add an estimated 700 feet of shoreline buffer along the Crow River.

The second Hutchinson Parks and Recreation site was within the Miller Woods Oak Savanna, an ongoing prairie restoration area. This park land includes an ongoing restoration of an oak savanna that is often used for recreation and education. There are currently 20 acres of prairie being restored. However, seven acres required over-seeding due to low numbers of natives and lack of diversity. Broadcast seeding was used within this area. An additional .5-acre low area was over-seeded due to water retention in the area. This area was broadcast seeded by hand.

This approximately 10-acre demonstration project (total acreage within the two sites) in Hutchinson features four treatments to further monitor for best practices in management: drill seed near lowland river area; broadcast seed near high-ground river area; hand-seed; and over-seeding of a continued restoration project. The seed was purchased from Prairie Restorations, Inc. in the amount of $13,965.36.

Each native prairie demonstration project was incorporated into one of the regional workshops to further share the planting process and methodology information. The City of East Bethel constructed a pavilion near the entrance to the first demonstration area trails, and completed fencing to enclose the area (save the ingress gate). The demonstration areas will continue to provide best practices for management and maintenance as both sites mature.

Result 2: *Regional Workshops*

Description: At least three workshops will be conducted to exchange management information and techniques used during the demonstrations, and to develop best management practices information to include within the website. The information exchange will also include video and/or photo images to further connect the project process. The workshops will be marketed to city, county, state, and federal agencies; the private sector; academia; and non-profit groups. Workshop topics will include, but not limited to, the areas emphasized during the demonstrations, along with complementary plenary sessions to further the knowledge base of participants. The regional workshops will reach approximately 225 participants.

Summary Budget Information for Result 2:	**Trust Fund Budget:**	**$ 15,000.00**
	Amount Spent:	**$ 4,207.90**
	Balance:	**$ 10,792.10**

Deliverable	**Completion Date**	**Budget**	**Status**
1. Metro Workshop	**September 22-25, 2009**	**$4,707.90**	**Completed**
2. Out-State Workshop	**November 19, 2009**	**$ 500.00**	**Completed**
3. Capstone Workshop	**April 15, 2010**	**0**	**Completed**

Completion Date: April 15, 2010

Final Report Summary:
The metro regional has been moved to 2009. The regional workshop will follow the metro demonstration project implementation. This workshop will be held in Anoka County at the Cedar Creek Ecosystem Science Reserve.

The grant project's first workshop will be held in conjunction with the Minnesota Recreation and Park Association Annual Conference. The conference will be held September 22 – 25 in Anoka County. A presentation at the Cedar Creek Ecosystem Science Reserve will focus on native prairie impacts, and will include prairie-related research that's centered on ecology and the services ecosystems provide. The

presentation will also include information on biodiversity and its impacts on prairie ecosystems, bioenergy, climate, productivity, and resistance to drought, disease, and pests. Additionally, the benefits of engaging youth with natural areas will be discussed during the conference's closing keynote address.

Initial planning has begun for the grant project's second regional workshop, which will be held in the fall of 2009 in Hutchinson, Minnesota.

Similar to its 2006 best practices grant workshop structure, Minnesota Recreation and Park Association held the first regional workshop in conjunction with its Annual Conference as a way to increase exposure for the project. The MRPA Annual Conference is the Association's largest gathering of parks and recreation professionals annually. There were 264 individual registered for the conference. The conference was held September 22 – 25, 2009 at the National Sports Center in Blaine, Minnesota. The speakers associated with the regional workshop focused on native prairie impacts and nature: Jeff Corney and Yusuf Burgess.

The pre-conference institute centered on native prairie impacts and research. Sixty-four individuals registered for the Institute; however, only 15 attended the seminar. Attendees were transported via bus from the National Sports Center to Cedar Creek Ecosystem Science Reserve in East Bethel, Minnesota. Cedar Creek Associate Director Jeff Corney was the guest presenter. Session content included biodiversity and its impacts on prairie ecosystems, bioenergy, climate, productivity and resistance to drought, disease, and pests. Participants then toured prairie sites, including the first demonstration area planting associated with this grant project. The second speaker, Yusuf Burgess, was the overall conference's closing keynote speaker. Approximately 175 individuals attended this presentation. Session content included the benefits of reconnecting children with the native environment and nature. He provided practical examples of how parks and recreation agencies can provide ways for youth to reconnect with the native environment, and teach them the value of the native prairies, lands, and waterways. Burgess serves as the current chairperson of the Environmental Awareness Network for Diversity in Conservation (EANDC). He is a former environmental educator for the New York State Department of Environmental Conservation, and a national board member for the Children and Nature Network.

The second regional workshop was held November 19, 2009 in Hutchinson. The workshop was hosted by Hutchinson Parks and Recreation. There were 26 individuals in attendance.

This regional workshop was designed to gather together a cross-section of professionals to discuss strategies and solutions for best practices in native prairie management. The panel speakers focused on the topic of native prairie management from numerous perspectives, including engineering, wildlife, natural resources, park resources, and water resources.

Due to many agencies' reduced travel budgets, Minnesota Recreation and Park Association held the grant project's third regional workshop in conjunction with its

Annual Conference – an event professionals from throughout Minnesota attend. The MRPA Annual Conference is the Association's largest gathering of parks and recreation professionals annually. The event was held April 14-15 in Prior Lake, Minnesota, located within Scott County. There were 160 individuals registered for the conference. However, only 15 participants attended the seminar focused on native prairies - the Prairie and Wetland Restoration Institute. Guest presenters included: Chris Dill, Recreation Supervisor, City of Savage, and the Mdewakanton Community.

Institute attendees were transported via bus from the conference site to prairie sites throughout the cities of Prior Lake and Savage. One educational area included the City of Savage's LEED-certified McColl Pond Environmental Learning Center (ELC). Institute participants gained information regarding how the prairie and native tree plantings were protected or restored around the building to provide natural habitats for native plants and animals. Additionally, the site's historical value was described. Development of the McColl Pond ELC began in the summer of 1997. Native prairie and wildflower seeds were carefully chosen to recreate what this site looked like prior to European settlement. Around this time, the Mdewakanton Dakota people settled in much of Scott County, hunting and gathering food in and around McColl Pond. The prairie planted here gives visitors a glimpse of one of the three major biomes that meet in Minnesota.

Another educational area was the Mdewakanton Community's campus throughout Scott County. The campus allowed for Institute participants to learn about the agricultural development that has been the one of the largest source of local habitat removal – how over the past 150 years, nearly 70-percent of upland forest and prairie in the area have been removed for agriculture. This removal has resulted in the loss of native plants and animals in the area. The Mdewakanton Community has focused on restoring these prairies to their original native habitat. The Mdewakanton Community has also converted more than 600 acres of former agricultural land to native prairie and wetland using plants like sage, sweet grass, reeds, wild rice, arrowhead, and others. This regional workshop incurred no expenses. Guest presenters provided additional in-kind services.

The second and third workshops' host agencies and speakers provided in-kind services to provide for substantial savings. Thus, the costs for these two workshops were minimal. The agency and speaker in-kind support is the reason the regional workshop result has a substantial balance remaining.

V. TOTAL TRUST FUND PROJECT BUDGET:

Staff or Contract Services: $4,207.90
Restoration: $29,656.01 (one metro and one out-state area)
Other: $0

TOTAL TRUST FUND PROJECT BUDGET: $ 45,000 appropriated; $33,863.91 spent; 11,136.09 remaining

Explanation of Capital Expenditures Greater Than $3,500:

VI. OTHER FUNDS & PARTNERS:

A. Project Partners: MRPA received the total grant funding dollars to manage the project. Project partners include Minnesota Recreation and Park Association, University of Minnesota's Cedar Creek Ecosystem Science Reserve, Anoka County Parks, Hutchinson Parks and Recreation, City of Savage, Scott County, and the Mdewakanton Community. These partners shared their staff's time and knowledge to further the project's outcomes. Partners may also provide inkind services for project development.

B. Other Funds Proposed to be Spent during the Project Period:

- Local Agencies ($8,000): in-kind staff for planning and field demonstrations; meeting facility donation; and equipment usage and demonstrations
- University of Minnesota's Cedar Creek Ecosystem Science Reserve ($1,600): labor and material

C. Past Spending: No funds will be spent prior to the timeframe for this specific project. However, the project will build upon the $200,000 grant funds received for the 2005 Best Management Practices for Parks and Outdoor Recreation project.

D. Time: July 1, 2008 through June 30, 2010

VII. DISSEMINATION:

- Convene two demonstration projects to reach 200 to 300 participants
- Conduct at least three regional workshops to reach 225 participants
- Present information at additional Minnesota Recreation and Park Association educational trainings to reach 250 participants

VIII. REPORTING REQUIREMENTS:

Periodic work program progress reports will be submitted not later than December 2008, June 2009, and December 2009. A final work program report and associated products will be submitted between June 30 and August 1, 2009 or 2010 as requested by the LCCMR

IX. RESEARCH PROJECTS:

J:\SHARE\WORKFILE\ML2008\Work Program Information\2008WPTemplateblank.doc

Reimbursement Request – Invoice Summary Spreadsheet - Part 2

Instructions:

1. **Enter your budget from your current approved work program (Attachment A)**
2. **Update the beginning balances with the ending balance from your previous Invoice Summary Spreadsheet.**
3. **Insert the amounts of your current invoice by category and provide the total.**
4. **Calculate the ending balances for this reimbursement request.**
5. **Attach copies of invoices, checks and time cards.**
6. **Fill out and submit the Reimbursement Request Form**
7. **Send completed documentation to the authorized state contract person.**

Project Title: Best Practices for Native Prairie Management

Legal Citation: Laws of Minnesota 2009, Chapter 367, Section 2, Subdivision 3 (0).

Period Covered by Reimbursement Request: Final Attachment A
Request # Final Report

Budget for Results from Work Program

Budget Item	Result 1: (Best Practice Native Prairie Demonstrations) Budget	Beginning Balance	Current Invoice	Ending Balance	Result 2: (Regional Workshops) Budget	Beginning Balance	Current Invoice	Ending Balance	Result 3: (Insert Title of Result) Budget	Beginning Balance	Current Invoice	Ending Balance	Project Total Budget	Beginning Balance	Current Invoice	Ending Balance
Use information from Attachment A from Work Program	$30,000.00	$29,656.01	$0.00	$343.99	$15,000.00	$4,207.90	$0.00	$10,792.10								
Contracts																
Professional / Technical • Professional Technical Contracts (Field Experts)	$0.00															
Other Contracts • Speaker Fees • Accounting Personnel • Bus Transportation • Participant Meals (offset by participant registration fees)					$12,000.00	$4,207.90	$0.00	$7,792.10								
Other Direct Operating Costs • Seed, Plants, Restoration Materials	$30,000.00	$29,656.01		$343.99												
Printing	$0.00				$1,000.00			$1,000.00								
Other Supplies • Demonstration and Workshop Supplies	$0.00				$1,000.00			$1,000.00								
Travel Expenses in Minnesota	$0.00				$1,000.00			$1,000.00								
Other																
Column Total	$30,000.00	$29,656.01	$0.00	$343.99	$15,000.00	$4,207.90	$0.00	$10,792.10								

2008 Project Abstract
For the Period Ending June 30, 2011

PROJECT TITLE: Climate change, CO_2, and prairie/forest production
PROJECT MANAGER: Peter Reich
AFFILIATION: University of Minnesota
MAILING ADDRESS: 1530 Cleveland Avenue North
CITY/STATE/ZIP: St. Paul, MN 55108
PHONE: 612-624-4270
E-MAIL: preich@umn.edu
WEBSITE: http://forestecology.cfans.umn.edu/index.html
FUNDING SOURCE: Environment and Natural Resources Trust Fund
LEGAL CITATION: ML 2008, Chap. 367, Sec. 2, Subd. 3(p)

APPROPRIATION AMOUNT: $330,000

Overall Project Outcome and Results

Funds from ENRTF were used to help establish, maintain, and expand studies regarding impacts of elevated carbon dioxide and changing climate on productivity (i.e. carbon acquisition) and carbon sequestration of woody and herbaceous vegetation. Two new state-of-the-art open air experiments were begun. A new biofuel-oriented experiment was installed in 72 elevated CO2 plots within the ongoing BioCON (Biodiversity, CO2, and Nitrogen) experiment – an effort started in 1997 that is examining how plant communities respond to environmental changes in biodiversity, CO2, and Nitrogen; these plots were planted with potentially "high-yielding" woody and herbaceous perennials. A Boreal Forest Warming experiment in Cloquet and Ely was installed, planted and warming treatments implemented in 2009 and 2010. ENTRF funds were also used to support specific carbon cycling measures in the original, ongoing BioCON experiment. The following findings were documented:

1. In all studies, results showed that acquisition of new carbon is likely in a world with higher CO2 levels and/or with modest warming, but is significantly dampened during periods of low water availability or when soil nutrients are limiting.
2. Long-term sequestration in soil of acquired carbon is likely modest due to the rapid return (through respiration of roots and decomposers) of new carbon to the atmosphere.
3. Soil carbon storage is likely dependent upon soil characteristics however, with sandy soils in our experiments less able to build up carbon stores than finer-textured soils might be.
4. Results suggest considerable potential to grow biomass carbon that could potentially contribute to biofuel offsetting of fossil fuel use and to carbon sequestration in live biomass, dead biomass, and potentially in soils.

Project Results Use and Dissemination

Several publications are in preparation. These include experiment-specific papers (about individual experiments), cross-experiment papers for several related experiments at the Cedar Creek station, and meta-analyses and synthesis papers for which data from this ENRTF project have been combined with similar data from other experiments in North America, Europe, and Asia.

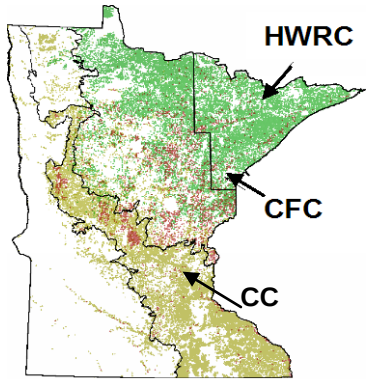
Environment and Natural Resources Trust Fund 2008 Work Program
Final Report

Date of Report: August 15, 2011
Final Report
Date of Work program Approval: June 10, 2008
Project Completion Date: June 30, 2011

I. PROJECT TITLE: Climate change, CO2, and prairie/forest production

Project Manager: Peter Reich
Affiliation: University of Minnesota
Mailing Address: 1530 Cleveland Avenue North
City / State / Zip: St. Paul, MN 55108
Telephone Number: 612-624-4270
E-mail Address: preich@umn.edu
FAX Number: 612-625-5212
Web Page address: http://www.forestry.umn.edu/people/facstaff/reich/

Location: Isanti, Carlton, St. Louis counties



HWRC: Hubachek Wilderness Research Center
CFC: Cloquet Forestry Center
CC: Cedar Creek Ecosystem Science Reserve

Total Trust Fund Project Budget:	**Trust Fund Appropriation:**	**$ 330,000**
	Minus Amount Spent:	**$ 333,000**
	Equal Balance:	**$ 0**

Legal Citation: ML 2008, Chap. 367, Sec. 2, Subd. 3(p)

Appropriation Language:
$330,000 is from the trust fund to the Board of Regents of the University of Minnesota to accelerate research simulating future changing CO2, rainfall, and temperature level impacts on biomass production, carbon sequestration, and water quality in prairie and tree species. This appropriation is available until June 30, 2011, at which time the project must be completed and final products delivered, unless an earlier date is specified in the work program.

Amendment approved by LCCMR staff on April 7, 2011.

II. and III. FINAL PROJECT SUMMARY

Overall Project Outcome and Results

Funds from ENRTF were used to help establish, maintain, and expand studies regarding impacts of elevated carbon dioxide and changing climate on productivity (i.e. carbon acquisition) and carbon sequestration of woody and herbaceous vegetation. Two new state-of-the-art open air experiments were begun. A new biofuel-oriented experiment was installed in 72 elevated CO2 plots within the ongoing BioCON (Biodiversity, CO2, and Nitrogen) experiment – an effort started in 1997 that is examining how plant communities respond to environmental changes in biodiversity, CO2, and Nitrogen; these plots were planted with potentially "high-yielding" woody and herbaceous perennials. A Boreal Forest Warming experiment in Cloquet and Ely was installed, planted and warming treatments implemented in 2009 and 2010. ENTRF funds were also used to support specific carbon cycling measures in the original, ongoing BioCON experiment. The following findings were documented:

1. In all studies, results showed that acquisition of new carbon is likely in a world with higher CO2 levels and/or with modest warming, but is significantly dampened during periods of low water availability or when soil nutrients are limiting.
2. Long-term sequestration in soil of acquired carbon is likely modest due to the rapid return (through respiration of roots and decomposers) of new carbon to the atmosphere.
3. Soil carbon storage is likely dependent upon soil characteristics however, with sandy soils in our experiments less able to build up carbon stores than finer-textured soils might be.
4. Results suggest considerable potential to grow biomass carbon that could potentially contribute to biofuel offsetting of fossil fuel use and to carbon sequestration in live biomass, dead biomass, and potentially in soils.

Project Results Use and Dissemination

Several publications are in preparation. These include experiment-specific papers (about individual experiments), cross-experiment papers for several related experiments at the Cedar Creek station, and meta-analyses and synthesis papers for which data from this ENRTF project have been combined with similar data from other experiments in North America, Europe, and Asia.

IV. OUTLINE OF PROJECT RESULTS*:*

Result 1: On the Ground Field Experiments

Completion of on the ground experiment installation for new 72 plots within the existing BioCON experimental facility at Cedar Creek Ecosystem Science Center (described as Part 1 in the Research Addendum below). Root and soil carbon sampling completed for Parts 1 and 2, which include samples from several experiments

Climate change, CO_2, and prairie/forest production

Description: 72 new plots selected, laid out, seeds and plants installed, initial plant measures made. Soil cores and root samples taken for baseline chemical analysis

Summary Budget Information for Result 1: **Trust Fund Budget: $ 40,000**
Revised Budget: $ 38,885
Amount Spent: $ 38,885
Balance: $ 0

Deliverable	Completion Date	Budget	Status
1. Completion of on the ground experiment installation	Dec 2008	$35,708	completed
2. Initial baseline root and soil carbon sampling completed	Dec 2008	$2,082	completed
3. Travel in State to install Warming Experiment	Approved 4-11-2011	$407	Completed
3. Field Equipment repairs to CO2 delivery system	Approved 4-11-2011	$689	Completed

Completion Date: June 2009

Final Report Summary:
Both the potential prairie- and woody-biofuel plots were successfully established. Early mortality was high for the trees though, and these needed to be replanted in 2010. Plants and plots are continuing to be treated experimentally and monitored for biological response after the end date of the LCCMR project.

Result 2: Sampling and Data Set Compilation - Phase 1
2009 treatments applied, and data and samples collected (described in Parts 1 and 2 of Research Addendum). This will maintain experimental treatments in the BioCON experiment, provide information on treatment effects on vegetation growth and composition in the new plots in that experiment, and prepare and archive biomass samples for future chemical analyses.

Description: Plot maintenance, treatments applied, above ground plant growth and composition measured and above ground biomass sampled, weighed and prepared for chemical analysis. Soil CO2 flux measurements taken.

Summary Budget Information for Result 2: **Trust Fund Budget: $ 90,000**
Revised Budget: $ 90,280
Amount Spent: $ 90,280
Balance: $ 0

Climate change, CO_2, and prairie/forest production

Deliverable	Completion Date	Budget	Status
1. 2009 year composition**,** biomass and growth data sets compiled	Dec. 2009	$62,200	completed
2. Biomass samples stored and prepped for analysis	March 2010	$8,500	completed
3. CO2 applied to plots	Dec 2009	$ 19,580	completed

Completion Date: March 2010

Final Report Summary:
Results 2 were carried out successfully as described in detail in prior "Results Status" reports. All treatments were applied as planned, and samples collected.

Result 3: Sampling and Data Set Compilation - Phase 2
2010 treatments applied, and data and samples collected (described in Parts 1 and 2 of Research Addendum). This will maintain experimental treatments in the BioCON experiment, provide information on treatment effects on vegetation growth and composition in the new plots in that experiment, and prepare and archive biomass and soil samples for future chemical analyses.

Description: Plot maintenance, treatments applied, above ground plant growth and composition measured and above ground biomass sampled, weighed and prepared for chemical analysis. Roots and soils sampled. Soil CO2 flux measurements taken.

Summary Budget Information for Result 3: **Trust Fund Budget: $ 115,000**
Revised Budget: $ 115,835
Amount Spent: $ 115,835
Balance: $ 0

Please note minor adjustment in budget: April 7th 2011 amendment request approved shifting $835 in salaries from Results 1 to Results 4, however, synthesis and compilation of soils, plant composition, biomass and growth data sets from BioCON and B4WARM required additional effort during this result in preparation for final analysis is Results 4.

Deliverable	Completion Date	Budget	Status
1. 2010 year composition**,** biomass and growth data sets compiled	Dec 2010	$61,235	completed
2. Root and soil carbon sampling	Dec 2010	$25,000	completed
3. All years biomass samples collected & prepped for analysis	March 2011	$ 8,500	completed
4. CO2 applied to plots	Dec 2010	$21,100	CO2 applied, Maintaining equip

Completion Date: March 2011

Final Report Summary:
Results 3 were carried out successfully as described in detail in prior “Results Status” reports. All treatments were applied as planned, and samples collected.

Result 4 Complete Lab Analyses and Data Synthesis
This will provide data on total stocks of carbon in plants and soils

Description: Chemical analysis of all years samples, all data sets synthesized and analyzed for final report. Chemical analyses anticipated to be done in the laboratory of a colleague at the University of Nebraska; total number of samples

Both the woody plants and prairie grasses showed greater production under elevated carbon dioxide. For the prairie plots we see (Figure a.) that aboveground biomass was increased by both nitrogen addition and CO2 enrichment, with biomass 31% greater under high levels of both factors, compared with ambient plots. This is mirrored by data showing similar increases in soil CO2 flux (loss of carbon back to the atmosphere) due to the metabolic activity of plant roots and soil organisms, primarily microbes. These data suggest considerable potential to increase biofuel production in a rising CO2 world, especially if soil amendments are also made.

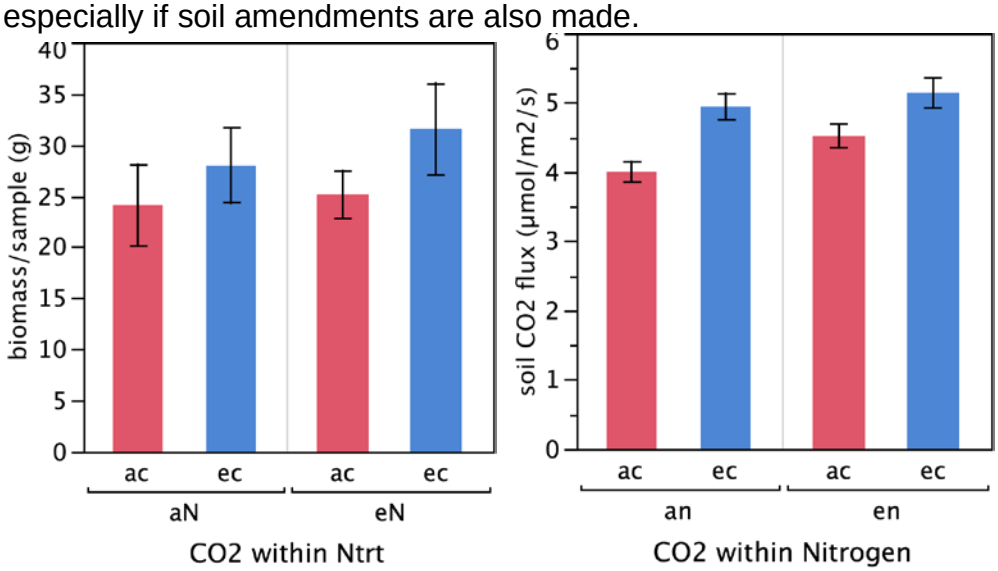


Figure a. Biomass per sample, summer 2010 of the planted prairie biofuel plots at all combinations of ambient nitrogen (aN), enriched nitrogen (eN), ambient CO2 (ac), and elevted CO2 (ec). Biomass was 31% higher at enriched levels of both N and CO2 than ambient control plots, and mean soil carbon dioxide flux was 29% higher at enriched levels of both N and CO2 than ambient control plots.

In the BioCON experiment, we found that the water-savings effects of elevated CO2 (via reduced stomatal conductance) contribute very little to the elevated CO2 stimulation of soil CO2 flux, hence these two can be considered as largely separate. This is consistent with findings that the water-savings effects of elevated CO2 do not ameliorate low rainfall inputs and result in a proportionally larger CO2 effect on biomass under dry conditions. On the contrary, and consistent with multiple-limitation theory, plant biomass was markedly enhanced by elevated [CO2] except when availability of both N and water was low (Figure b.). When examined as individual main effects (averaged across all levels of other treatment factors), higher levels of [CO2], N, and rainfall all increased biomass (by 25%, 14%, and 12%, respectively, the first two significant, $P<0.05$). However, there was a significant three-way interaction between [CO2], water, and N ($P=0.03$, Fig. b). Under higher availability of either water or N, or both, the elevated [CO2] treatment increased biomass by at least 27% (Fig. b). In contrast, under the reduced rainfall and ambient N treatment (Fig. b), biomass was not increased by elevated [CO2]. Thus, our study shows that under sub-optimal levels of two other

resources, the potential biomass (i.e. carbon) accumulation in response to elevated [CO2] was negligible, whereas under higher soil resource supply, it was strongly positive. Consequently, our study suggests caution is necessary in extrapolating strong [CO2] fertilization effects in a world with widespread soil nutrient and water limitation. It also suggests that biofuel production will be maximized in a high-CO2 world when other needed plant resources are abundant or made available.

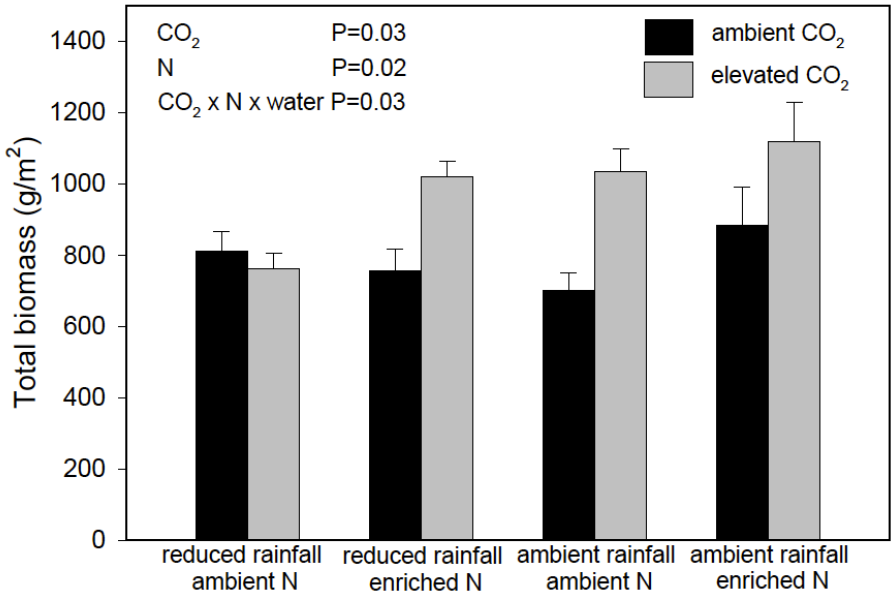


Figure b. Total biomass (aboveground and belowground, 0-20 cm; mean ± one SE of the mean) at all combinations of reduced and ambient rainfall, ambient and enriched N, and ambient and elevated [CO2]. Statistically significant main effects and interactions are shown inset in the figure.

Similar to the results of grassland vegetation, global change (in this case warming) of forest plots, increased carbon uptake but also increased carbon flux back to the atmosphere, commensurately (to the level the data can address this). Also, consistent with results of the BioCON experiment (biomass carbon acquisition data described above), shortfalls of soil moisture limited metabolic carbon flux processes, both belowground (Figure c) and aboveground (figure d). When soil moisture was plentiful, plants in the warmed treatment had

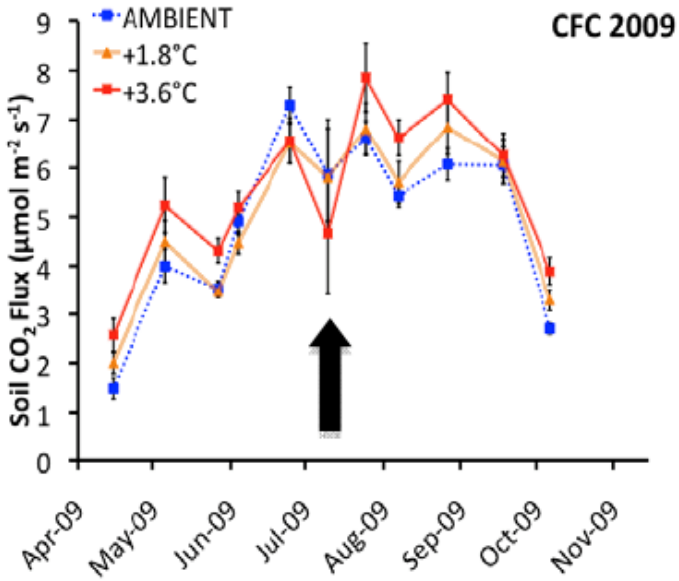


Figure c. Soil CO2 flux measured at Cloquet in 2009. During drought (indicated by arrow), the enhanced CO2 flux in the +3.6 °C treatment was reversed. Similar effects occurred in 2010 (not shown).

heightened photosynthetic carbon gain, but during dry periods, warmer temperatures themselves led to additional soil water loss, which limited photosynthesis considerably (fig d). Similarly, metabolic activity belowground (i.e. roots and soil microbes) and associated carbon flux, was reduced by warming during dry periods when warming exacerbated soil drought (arrow in fig c), but was increased by warming otherwise.

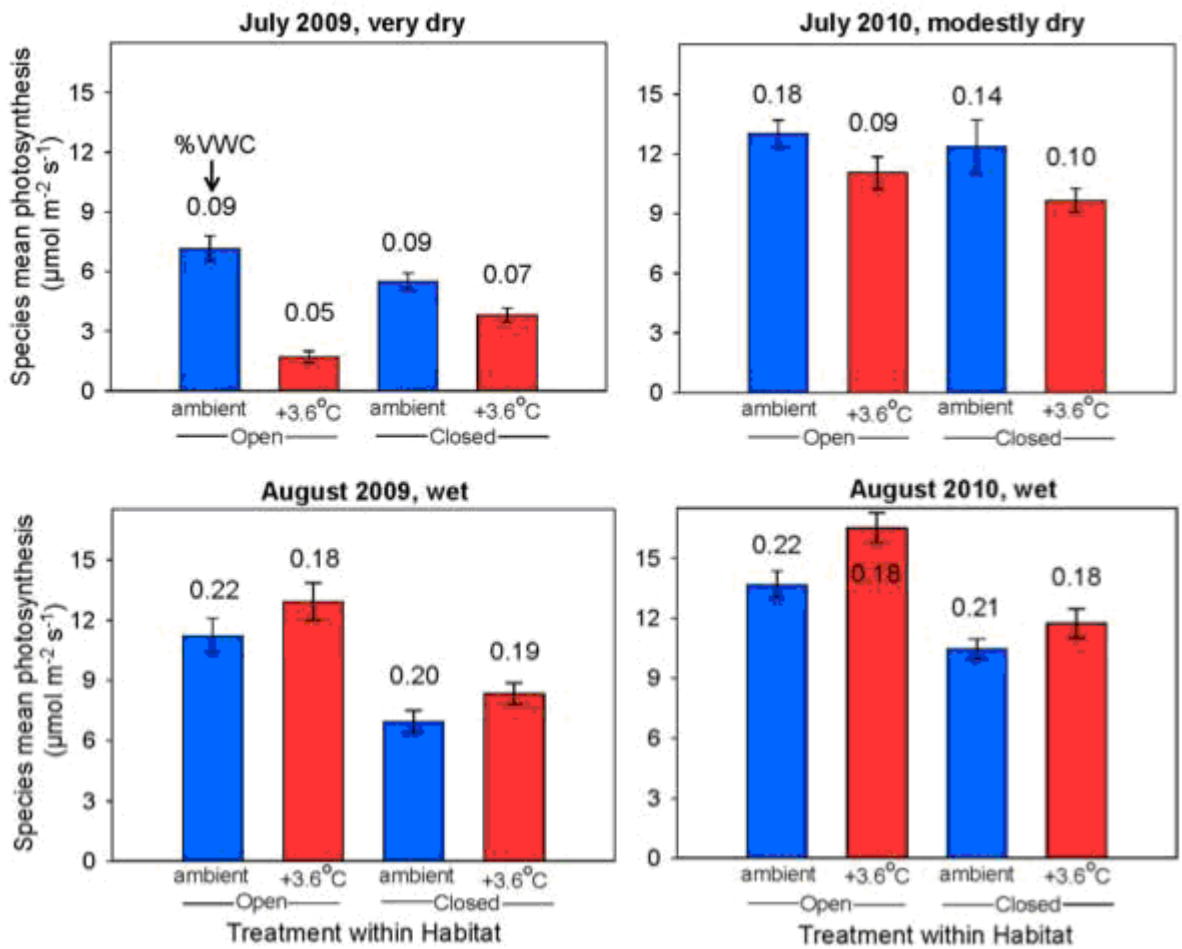


Figure d. An example of how light-saturated photosynthetic carbon acquisition varies with soil moisture (VWC; %volumetric water content). Data are averages for all species measured in each time period at Cloquet. Similar results found in other years at both sites.

Results such as described above emphasize the complexity of plant and ecosystem response to global change factors, and the influence of weather and climate on those responses. The joint impact of rising CO2 and rising temperatures may well lead to increased carbon acquisition in Minnesota grasslands and forests, including those grown for biofuels, but this will be dependent upon whether rainfall amounts or frequency decreases.

Climate change, CO_2, and prairie/forest production

V. TOTAL TRUST FUND PROJECT BUDGET: $330,000

Staff or Contract Services: $275,000

This includes $55,000 for undergraduate assistants, $26,000 for professor (partial funding, summers only), $75,000 for postdoctoral research associates, and $119,000 for technicians. All numbers include both salary and fringe benefits

Equipment: 0

Other (CO2, chemical analysis, field supplies, travel): $ 55,000

This includes $23,000 for carbon dioxide, $19,000 for chemical analyses, and $13,000 for miscellaneous supplies and travel.

VI. OTHER FUNDS & PARTNERS:

A. Project Partners: John Bradford from the USDA Forest Service (but will not receive any funds from this appropriation), also David Tilman, Clarence Lehman, Rebecca Montgomery, Roy Rich and Jared Trost from the University of Minnesota (but will not receive any funds from this appropriation)

B. Other Funds Proposed to be spent during the Project Period: no technical matching support but there are several externally supported projects with funds that will be spent on related research (approximately $850,000 during the LCCMR project period).

C. Past Spending: no funding from LCCMR, but LCMR/LCCMR funds have supported work (Tilman, Lehman) on related themes at Cedar Creek

D. Time: none

VII. DISSEMINATION: via forest ecology web site, to be published later

VIII. REPORTING REQUIREMENTS:

Periodic work program progress reports will be submitted not later than March 2009, October 2009, March 2010, October 2010 and March 2011. A final work program report and associated products will be submitted between June 30 and August 1, 2011.

IX. RESEARCH PROJECTS:

Research Addendum, May 2008

Project Manager: Peter B. Reich

Climate change and CO2 affect prairie/forest production

Project number: 07-059-000

Submitted by:

Peter Reich

Collaborators

David Tilman
Clarence Lehman
Rebecca Montgomery
Roy Rich
Jared Trost

University of Minnesota

And

John Bradford

U.S. Forest Service, Northern Research Station

I. Abstract

Biofuels will likely be an important part of Minnesota's energy future by providing alternative, renewable energy to lessen our dependence on fossil fuels and simultaneously reduce our carbon emissions. Perennial biofuels can be an important, and perhaps dominant, part of the overall biofuel mix in the state. However, much uncertainty surrounds the growth potential and carbon sequestration potential of different perennial biofuels, especially with respect to anticipated changes in climate and atmospheric chemistry in the present century. The best scientific evidence indicates that by 2040-2060 temperature, rainfall, and atmospheric CO2 levels in Minnesota will differ markedly from those in 1985-2005. These future changes will influence the state's vegetation, including any future biofuel stands. Most relevant to this proposal, future changes in temperature, rainfall and CO2 levels will influence potential biofuel yields, and carbon stored in plants and soils in grassland and woodland communities.

At present, our predictions regarding how grassland and woodland plants will respond to future climate and atmospheric CO2 levels are uncertain and in part educated guesswork, as we have little direct evidence upon which to make such predictions. In this project we leverage several large, complex, field experiments that directly test the impacts of climate and CO2 on grassland and forest species. These experiments use novel approaches that allow manipulative experiments for plants growing in the open in otherwise natural field conditions. For example, to simulate future CO2 levels we experimentally raise CO2 concentrations in the air surrounding the experiments to CO2 levels expected in the future. Simulating future CO2 concentrations is done with vertical pipes that surround clusters of

Climate change, CO_2, and prairie/forest production

At present, the vast majority of biofuel energy in Minnesota and the U.S. is derived from corn-based ethanol. However, several issues could limit the utility and/or expansion of this route to future renewable energy production and reduced greenhouse gas emissions; these point to biofuel from renewable perennials as a possible alternative or complementary strategy. First, although corn ethanol is currently thought to reduce greenhouse gas contributions over its life-cycle by less than 20% compared with motor gasoline (Hill et al. 2006, Wang et al. 2007), even that effect may be illusory, as N_2O flux from fertilized biofuel crops may contribute more to climate warming than any possible saved carbon emissions from fossil fuel displacement (Crutzen et al. 2007). In addition, the land required for corn ethanol production to play a meaningful role would be very large, and would compete with the land needed to raise corn and other foodstocks (Hill et al. 2006). In contrast, greenhouse gas reductions from power produced by biomass (in cogeneration facilities) and/or cellulosic ethanol from perennial plants could be significant, and without competing for quality farmland (Tilman et al. 2006, Groode & Heywood 2007). The technology to produce cellulosic ethanol on a large scale is not currently available, but represents an active area in applied research and development.

Despite the potential for biofuels from perennial plants, many barriers exist and many important questions remain to be answered before their utility can be clearly understood. These include several questions involving growth and carbon storage, the focus of this proposed research. For instance, in addition to contributing to reduced carbon emissions as potentially renewable biofuel, prairie and woody vegetation can also contribute by carbon sequestration potential, in aboveground and belowground biomass, and in soil carbon storage. Research in these areas is still relatively scarce, and given widely disparate results for studies relevant to Minnesota (Fissore, Espeleta, Nater, Hobbie, Reich, and Beduhn; unpublished data), it is difficult at present to be confident regarding which provides the most on-site carbon storage. In addition, how biomass production by grassland and woody species will be influenced by changing environmental conditions is highly uncertain (Norby and Luo 2004, Reich et al. 2006ab), but important, as changes in atmospheric CO2, N, and climate could cause shifts in biomass production as large as 50 to 100% in some cases. In the next several paragraphs, some of these issues relevant to the proposed research are highlighted.

By mid-century, Minnesota and most of the globe is likely to experience higher levels of atmospheric CO2, warmer temperatures, and altered precipitation amounts and timing (IPCC 2007). The first of these changes is virtually certain, as CO2 is destined to rise for 50 years or more, even if we stop increasing our carbon emissions today. The second of these changes (rising temperatures) is considered extremely likely by the IPCC (2007). The third change (altered precipitation regimes) is considered likely, although predictions of whether a specific region will have increased or decreased precipitation remain uncertain. Although the general mechanisms by which CO2, ambient temperature, and precipitation influence grassland and woody vegetation are widely recognized, the realized impact of changes in each of these are highly dependent upon (a) the innate physiology of the individual plant species in question, (b) the characteristics of the plant community, which for instance depend in part on the mix of plant species, and (c) the mix of other environmental factors that can influence responses to CO2, temperature or precipitation. These other factors include possible interactions among the three environmental factors listed above, but in addition, include possible interactions with soil conditions, nutrient supply, or others. The uncertainties are critical to our collective scientific capacity to predict future atmospheric concentrations of greenhouse gases and future climate—uncertainties regarding the CO2 fertilization effect (i.e. enhancement of crop, forest and grassland productivity) and its impact on atmospheric CO2 levels represent a large, if not the single largest, uncertainty in our capacity to predict future global carbon cycling (IPCC 2007).

For good reasons then, currently there are no published estimates of how Minnesota's potential perennial biofuel species will respond to changes in CO2, temperature or precipitation. Although our proposed project cannot hope to fully answer these questions, we believe it will begin to provide important and meaningful information, and do so in an economically efficient way by building our LCCMR project onto expensive ongoing field experiments that manipulate CO2, temperature and precipitation. Such experiments are scarce because they require substantial funding, experimental infrastructure, and long-term planning and programming. As an example of the rarity of these studies we plan to "piggy-back" on, there are only four long-term free-air CO2 experiments that manipulate perennial vegetation in North America, only one of these (ours) has manipulated nitrogen supply as well as CO2, and only one of these (ours) includes a variety of species types and mixtures as part of the experimental design. Our grassland rainfall manipulation and warming studies and our forest warming study are also rare (see description of Part 2 below).

Given that carbon is a necessary plant nutrient, plants should increase growth with rising CO2 levels. In fact, synthetic analyses of all open-air studies show that elevated CO2 generally does increase plant biomass production, with a noted range from -42% to +89% for individual outdoor studies without chambers (Ainsworth and Long 2005) and with average enhancements (from several reviews) of aboveground biomass of grassland and woody plants ranging from +20 to +38% depending on the study (e.g., Curtis and Wang 1998, Wand et al. 1999, Ainsworth and Long 2005). In our BioCON experiment, plots experiencing elevated CO2 coupled with modest nitrogen fertilization have had 40% greater biomass than control plots over a nine-year period (Reich et al. 2006a, Reich, unpublished data). This raises the question of what might be the maximum productivity of specifically constructed communities under elevated CO2, with and without modest nitrogen fertilization.

Given this impressive "fertilization" impact of elevated CO2, the potential for continued enhancement of biomass in agricultural, forestry and natural communities has been long considered by some to be a positive effect overall of rising carbon emissions, and one that potentially can help slow down the rise of CO2 in the atmosphere. However the achieved increase in biomass due to elevated CO2 is not uniformly high and is dependent upon (a) nitrogen availability, with plots under elevated nitrogen supply more responsive to elevated CO2 (Reich et al 2006ab), (b) the species or functional diversity of the plant community, with more diverse plots more responsive to elevated CO2 (Reich et al. 2001a, 2004), and (c) the degree of water limitation, with modestly water limited ecosystems more responsive to elevated CO2 than either wet or dry ones (Reich et al. 2006b). Responses to rising temperatures will also be difficult to predict. Higher temperatures can directly increase growth rates during cooler times of the growing season (and extend the growing season as well) but directly decrease growth rates if hot spells become excessive or prolonged. Additionally, if precipitation is unaltered, higher temperatures alone will lead to greater soil water deficits. Moreover, in aggregate, changes in temperature and soil moisture will alter soil nutrient availability in ways difficult to predict. Thus, responses to warming will vary among sites and species depending on the relative degree of limitation by low vs. high temperature and on the specific precipitation and growing season temperatures of a given year or site. Our proposed project will address the issues raised in this and earlier paragraphs in several ways.

First, we propose to add 72 plots to an existing open-air elevated CO2 project (Part 1). Half of the plots will be used for grassland species and the other half for woody plants. In each case we will select plant materials (see below) designed to maximize biomass production. These plots, in conjunction with our existing mixtures and monocultures, will give us a data set useful

in evaluating the relative range of biomass responses to future CO2 levels and how much these can be boosted by modest nitrogen inputs. The new plots will also provide some idea of the maximum productivity we might expect under future CO2 levels from carefully designed perennial systems. Our plots are imperfect for woody plants, which would be better served by larger plots and longer-term CO2 experiments (beyond the financial scope of the LCCMR program). Nonetheless, we believe that some information on responses of very young trees is still much better than having no information whatsoever.

Second, we propose to make specific measurements and analyses in several existing experiments that will provide us with meaningful information relevant to carbon sequestration responses (Part 2). These will be made using expensive experiments established (with non-LCCMR funds) for related, but distinct ecological purposes (see below). The additional measurements we propose to make include assessments of total carbon stocks in roots and in soils to 1-meter depth, as well as measures of the flux of CO2 from the soil to the atmosphere. These measurements will provide an indication of whether root and soil carbon storage is likely to increase, or decrease, and by what magnitude, following experimental warming, precipitation alteration, or elevated CO2. The additional analyses would logically include analyses of the new data, but would also include analyses focused on implications of the experimental data from the existing experiments from an energy (i.e., biofuel) perspective.

Hypotheses

Hypothesis 1 (relevant to Part 1). Fast-growing woody plants will have the largest biomass and carbon storage, followed in rank order by our “designed prairie mixtures” and by our existing randomly assembled prairie mixtures and monocultures. The woody plants will additionally have the largest responses to elevated CO2 and nitrogen availability, in all combinations. Response to elevated CO2 will depend upon level of nitrogen availability as well (with greater response to CO2 predicted with modest nitrogen fertilization than without). These hypothesized responses, if supported by the evidence, would indicate a good potential for perennial prairie mixes or woody plants to sustainably produce high biomass under future conditions with modest or no inputs.

Hypothesis 2 (relevant to Part 2). We hypothesize that treatments that limit root and soil microbial activity will enhance root and soil carbon storage and conversely those that enhance root and soil microbial activity will reduce roots and soil carbon storage. This hypothesis is uncertain and is offered as a working hypothesis, rather than a prediction. The rationale for this hypothesis is that the balance between changes in new carbon inputs (biomass production) and carbon losses (via plant respiration and decomposition processes) will be the main driver of whether a given stand is a sink or source of carbon belowground. Moreover, this hypothesis is based on the notion that belowground processes largely determine belowground carbon storage—witness high amounts of carbon belowground in systems with slow decomposition rates (peatlands, Great Plains grasslands). Thus, we hypothesize that warming will stimulate root and soil microbial activity (except during drought) and increase carbon losses; whereas precipitation removal will suppress root and soil microbial activity (due to dry soils) and enhance belowground carbon storage; and elevated CO2 will have complex effects by dint of changes in the chemistry and amount of carbon allocated belowground (Adair et al, submitted).

III. Description of methodology

Our approach is explicitly “value-added” by “piggy-backing” the planned studies on existing projects. Part 1 involves a set of new plots in a single experiment and a variety of related activities. Part 2 involves a set of belowground measurements in a variety of plots (including

those in Part 1) and analyses focused on implications of the experimental data from the existing experiments from an energy (i.e., biofuel) perspective.

Part 1. 72 New plots: potential biofuels under elevated carbon dioxide.

The Biodiversity x CO2 x Nitrogen (BioCON) Experiment. For the new plots in Part 1, we will use the BioCON experiment at the University of Minnesota's Cedar Creek Long-Term Ecological Research site. *CO2*. Six circular areas (24 m dia.) were randomly assigned, three each to ambient and elevated CO2 (560 ppm, early spring to late fall), which is delivered using free-air CO2 enrichment (FACE) technology (Hendrey *et al*. 1993). Within the central 20 m diameter-zone in each ring, we established 61-63 square (2m x 2m) plots, totaling 371 in all, which are used in a set of complementary ongoing CO2 x nitrogen x richness or composition experiments (e.g., Craine et al. 2001ab, 2004; Reich et al. 2001ab, 2004, 2006; Dijkstra et al. 2005, 2007; Chung et al. 2007).

There are also an additional 72 plots (1.5 x 2 m), 12 per ring, that were used in a complementary study of CO2 effects on oak establishment in secondary successional grasslands (Davis et al. 2007). The new plots to be established in Part 1 of this project will be located in those same 72 plots, as the prior experiment has been completed. The new experiment will be a 2 x 2 x 2 factorial with nine replicates, consisting of two vegetation types (woody vs. grassland), two levels of CO2 and two levels of nitrogen fertilization (none and +4 g N m^{-2} yr^{-1} ammonium nitrate (NH_4NO_3). The nitrogen fertilizer will be delivered in equal fractions in early May, June and July, with a ^{15}N label that gives the nitrogen a unique positive signature. We note that N treatments in BioCON are relevant to questions regarding response to CO2 across soils/sites differing in soil nitrogen supply as well as to potential interactions of CO2 with nitrogen deposition, which varies globally from much less to as much as our nitrogen addition treatment.

The grassland plots will employ mixtures of six species mixtures and include two species each from the following three functional groups: C4 grass, C3 grass, and nitrogen-fixing legume. The species will be switchgrass (*Panicum virgatum*), big bluestem (*Andropogon gerardii*), smooth brome (*Bromus inermis*), quackgrass (*Agropyron smithii*), lupine (*Lupinus perennis*) and roundhead lespedeza (*Lespedeza capitata*). These species are all native or naturalized and have grown well in mixtures in prior biodiversity experiments at the Cedar Creek site (e.g., Tilman et al 1997, Reich et al. 2001ab). The grassland mixture includes a set of species that are likely to have positive interactions (facilitation leading to over-yielding) based on prior experiments with prairie species mixtures (e.g., Tilman et al 2001, 2006ab, Hille RisLambers et al 2003, Reich et al. 2001a, 2004). The species choice will be revisited just before planting, making use of any more recent information.

Three woody taxa will be used in the tree plots; we will focus on fast-growing species known to have high potential to gain and sequester carbon in the short-term in conditions relevant to Minnesota (Fissore, Espeleta, Nater, Hobbie, Reich, and Beduhn; unpublished data). The candidates are hybrid aspen, hybrid poplar, and native cottonwood, based on recommendations from leading researchers in fast-growing short-rotation woody species in Minnesota (e.g., D. Riemenschneider, US Forest Service; W. Berguson, NRRI; A. David, U of Minnesota). We will consult with the investigators of those projects regarding the final choice. A willow taxon may be used instead of one of the candidates, but information at present is insufficient to ensure good growth at our study site. Each woody species plot will include equal numbers of all three taxa grown at a narrow spacing (• • • • • • • • • •• • • • • • • • • •••• • • • • •• • • •• •

experience growing hybrid poplars in high density field settings in global environmental change experiments (e.g., Reich et al 1984).

Plots will be seeded with the prairie species whereas seedlings of the woody species will be planted. If other (non-LCCMR) funds become available to purchase seeds and plants, we will plant the plots in spring of 2008, before the start of the LCCMR project, in order to gain an additional field season. All other experimental treatments, plot maintenance, and standard measurements will be as made in BioCON in previous years (Reich et al 2001ab, 2006ab). Among other reasons, this allows us to use very well developed protocols and methods, and additionally will enable us to compare the new plots with measurements in the existing plots. Although the new plots will be in their first, second and third year roughly a decade after the existing plots, we will be able to compare the new-plot performance to the existing plots both in the same chronological year (e.g., 2009) as well as the same stage of stand development (e.g., year 3, being 2010 for new plots and 2000 for existing plots). These comparisons are problematic for this reason and will be considered with great circumspection. However, the more important findings will be the comparisons of the new plots considered as a single experiment.

Plots will receive elevated CO2 in all daylight hours from early spring to late autumn each year (Reich et al. 2006). Non-destructive measures of plant height, diameter and leaf area will be made annually for the woody plants. For the prairie mixtures, aboveground plant biomass, abundance, richness, and %cover will be once per year (August) using established methods (Reich *et al.* 2001ab).

Challenges: A major concern involves the short time frame of the LCCMR supported project when viewed against the time frame needed to obtain the best possible information relevant to biomass production, especially for woody plants. All research on woody plants in a field context faces challenges because of both the spatial and temporal scales involved. We recognize this concern, but note that learning a limited amount about influences of environmental change factors such as elevated carbon dioxide on early growth of woody plants being considered for potential biomass and biofuel purposes is still much better than knowing nothing about such responses. It is also important to note that work with fast-growing woody plants represents only a portion of the planned research and that the likelihood of having sufficient time to obtain satisfactory information about perennial grassland species is high: we plan for three years of research (two growing species likely because of the July 1 start date) and have a relatively high degree of confidence that we could continue the grassland plots for at least another year or two from funding to be found in the future—a total of 3 or 4 years is usually sufficient for grassland plots to demonstrate biomass productivity results. In summary, over the 2008-2011 time frame, our research will not as completely answer important questions regarding (especially) woody biomass production in light of global change as well as we would like, but will provide some important information about the physiological responses of woody plants that is critical to developing understanding of the potential productivity responses to various global change factors.

Part 2. Carbon sequestration responses in global change experiments.

We will measure root and soil C, and soil CO2 flux from plots in at least two and as many as five different experiments, all led by Reich (4) or Tilman (1). We will also perform analyses focused on implications of the experimental data from the existing experiments from an energy (i.e., biofuel) perspective. Funds for these detailed measures and analyses are not available in the

existing awards supporting those projects, but will be supported by the LCCMR award. The experiments are as follows:

1. New CO2 -Biofuels Experiment. 72 plots, called Part 1 above; part of the BioCON project.
2. Biodiversity- CO2 -N experiment. 323 plots in the existing BioCON experiment; these include all combinations of species richness (1, 4, 9 or 16 species per plot), ambient and elevated CO2, and ambient and enriched nitrogen. Begun in 1998.
3. CO2 -N-water manipulation experiment. 48 plots in the existing BioCON experiment. This experiment examines whether responses to elevated CO2 depend on water supply and nitrogen availability; this includes all combinations of two levels each of water availability x CO2 x N, all in 9-species mixture plots in BioCON. Begun in spring 2007.
4. Biodiversity-climate warming experiment. 40 plots in a warming experiment, part of a grassland biodiversity experiment begun in 1996; the treatments to be used would be the ambient and warmest treatment, and five levels of species richness (1, 2, 4, 8, 16); warming experiment to begin spring 2008.
5. Boreal forest warming experiment. 96 plots in a pair of boreal forest warming experiments at Cloquet Forestry Center and the Hubachek Wilderness Research Center, near Ely. This experiment includes two sites (Cloquet, Ely), three levels of warming (ambient, +2C, +4C), and two habitat types (forest understory, clearing); experiment to begin in 2008.

Experiments 1 and 5 will require “initial” sampling of root and soil carbon prior to (or early in) the experiments; the others all have been sampled before and/or during the experiment. We will sample each plot (by either diagnostic or regularly spaced horizons) to 1-meter depth (if possible) for root and soil carbon in the last year of the LCCMR project, hopefully after three years (Experiments 1, 4, 5), four years (Experiment 3) or 13 years (Experiment 2) of treatments. After 10 years of experience in the BioCON project, we have well developed protocols for coring for roots and soils; for handling, processing, and preparing samples; for chemical analyses; and for data storage and management.

We (and/or collaborators) will also measure soil CO2 flux in selected plots of at least two of the experiments. These measures are made using portable infra-red gas analyzers and chambers (e.g., Craine et al. 2001ab). The available funding from LCCMR is sufficient for only sporadic soil CO2 flux sampling. Unless these can be increased by further funds being sought, they will be considered as qualitative indicators of soil processes, rather than used to assess total carbon budgets of plots. Except at the Ely sites (which are too stony), volumetric moisture will be measured using TDR periodically during the growing season in selected plots at each site. If resources allow, we will use the BROOK90 (or an alternative) model to estimate drainage and evapotranspiration. BROOK90 works well at assessing SWC from 0 to 120 cm depth in Cedar Creek grasslands (Dijkstra *et al.* 2006).

Analyses of data (including data going back as far as 1998) from the existing experiments will be assessed from a biofuels potential perspective. This will include analyses of response of C uptake (i.e. production) and storage in plants and soils in relation to treatments and of implications from both ecological and energy standpoints if biomass were removed for electric power generation or liquid biofuel production.

IV. Description of the results and/or products (deliverables) to be produced from the proposed research

The deliverables of the project will be (1) “on the ground” field experiments that serve the current objectives but which additionally may be valuable resources for continued research; documentation of experimental treatments, including timing and dosage or level (when appropriate); (2) datasets that enable evaluation of biomass and soil carbon responses of grassland and woody vegetation to a variety of environmental changes that will occur in the next century; (3) analyses of those datasets that will highlight the promise, in terms of potential biomass production, of differing “biofeedstocks” and of several measures relevant to soil carbon sequestration, (4) recommendations regarding plant types and management options that would maximize biomass production and soil carbon storage under future environmental conditions, and (5) policy-maker and public education accomplished via a combination of conferencing, reports, seminars, web-based information, and educational materials at the field sites.

V. Timetable for completing the proposed research (milestones and dates)

Part 1. New experiment establishment and related aboveground measures.

Date	Milestone
1 July-08	Project begins
31 Dec-08	72 new plots selected, laid out, seeds and plants ordered
1 April-09	Plots planted; treatments begun[1]
30 Aug-09	2009 aboveground plant growth and composition measured
1 April-10	2009 aboveground biomass weighed, prepped for chemical analysis
30 Aug-10	2010 aboveground plant growth and composition measured
15 Mar-11	2010 aboveground biomass weighed, prepped for chemical analysis
30 Jun-11	Data synthesis complete, final report complete, project end

[1]If additional non-LCCMR funds are available; the new plots will be planted in late spring 2008, in order to have an additional year of field results before the 30 June 2011 end date.

Part 2. Belowground measures in new Experiment (Part 1) and four other existing experiments. Experimental treatments in all five experiments will be ongoing, and thus are not shown on the milestone table.

Date	Milestone
1 July-08	Project begins
1 Nov- 08	Initial root and soil carbon sampling completed
30 Aug -09	2009 soil CO2 flux measurements;
30 Aug-10	2010 soil CO2 flux measurements completed;
15 Oct-10	Roots and soils sampled to 1-meter depth (as possible)
15 Mar-11	Chemical analyses of roots and soils complete
30 June-11	Data synthesis complete, final report complete, project end

VI. Deliverable products correlated to the timetable and budget

The deliverables of the project and their relationship and the timetable and budget:

(1) “on the ground” field experiments; and documentation of experimental treatments: as the experiments are ongoing in time and require roughly constant staff input per year, these deliverables will be a constant product and require roughly one-fourth of staff time. All CO2 costs are dedicated to this deliverable.

(2) datasets that enable evaluation of responses of grassland and woody vegetation to coming environmental changes: compiling these datasets will require roughly one-third to one-half of all staff time and all remaining supplies and analyses costs. These costs will be incurred in close proportion to the timing of annual measurements of soil CO2 flux, and root and soil carbon. As root and soil carbon sampling will largely be in the final year, the costs for all of the deliverables in this category will be higher in that year.

(3) analyses:

Bradford) will spend time on projects (not paid for by LCCMR) closely related to and complementary to this current project. Additionally, five grants currently in place (two U.S. National Science Foundation [NSF], two U.S. Department of Energy [DOE], and one U.S.D.A. Forest Service) provide • • • • • ‰• • • • ••• •• including the experimental facilities, maintenance of plots and treatments, data management, and many other measures of plant physiological, growth, plant-pest interactions, biogeochemistry, and others that are beyond the scope of the LCCMR project but provide complementary data.

Note on budget: Bahauddin, Trost, and Worm are all technical support staff; and currently are and will be supported for the remainder of their appointments by other grant funds to the investigators; i.e., the requested funds here will support part of their work tasks and appointment.

References Cited

Ainsworth, E.A., and S.P. Long. 2005. What have we learned from 15 years of free-air CO2 enrichment (FACE)? A meta-analytic review of the responses of photosynthesis, canopy properties and plant production to rising CO2. New Phytology 165:351-72.

Chung, H., D. Zak, P.B. Reich, D.S. Ellsworth. 2007. Plant species richness, elevated CO2, and atmospheric N deposition alter soil microbial community composition and function**.** Global Change Biology 13:980–989.

Craine, J.M., P.B. Reich, G.D. Tilman, D. Ellsworth, J. Fargione, J. Knops, and S. Naeem. 2003. The role of plant species in biomass production and response to elevated CO2 and N. Ecology Letters 6:623-630.

Craine, J.M., D.A. Wedin, and P.B. Reich. 2001a. Grassland species effects on soil CO2 flux track the effects of elevated CO2 and nitrogen. New Phytologist 150:425-434.

Craine, J.M., D.A. Wedin, and P.B. Reich. 2001b. The response of soil CO2 flux to changes in atmospheric CO2, nitrogen supply, and plant diversity. Global Change Biology 7:947-953.

Crutzen, P.J., A. R. Mosier, K.A. Smith, and W. Winiwarter, 2007. N_2O release from agro-biofuel production negates global warming reduction by replacing fossil fuels. Atmospheric Chemistry and Physics Discussions 7: 11191–11205.

Curtis P.S., Wang X. 1998. A meta-analysis of elevated CO2 effects on woody plant mass, form, and physiology. Oecologia113:299–313.

Davis, M., P.B. Reich, J. Knoll, L. Dooley, M. Hundtoft, I. Attleson. 2007. Elevated Atmospheric CO2: A Nurse Plant Substitute for Oak Seedlings Establishing in Old Fields. Global Change Biology (in press)

Dijkstra, F., S. Hobbie, P. Reich, and J. Knops. 2004. Nitrogen deposition and plant species interact to influence soil carbon stabilization. Ecology Letters 7:1192-1198.

Dijkstra, F., S. Hobbie, P. Reich, J. Knops. 2005. Divergent effects of elevated CO2, N fertilization, and plant diversity on soil C and N dynamics in a grassland field experiment. Plant and Soil 272:41-52.

Dijkstra, F.A., K. Wrage, S.E. Hobbie, P.B. Reich. 2006. Tree patches show greater N losses but maintain higher soil N availability than grassland patches in a frequently burned oak savanna. Ecosystems 9:441-452.

Dijkstra, F.A., J.B. West, S.E. Hobbie, P.B. Reich. 2007. Dissolved inorganic and organic N leaching from a grassland field experiment: interactive effects of plant species richness, atmospheric [CO2] and N fertilization. Ecology 88:490–500.

Donner, S., and C. Kucharik, 2003. Evaluating the impacts of land management and climate variability on crop production and nitrate export across the Upper Mississippi Basin. *Global Biogeochemical Cycles* 17: 1085.

Groode, T.A., and J. B. Heywood, 2007. Ethanol: A Look Ahead. Massachusetts Institute of Technology Laboratory for Energy and the Environment, Report No. LFEE 2007-02 RP, Cambridge.

Hendrey, G.R., K.F. Lewin, and J. Nagy. 1993. Control of carbon dioxide in unconfined field plots. *In* Schulze E-D, Mooney HA, eds. Design and execution of experiments on CO2 enrichment. Ecosystems Research Report 6. Brussels, Belgium: Commission of the European Communities, CEC-DGXII/D-1, 309-329.

Hill, J., E. Nelson, D. Tilman, S. Polasky, and D. Tiffany, 2006. Environmental, economic, and energetic costs and benefits of biodiesel and ethanol biofuels. *PNAS* 103(30): 11206-11210.

Hille Ris Lambers, J., W.S. Harpole, D. Tilman, J. Knops, P.B. Reich. 2004. Mechanisms responsible for the positive diversity-productivity relationship in Minnesota grasslands. Ecology Letters 7:661-668.

Hoogwijk, M., Faaij, A., Eickhout, B., de Vries, B., Turkenburg, W. 2005. Potential of biomass energy out to 2100, for four IPCC SRES land-use scenarios, Biomass and Bioenergy 29 (2005) 225–257

IPCC. 2007. Climate Change 2007 - The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the IPCC.

Norby RJ, Luo Y. 2004. Evaluating ecosystem responses to rising atmospheric CO2 and global warming in a multi-factor world. *New Phytol.* 162:281-293

Pacala, S. and R. Socolow, 2004. Stabilization Wedges: Solving the Climate Problem for the Next 50 Years with Current Technologies. Science 305: 968-972.

Reich, P.B. J.P. Lassoie, R.G. Amundson. 1984. Reduction in growth of hybrid poplar following field exposure to low levels of O_3 and (or) SO_2. Canadian J of Botany 62:2835-2841.

Reich, P.B., J. Knops, D. Tilman, , J. Craine, D. Ellsworth, M. Tjoelker, T. Lee, S. Naeem, D. Wedin, D. Bahauddin, G. Hendrey, S., Jose, K. Wrage, J. Goth, W. Bengston. 2001a. Plant diversity enhances ecosystem responses to elevated CO2 and nitrogen deposition. Nature 410:809-812.

Reich, P.B., D. Tilman, J. Craine, D. Ellsworth, M. Tjoelker, J. Knops, D. Wedin, S. Naeem, D. Bahauddin, J. Goth, W. Bengston, T. Lee. 2001b. Do species and functional groups differ in acquisition and use of C, N and water under varying atmospheric CO2 and N deposition regimes? A field test with 16 grassland species. New Phytologist 150:435-448.

Reich, P.B., D. Tilman, S. Naeem, D. Ellsworth, J. Knops, J. Craine, D. Wedin, J. Trost. 2004. Species and functional diversity independently influence biomass accumulation and its response to CO2 and N. Proceedings of the National Academy of Sciences USA 101:10101-10106.

Reich, P.B., S.E. Hobbie, T. Lee, D.S. Ellsworth, J.B. West, D. Tilman, J. Knops, S. Naeem, and J. Trost. 2006a. Nitrogen limitation constrains sustainability of ecosystem response to CO2. Nature 440:922-925.

Reich, P.B., B.A. Hungate, and Y. Luo. 2006b. Carbon-Nitrogen Interactions in Terrestrial Ecosystems in Response to Rising Atmospheric CO2. Annual Review of Ecology, Evolution, and Systematics 37: 611-636.

Seeley, M., 2007. Climate Change in Minnesota: Measurement Evidence, Consequence, and Implications. Presentation in the Water Resources Science Seminar series. November 2, University of Minnesota.

Tilman, D., J. Knops, D. Wedin, P.B. Reich, M. Ritchie, E. Siemann. 1997. The influence of functional diversity and composition on ecosystem processes. Science 277:1300-1302.

Tilman, D., P.B. Reich, J. Knops, D. Wedin, T. Mielke, C. Lehman. 2001. Diversity and productivity in a long-term grassland experiment. Science 294: 843-845.

Tilman, D., J. Hill and C. Lehman, 2006. Carbon-Negative Biofuels from Low-Input High-Diversity Grassland Biomass. Science 314: 1598-1600.

Wand S.E., Midgley G.F., Jones M.H., Curtis P.S. 1999. Responses of wild C4 and C3 grasses (Poaceae) species to elevated atmospheric CO2 concentration: a meta-analytic test of current theories and perceptions. Global Change Biol 5:723–741

Wang, M., M. Wu, and H. Huo, 2007. Life-cycle energy and greenhouse gas emission impacts of different corn ethanol plant types. *Environmental Research Letters* 2: 1-13.

VIII. Identification and background of principal investigators and cooperators who will carry out the proposed research

Biographical sketch- Peter B. Reich

Department of Forest Resources
1530 Cleveland Avenue North, University of Minnesota, St. Paul, MN 55108
Phone: 612-624-4270; FAX 612-625-5212; E-mail preich@umn.edu

Education
Ph.D. (1983) Environmental Biology and Plant Ecology, Cornell University, Ithaca, NY
M.S. (1977) Forest Ecology, University of Missouri, Columbia, MO
B.A. (1974) Writing and Physics, Goddard College, Plainfield, VT

Professional Experience
Regent Professor, University of Minnesota, St. Paul, MN, 2007 -
Distinguished McKnight University Professor, 2003-
F.B. Hubachek, Sr., Professor, Dept Forest Resources, U. Minnesota, St. Paul, MN, 1991-
Assistant /Associate Professor, Dept Forestry, U. Wisconsin, Madison, WI, 1985-1991.

5 publications relevant to this project:
Dijkstra, F.A., J.B. West, S.E. Hobbie, P.B. Reich. 2007. Dissolved inorganic and organic N leaching from a grassland field experiment: interactive effects of plant species richness, atmospheric [CO2] and N fertilization. Ecology 88:490–500.
Reich, P.B., J. Knops, D. Tilman, , J. Craine, D. Ellsworth, M. Tjoelker, T. Lee, S. Naeem, D. Wedin, D. Bahauddin, G. Hendrey, S Jose. K. Wrage, J Goth, W. Bengston. 2001. Plant diversity enhances ecosystem responses to elevated CO2and nitrogen deposition. Nature 410:809-812.
Reich, PB , SE Hobbie, T Lee, DS Ellsworth, JB West, and others. 2006. Nitrogen limitation constrains sustainability of ecosystem response to CO2. Nature 440:922-925.
Reich, P.B., B.A. Hungate, Y. Luo. 2006. Carbon-Nitrogen Interactions in Terrestrial Ecosystems in Response to Rising Atmospheric CO2. Annual Review of Ecology, Evolution, and Systematics 37: 611-636.
Tilman D, PB Reich & JMH Knops. 2006. Biodiversity and ecosystem stability in a decade-long grassland experiment. Nature 441:629-632.

5 other peer-reviewed publications (out of >280 in total)
Hale, C., L.E. Frelich, P.B. Reich, J. Pastor. 2005. Effects of European earthworm invasion on soil characteristics in northern hardwood forests of Minnesota, USA. Ecosystems 8:911-927.
Reich PB, MG Tjoelker, JL Machado J Oleksyn. 2006. Universal Scaling of Respiratory Metabolism, Size, and Nitrogen in Plants. Nature 439: 457-461.
Reich, PB , D Tilman, S Naeem, D Ellsworth, J Knops, J Craine, D Wedin, J Trost. 2004. Species and functional diversity independently influence biomass accumulation and its response to CO2 and N. Proc Nat Acad Sci USA 101:10101-10106.
Withington JM, PB Reich, J Oleksyn, DM Eissenstat. 2006. Comparisons of structure and lifespan in roots and leaves among temperate trees. Ecological Monographs 76:381-397.
Wright I, PB Reich, M Westoby, and GLOPNET researchers. 2004. The worldwide leaf economics spectrum. Nature 428:821-827.

Climate change, CO_2, and prairie/forest production

Synergistic Activities, Honors, Recognition, and Service (selected recent)

Institute for Scientific Information (ISI) Science Citation Index, List of Top 20 Ecologists and Environmental Scientists in the World, 2002 – present (Current rank #6)

National Institute on Climate Change Research, Midwestern Regional Panel, 2006-07

National Science Foundation, Biocomplexity and the Environment Program, Coupled Biogeochemical Cycles Panel member, 2004

NSF, Ecological and Evolutionary Physiology Panel Member, 1994-97

Editorial Review Board (or equivalent): *Oecologia (2006-08), Tree Physiol*, *(1993-95, 2004-) Trees (1991-97), Can Journal Forest Research (1992-98), Ecologyy/Ecological Monographs (1995-99)*

BIOGRAPHICAL SKETCH - G. David Tilman

BIRTH: Aurora, Illinois

ADDRESS: Department of Ecology, Evolution and Behavior
100 Ecology Building, 1987 Upper Buford Circle,
University of Minnesota, St. Paul, Minnesota 55108-6097

EDUCATIONAL HISTORY:
University of Michigan 8/67-5/71 B.S. Zoology (High Distinction)
University of Michigan 9/71-4/76 Ph.D. Zoology (Ecology)

PROFESSIONAL APPOINTMENTS:
Assistant Professor, University of Minnesota 1976-1980
Associate Professor, University of Minnesota 1980-1984
Professor, University of Minnesota 1984-1996
Director, Cedar Creek Natural History Area 1992-present
Distinguished McKnight University Professor 1996-2001
Member, Institute for Advanced Study, Princeton, NJ 2000
Regents Professor, University of Minnesota 2002-present

AWARDS, HONORS, NATIONAL AND INTERNATIONAL SERVICE (selected):
Guggenheim Fellow 1984-1985
Fellow, American Association for the Advancement of Science 1985
W. S. Cooper Award, Ecological Society of America 1989
Elected to the American Academy of Arts and Science 1995
Pew Scholar in Conservation Biology 1995-1998
MacArthur Award, Ecological Society of America 1997
Designated the Most Highly Cited Environmental Scientist of the Decade (1990-2000) by Essential Science Indicators 2000
Elected to the National Academy of Sciences 2002
Named Lectures and Keynote Addresses, including:
50th Anniversary of the Ecological Society of Japan 2003
The Holm-Thomas Lecture at Stanford University 2001
The Henry Oosting Lecture at Duke University 1999
Glaser Distinguished Lecturer, Florida International University 1999
Keynote Address, IX Congress on the Italian Society of Ecology 1999
The Moore Lecture, University of Virginia 1991
The Per Brink Lecture, Lund University, Sweden. 1988

SELECTED PUBLICATIONS:
Fargione, J., C. S. Brown and D. Tilman. 2003. Community assembly and invasion: An experimental test of neutral versus niche processes. Proceedings of the National Academy of Sciences 100:8916-8920.
Hill, J., E. Nelson, D. Tilman, S. Polasky, and D. Tiffany, 2006. Environmental, economic, and energetic costs and benefits of biodiesel and ethanol biofuels. *PNAS* 103(30): 11206-11210.
Hille Ris Lambers, J., W.S. Harpole, D. Tilman, J. Knops, P.B. Reich. 2004. Mechanisms responsible for the positive diversity-productivity relationship in Minnesota grasslands. Ecology Letters 7:661-668.
Reich, P.B., S.E. Hobbie, T. Lee, D.S. Ellsworth, J.B. West, D. Tilman, J. Knops, S. Naeem, and

J. Trost. 2006. Nitrogen limitation constrains sustainability of ecosystem response to CO2. Nature 440:922-925.

Tilman, D. 1988. Plant Strategies and the Dynamics and Structure of Plant Communities. Monographs in Population Biology, Princeton University Press. 360 pp.

Tilman, D., J. Knops, D. Wedin, P.B. Reich, M. Ritchie, E. Siemann. 1997. The influence of functional diversity and composition on ecosystem processes. Science 277:1300-1302.

Tilman, D., P.B. Reich, J. Knops, D. Wedin, T. Mielke, C. Lehman. 2001. Diversity and productivity in a long-term grassland experiment. Science 294: 843-845.

Tilman, D. 2004. Niche tradeoffs, neutrality, and community structure: A stochastic theory of resource competition, invasion, and community assembly. Proceedings of the National Academy of Sciences 101:10854-10861.

Tilman, D. J. Hille Ris Lambers, S. Harpole, R. Dybzinski, J. Fargione, C. Clark and C. Lehman. 2004. Does metabolic theory apply to community ecology? It's a matter of scale. Ecology 85:1797-1799.

Tilman, D., J. Hill and C. Lehman, 2006. Carbon-Negative Biofuels from Low-Input High-Diversity Grassland Biomass. Science 314: 1598-1600.

BIOGRAPHICAL SKETCH

Clarence L. Lehman
Adjunct Professor, Department of Ecology, Evolution, and Behavior

University of Minnesota

100 Ecology Building, 1987 Upper Buford Circle, St. Paul, Minnesota 55108-6097
Email lehman@umn.edu; Phone 612-625-5434; Fax 612-624-6777

Education and Training

Ph.D., Ecology, University of Minnesota, 2000
M.S., Ecology, University of Minnesota, 1991

Relevant Professional Experience

Adjunct Professor, Department of Ecology, Evoultion, and Behavior, University of Minnesota, 2000-present. Research and teaching on theoretical ecology, bioenergy, climate change, and computer applications to biology.

Associate Director, Cedar Creek Natural History Area, 1999-2006. Oversight, operations, and future planning for the field site.

Relevant Publications

Tilman, D.; Hill, J; Lehman, C. 2006. Carbon-negative biofuels from low-input high-diversity grassland biomass. *Science* 314:1598-1600. *[Introduces native grass/forb mixtures as a potential carbon-negative feedstock.]*
Tilman, D.; Polasky S.; Lehman, C. 2005. Diversity, productivity and temporal stability in the economies of humans and nature. *Journal of Environmental Economics and Management 49:405-426*. *[Examines connections between ecology and economics.]*

Tilman, D.; Lehman, C. 2002. Biodiversity, composition, and ecosystem processes: theory and concepts. Pages 9-41, in, A. Kinzig, S. Pacala and D. Tilman, Eds., *Functional Consequences of Biodiversity: Empirical Progress and Theoretical Extensions.* Princeton University Press, New Jersey.

Lehman, C. L. 2001. The concept of stability. Pages 467-479 in, S. A. Levin, Editor-in-Chief, *Encyclopedia of Biodiversity,* Vol. 5. Academic Press, San Diego, CA.

Tilman, D.; Lehman, C. 2001. Human-caused environmental change: Impacts on plant diversity and evolution. *Proceedings of the National Academy of Science 98:5433-5440.*

Tilman, D.; Reich, P. B.; Knops, J.; Wedin, D.; Mielke, T.; Lehman, C. 2001. Diversity and productivity in a long-term grassland experiment. *Science 294:843-845.*

Lehman, C. L.; Tilman, D. 2000. Biodiversity, stability, and productivity in competitive communities. *The American Naturalist 156:534-552.*

Lehman, C. L.; Tilman, D. 1997. Competition in spatial habitats. Pages 185-203 in, D. Tilman and P. Kareiva, eds., *Spatial Ecology: The Role of Space in Population Dynamics and Interspecific Interactions.* Princeton University Press, New Jersey.

Tilman, D.; Lehman, C. L.; Thomson, K. T. 1997. Plant diversity and ecosystem productivity: Theoretical considerations. *Proc. Natl. Acad. Sci. 94:1857-1861.*

Tilman, D.; May, R. M.; Lehman, C. L.; Nowak, M. A. 1994. Habitat destruction and the extinction debt. *Nature 371:65-66.* (Highlighted in The New York Times 27 September 1994, Science 26 August 1994, and other media.)

Synergistic Activities

Public engagement: Public lectures (over 30 in the past year) explaining bioenergy and its relationship to the environment, with public groups ranging from secondary schools to local environmental meetings to large public gatherings. The most prominent public gathering was on the west lawn of the U.S. Capitol in Washington DC (March 2007), addressing a group that the Washington press described as the largest gathering on climate yet assembled.

Prairie restoration: Personal experience (20 years) restoring degraded farmland to native prairie flora, accompanied by experiments for adaptive management of the restored prairie areas. The experiments test optimal and economic establishment methods and optimal seasons for seeding. This practical experience now can be applied to biofuel plantations.

Restoration aids: PRESTO, interactive computer software for prairie restoration. Selects native grasses and forbs suitable for a specified geographic area under specified soil, sun, and moisture conditions. Techniques and software here will be relevant to future restorations for biofuel plantations.

Research tools: DECLARE, a software system for field data entry on hand-held and laptop computers, and other scientific software (in http://www.cedarcreek.umn.edu/tools/). Relevant to data gathering for bioenergy research, as well as other purposes.

Data base support: PERM1, a technique for very long term storage of archival data (in http://www.cedarcreek.umn.edu/tools/). Relevant to data stored for future comparison and analysis in long-term projects in government and academia, including current bioenergy endeavors.

BIOGRAPHICAL SKETCH - Rebecca A. Montgomery

Department of Forest Resources
University of Minnesota
1530 Cleveland Avenue North
St. Paul, MN 55108
(612) 624-7249
rebeccam@umn.edu

Education and Training

Occidental College (California), Biology, A. B. Magna cum laude, 1994
University of Connecticut, Ecology and Evolutionary Biology, Ph.D., 1999
University of Wisconsin-Madison, Botany, post-doc, 2000-2003

Research and Professional Experience

2004-present	Assistant Professor, Forest Resources, University of Minnesota
2003-2004	Research Associate, Forest Resources, University of Minnesota
2003-2004	Instructor, Forest Resources, University of Minnesota
2000-2003	Research Associate, Botany, University of Wisconsin

Ten Publications

Dickie, I. A., **R. A. Montgomery**, P. B. Reich and S. A. Schnitzer. 2006. Physiological and phenological responses of oak seedlings to oak forest soil in the absence of trees. *Tree Physiology* 27: 133-140.

Montgomery, R. A. 2004. Effects of understory vegetation on patterns of light attenuation near the forest floor. *Biotropica* 36: 33-39.

Harms, K. E., J. S. Powers, **R. A. Montgomery.** 2004. Variation in small sapling density, understory cover and resource availability in four Neotropical forests. *Biotropica* 36: 40-51.

Givnish T.J., **R.A. Montgomery** and G. Goldstein. 2004. Adaptive radiation of photosynthetic physiology in the Hawaiian lobeliads: light regimes, static light responses, and whole-plant compensation points. *American Journal of Botany* 91: 228-246.

Montgomery, R. A. 2004. Relative importance of photosynthetic physiology and biomass allocation for tree seedling growth across a broad light gradient *Tree Physiology* 24:155–167.

Nicotra, A. B., R. L. Chazdon & **R. A. Montgomery**. 2003. Sexes show contrasting patterns of leaf and crown carbon gain in a dioecious rainforest shrub. *American Journal of Botany* 90:347-355.

Cabin, R. J., S. G. Weller, D. H. Lorence, S. Cordell, L. J. Hadway, **R. Montgomery**, D. Goo, and A. Urakami. 2002. Effects of light availability, alien grass, and native species additions on Hawaiian dry forest restoration. *Ecological Applications* 12:1595-1610.

Montgomery, R. A. and R. L. Chazdon. 2002. Light gradient partitioning by tropical tree seedlings in the absence of canopy gaps. *Oecologia* 131:165-174.

Montgomery, R. A. and R. L. Chazdon. 2001. Forest structure, canopy architecture and light transmittance in old-growth and second-growth stands of lowland rainforest in NE Costa Rica. *Ecology* 82: 2707-2718.

Chazdon, R. L., and **R. A. Montgomery**. 2001. La adquisición de carbono en las plantas. In: M. R. Guariguata and G. H. Kattan (Eds.) *Ecología y Conservación de Bosques Neotropicales.* Editorial Libro Universitario Regional, Costa Rica

Synergistic Activities

I am currently developing a database of plant functional traits for the entire Hawaiian flora in collaboration with Lawren Sack (U Hawaii at Manoa), Becky Ostertag (U Hawaii at Hilo), Jon Price (USGS) and Susan Corderl (USDA Forest Service).

Over the past five years, I have been involved in an international collaboration (>15 countries) examining the controls of leaf decomposition rates in tropical forests around the globe. This project is coordinated by Dr. Jennifer Powers (U Minnesota)

I am a collaborator on a recently funded Research Coordination Network on plant traits (Trait Net) led by Shahid Naeem and Daniel Bunker (Columbia University).

I am working with the MN Department of Natural Resources on the role of changed climate in timing of phenological events in white spruce common gardens originated from across latitudinal and longitudinal gradients.

Climate change, CO_2, and prairie/forest production

JOHN BRADFORD

Research Ecologist – USDA Forest Service

Northern Research Station
1831 Hwy 169 E.
Grand Rapids, MN 55744

Voice: (218) 326-7105
Fax: (218) 326-7123
jbbradford@fs.fed.us

EDUCATION

Degree	School	Dates
Ph.D. - Ecology	Colorado State University Fort Collins, CO 80523	Fall 1998 - Spring 2004
B.A. - Biology	Cornell University Ithaca, NY 14853	Fall 1994 - Spring 1996

EXPERIENCE

Title	Employer	Dates
Research Ecologist	USFS Northern Research Station Grand Rapids, MN	July 2006 - Present
Research Ecologist (Postdoc)	USFS Rocky Mountain Research Station Fort Collins, CO 80524	May 2004 - July 2006
Research Associate and Graduate Student	Graduate Degree Program in Ecology Colorado State University Fort Collins, CO	August 1998 - May 2004
Research Associate	Natural Resources Ecology Laboratory Fort Collins, CO	January 2002 - May 2004
Research Associate	Shortgrass Steppe Long Term Ecological Research Site Fort Collins, CO	January 2002 - May 2004

AWARDS

NASA Earth System Science Graduate Student Fellowship	2002 –2004
CSU College of Natural Resources Graduate Scholarships	2002 –2003
National Science Foundation Graduate Student Fellowship	1999 –2002
CSU College of Natural Resources Graduate Scholarships	1999 –2000
CSU College of Natural Resources Tuition Scholarship	1998 –1999
"Caring for the Land" Award for integrity/performance from the U.S.F.S.	1993

PROFESSIONAL SERVICE

Member: Ecological Society of America, American Geophysical Union, International Association for Landscape Ecology

Climate change, CO_2, and prairie/forest production

Ad-hoc Reviewer: Ecological Applications, Ecology, Ecosystems, Global Change Biology, Biogeochemistry, Global Ecology and Biogeography, Oecologia, Nature, Diversity and Distributions, Remote Sensing of Environment, Forest Ecology and Management

SELECTED PUBLICATIONS

Bradford, J.B., Birdsey, R. A., Joyce, L. A., and M. G. Ryan. (In review) Tree age, disturbance history, and carbon stocks and fluxes in subalpine Rocky Mountain forests. *Global Change Biology.*

Sherrill, K. R., Lefsky, M.A., **Bradford, J.B**., and M.G. Ryan. (In review) Forest Structure Estimation and Pattern Exploration from Discrete Return Lidar in Subalpine Forests of the Central Rockies. *Canadian Journal of Forest Research.*

Bradford, J.B. and M.G.Ryan. (In review). Approaches to quantifying soil respiration at landscape scales. Book Chapter.

Bradford, J. B., Hollinger, D. Y., Kolka, R. K., Weishampel, P., Smith, M. L, Ryan, M.G., and R. A. Birdsey. (In review). Landscape Carbon Sampling Strategy – Lessons Learned. Book Chapter.

Bradford, J.B. and N. T. Hobbs. (2008) Analysis of options for elk population management in Rocky Mountain National Park. *Journal of Environmental Management.* 86:520-528.

Binkley, D., Kashian, D. M., Boyden, S., Kaye, M. W., **Bradford, J. B**., Arthur, M. A., Fornwalt, P. J., and M. G. Ryan. (2006) Patterns of Growth Dominance in Forests of the Rocky Mountains, USA. *Forest Ecology and Management* 236: 193-201.

Bradford, J.B. Lauenroth, W.K., Burke, I.C. and J.M. Paruelo. (2006) The influence of climate, soils, weather and land-use on primary production and biomass seasonality in the U.S. Great Plains. *Ecosystems* 9: 934-950.

Bradford, J.B. and W. K. Lauenroth. (2006) Controls over cheatgrass invasion: the importance of climate, soils, disturbance and seed availability. *Journal of Vegetation Science 17: 693-704.*

Lauenroth, W.K. and **J.B. Bradford**. (2006) Ecohydrology and the Partitioning of AET between transpiration and evaporation in a semiarid steppe. *Ecosystems* 9: 956-967.

Bradford, J.B., Lauenroth, W.K., and I.C. Burke. (2005) The impact of cropping on net primary production in the U.S. Great Plains. *Ecology* 86(7) 1863-1872.

Bradford, J.B., Hicke, J., and W. K. Lauenroth. (2005) The relative importance of light-use efficiency modifications from environmental conditions and cultivation for estimation of large-scale net primary productivity. *Remote Sensing of Environment* 96(2) 246-255.

Adler, P.B. and **J.B. Bradford** (2002) Compensation: an alternative method for analyzing diversity-productivity experiments. *Oikos* 96: 411-420.

Attachment A: Final Budget Detail for 2008 Project

Project Title: Climate change, CO2, and prairie/forest production

Project Manager Name: Peter Reich

Trust Fund Appropriation: $330,000

2008 Trust Fund Budget	**Revised Results 1 Budget:** Revised as of April 7, 2011	**Amount Spent** (June 30th, 2011)	**Balance** (June 30, 2011)	**Revised Results 2 Budget:** Revised as of April 7, 2011	**Amount Spent** (June 30th, 2011)	**Balance** (June 30, 2011)	**Revised Result 3 Budget:** Revised as of April 7, 2011	**Amount Spent** (June 30th, 2011)	**Balance** (June 30, 2011)	**Revised Result 4 Budget:** Revised as of April 7, 2011	**Amount Spent** (June 30th, 2011)	**Balance** (June 30, 2011)	**TOTAL BUDGET**	**TOTAL BALANCE**
	On the ground field experiments			Sampling and data set compilation			Sampling and data set compilation			Lab analysis and data synthesis complete			**330,000**	**330,000**
BUDGET ITEM														
PERSONNEL: wages and benefits (Civil service staff ordering materials, preparing plots, coordinating efforts with BioCON and B4WARMED managers to install new plots, maintain ongoing plots, collect baseline samples and manage data. 2009-10 treatments were applied, measurements, data and samples were collected in all experiments.Sample processing for analysis in underway)	35,708	35,708	0	67,200	67,200	0	89,234	89,234	0	66,000	66,000	0	258,142	0
Other direct operating costs (Carbon Dioxide gas and rental on CO2 delivery system)				22,581	22,581	0	21,851	21,851	0	0	0	0	44,432	0
***Field supplies**: labels, sample bags & envelopes, plot tags, data sheets,, fertilizer, supplies for sample preparation and processing, consumables for soil flux (batteries, drierite, etc.) (Other supporting grants were used for supplies in results 2 because CO2 use was high.)	2,082	2,082	0	0	0	0	3,249	3,249	0	0	0	0	5,331	0
***Travel** (in state to B4WARMED for maintenace, data collection & sampling.)	407	407	0	500	500	0	1,500	1,500	0	0	0	0	2,407	0
***Field equipment repair** (repair BioCON main CO2 delivery valve)	689	689	0			0	0		0	0	0	0	689	0
Other (Chemical analyses of plants, soils)						0	0		0	19,000	19000	0	19,000	0
COLUMN TOTAL	**$38,885**	**$38,885**	**$0**	**$90,281**	**$90,281**	0	**$115,834**	**$115,834**	0	**$85,000**	**$85,000**	0	330,000	**0**

M.L. 2008 Project Abstract
For the Period Ending June 30, 2011

PROJECT TITLE: Biofuel production and wildlife conservation in working prairies.

PROJECT MANAGER: **Dr. Clarence Lehman**
AFFILIATION: **University of Minnesota**
MAILING ADDRESS: **1987 Upper Buford Circle**
CITY/STATE/ZIP: **St. Paul, MN 55108**
PHONE: **612-625-5734**
E-MAIL: **lehman@umn.edu**
WEBSITE: **http://www.cbs.umn.edu/wildlife**
FUNDING SOURCE: Environment and Natural Resources Trust Fund
LEGAL CITATION: **M.L. 2008, Chap. 367, Sec.[2], Subd. 3(q)**

APPROPRIATION AMOUNT: $ 750,000

Overall Project Outcome and Results

Minnesota prairies reliably produce bioenergy resources which largely go untapped. This project sought management practices to promote wildlife and habitat diversity on future working prairies used for bioenergy in Minnesota. It combined harvested areas with refuges and monitored wildlife populations and bioenergy potential in Minnesota grasslands, while developing protocols for future long-term work.

We collaborated with land managers of established prairies to survey birds, insects, small mammals, reptiles, amphibians, plants and soils in regions across western Minnesota. Statistical trends show that harvesting grasslands with refuge remaining does not reduce wildlife abundance. In fact, harvested areas supported greater biomass of insects for bird food. Harvesting can also increase overall small mammal abundance when equal area is left as refuge. These results are being clarified in the ongoing second phase of this project.

We measured bioenergy potential measured by harvesting prairies with production-scale equipment. We tested various harvesting machinery, techniques, and bale types, and found current round baling technology more amenable to these plots, a discbine cutter mounted on a four-wheel drive tractor as the most effective cutting equipment, and tractors with custom-made front and rear mounted bale spikes worked best for transport. We obtained noticeably higher quantities of biomass per acre in the south, but biomass quality was approximately the same. Harvesting three years in a row did not reduce yield, and we found mixed-species biomass can produce at least as much liquid fuel per unit mass as switchgrass. Our bioenergy partners reported that bales of prairie grass have better storage life than other renewable feedstocks they used.

The large amount of data produced is being made available on the project website for general use. Results from this first phase of the project will inform future land management by analyzing the intersection of renewable energy and wildlife conservation.

Project Results Use and Dissemination

We have a project website available (www.cbs.umn.edu/wildlife) to make the ideas and results available world-wide. This website will continue to develop as the protocols for this project are refined and as data become available. The project will also be featured in Cedar Creek educational programs for school-age and other groups. Presentations (oral and poster) to special interest groups, research groups, and other interested parties continued by project collaborators throughout the project. The first publication from this project in a peer-reviewed scientific outlet is now available. (Jungers et al., Characterizing Grassland Biomass for Energy Production and Habitat in Minnesota, Proceedings of the 22nd North American Prairie Conference, 2010). Further publications will be submitted as the project moves into its second phase.

(11/2008)

Ï Project information has been organized and posted on the web site.

Ï An informational poster has been created and is located at Cedar Creek Ecological Science Reserve and used for visitors.

(5/2009)

Ï Clarence Lehman prepared presentations that pertain to this study to deliver at conferences and workshops. These presentations have been delivered to audiences around the U.S. and Europe, including events such as the annual Pheasants Forever "Pheasant Fest" in Madison, WI, a small mammal conference in Atlanta, GA, and at a bioenergy conference in Sweden.

(2/2010)

Ï Jacob Jungers was invited to explain this project and related grassland bioenergy efforts to the Board of Directors of the Missouri Prairie Foundation. (Trip was funded by a member of the Missouri Prairie Foundation)

(5/2010)

Ï Clarence Lehman and Jacob Jungers were invited to the Tallgrass Prairie for Biofuel Conference held at Guelph University in Ontario Canada. Clarence delivered a keynote speech on prairie bioenergy while Jacob presented a poster outlining the details of this project. (Trip was funded by the Ontario Ministry of Natural Resources)

(8/2010)

Ï Clarence Lehman and Jacob Jungers attended the North American Prairie Conference at the University of Northern Iowa where Jacob presented a poster describing the details of this project. (The travel portion was funded by the USDA-NRCS Conservation Innovation Grant, and this resulted in a peer-reviewed publication.)

(9/2010)

Ï In September of 2010, we reported our findings to land managers, including DNR and USFW personnel, at a specially organized conference in Lac Qui Parle. We prepared multi-year data sheets for comparisons among years of data and conducted preliminary data analysis, which was presented in slides at the meeting.

(12/2010)

Ï Preliminary data was presented at the 71st Midwest Fish and Wildlife Conference, held in Minneapolis, by project entomologist Colleen Satyshur.

Environment and Natural Resources Trust Fund 2008 Work Program
Final Report

Date of Report:	1/31/2012
Final Report	
Amendment Request:	2/15/2010
Amendment Approved:	5/1/2010
Date of Work program Approval:	6/30/2008
Project Completion Date:	6/30/2011

I. PROJECT TITLE: **Biofuel production and wildlife conservation in working prairies.**

Project Manager:	**Dr. Clarence Lehman**
Affiliation:	**University of Minnesota**
Mailing Address:	**1987 Upper Buford Circle**
City / State / Zip :	**St. Paul, MN 55108**
Telephone Number:	**612-625-5734**
E-mail Address:	**lehman@umn.edu**
Fax Number:	**612-624-6777**
Web Page address:	**http://www.cbs.umn.edu/wildlife**

Location: Three field sites located along the western landscape of Minnesota, headquartered at Cedar Creek Ecosystem Science Reserve. Lab address is 2660 Fawn Lake Drive, Bethel, MN 55005.

Total Trust Fund Project Budget:	**Trust Fund Appropriation:**	$ 750,000
	Minus Amount Spent:	$ 750,000
	Equal Balance:	$ 0

Legal Citation: M.L. 2008, Chap. 367, Sec.[2], Subd. 3(q)

Appropriation Language:
$250,000 is from the trust fund to the Board of Regents of the University of Minnesota to research and evaluate methods of managing diverse working prairies for wildlife and renewable bioenergy production. On June 1, 2008, the $500,000 appropriation for the Phillips biomass community energy system under Laws 2006, chapter 243, section 20, subdivision 3, is transferred and added to this appropriation. This appropriation is available until June 30, 2011, at which time the project must be completed and final products delivered, unless an earlier date is specified in the work program.

II. AND III. FINAL PROJECT SUMMARY:

Minnesota prairies reliably produce bioenergy resources which largely go untapped. This project sought management practices to promote wildlife and habitat diversity on future working prairies used for bioenergy in Minnesota. It combined harvested areas with refuges and monitored wildlife populations and bioenergy potential in Minnesota grasslands, while developing protocols for future long-term work.

We collaborated with land managers of established prairies to survey birds, insects, small mammals, reptiles, amphibians, plants and soils in regions across western Minnesota. Statistical trends show that harvesting grasslands with refuge remaining does not reduce wildlife abundance. In fact, harvested areas supported greater biomass of insects for bird food. Harvesting can also increase overall small mammal abundance when equal area is left as refuge. These results are being clarified in the ongoing second phase of this project.

We measured bioenergy potential measured by harvesting prairies with production-scale equipment. We tested various harvesting machinery, techniques, and bale types, and found current round baling technology more amenable to these plots, a discbine cutter mounted on a four-wheel drive tractor as the most effective cutting equipment, and tractors with custom-made front and rear mounted bale spikes worked best for transport. We obtained noticeably higher quantities of biomass per acre in the south, but biomass quality was approximately the same. Harvesting three years in a row did not reduce yield, and we found mixed-species biomass can produce at least as much liquid fuel per unit mass as switchgrass. Our bioenergy partners reported that bales of prairie grass have better storage life than other renewable feedstocks they used.

The large amount of data produced is being made available on the project website for general use. Results from this first phase of the project will inform future land management by analyzing the intersection of renewable energy and wildlife conservation.

IV. OUTLINE OF PROJECT RESULTS:

Result 1: Site selection and initial conditions. (July 2008-February 2009)

Description: We examined an array of six spatially distributed and ecologically representative areas of Minnesota, favoring locations of good biofuel potential, and established three multi-acre tracts for scientifically testing management practices in a replicated block design. General site evaluations on availability and suitability of sites took place from July to September of 2008, in concert with federal, state, and private partners. Detailed site selection with formal contracts and agreements continued through the spring season of 2009.

1. *Land reports with site maps.* The goal of this deliverable was site selection and experimental plot establishment. Site selection used lists of public, private, and NGO lands, together with GIS (geographic information systems) and satellite imagery to narrow the number of potential sites. Visiting potential sites and

their corresponding land managers was part of the final site selection. Key to this process was establishing working relationships with land managers to coordinate their prescribed burning regimes and our harvesting and sampling regimes. After specific sites were selected, experimental plots were designated and marked. The information generated through this process resulted in land reports and site maps. These are available on the project web site (www.cbs.umn.edu/wildlife).

The budget for this deliverable included

- purchase of field supplies
- transportation to potential sites
- lodging
- GIS and satellite imagery
- personnel time for project management
- supervisors
- research interns (site layout)

2. *Biomass, floral and soil datasets.* The goal of this deliverable was the establishment of starting conditions and testing of sampling protocols and methodology for:
    - small mammals (including required permitting on federal/state lands)
    - large mammals
    - birds
    - insects
    - plants, including harvesting methods
    - reptiles and amphibians (as appropriate and possible)
    - soil

    The budget for this deliverable included
    - purchase of field supplies
    - personnel time for project and data management
    - supervisors
    - undergraduate interns (initial plant survey and soil collection)
    - soil analysis
    - transportation to sites and lodging

Summary Budget Information for Result 1: Trust Fund Budget: $ 176,000

Amount Spent: **$ 176,000**
Balance: **$ 0**

Deliverable	Completion Date	Budget	Status
1. Land reports with site maps	Feb 15, 2009	$ 90,000	**Completed**
2. Biomass, floral and soil datasets	Dec 15, 2009	$ 86,000	**Completed**

NOTE: It was necessary to change the completion dates for deliverables 1 and 2, due in part to the amount of time needed to secure permissions from land managers and in part to the rarity of restored prairies of the desired size and diversity. The initial soil sampling and plant inventories were conducted during the following field season but are listed here, as they relate to the goals and deliverables of result 1.

Completion Date: 6/30/2011

Final Report Summary for Result 1:
In the fall of 2008, potential field sites were identified in six geographic regions of Minnesota. Specific ecological and management conditions were required to be selected as long-term prairie research sites for this project. Many sites did not meet these conditions, as they were often inaccessible, too wet, or poorly managed for weeds or woody plants. The project team reduced the regional site locations to three, which spanned the moisture and temperature gradient in western Minnesota (fig. 1). Sites were chosen based on availability of funds, feasibility of the sites, uniformity within its climate and soils, and the ability to conform to randomized block design. Each site had four blocks containing four 20-acre plots. One block represented one repetition with all treatments within it.

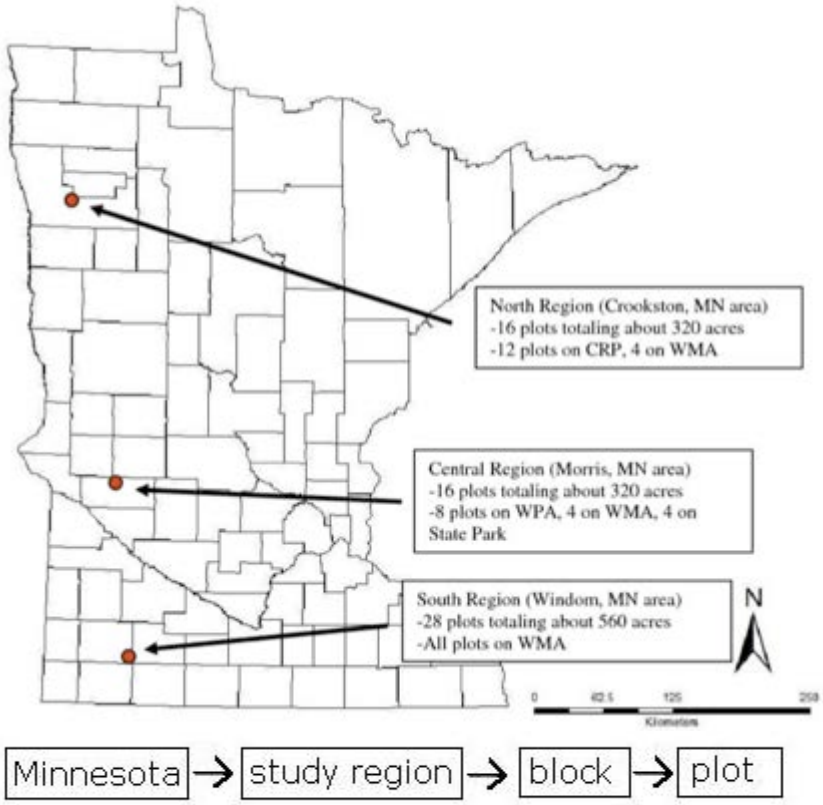


Figure 1. Three research sites were chosen, spanning Minnesota's western latitudes.

Land-use permits were acquired from the Minnesota Department of Natural Resources (DNR), the U.S. Fish and Wildlife Service (USFWS), and the U.S. Department of Agriculture (USDA) to conduct wildlife surveys and harvest grassland biomass. All plots in the southwest site (near Windom, MN) were established on DNR-owned Wildlife Management Areas (WMAs). Plots in the central site (near Morris, MN) were established on federally-owned Waterfowl Production Areas (WPAs) and on MN State Park land. Plots in the northwest site were established on WMAs and on privately-owned parcels enrolled in the Conservation Reserve Program (CRP).

The managing entity of each plot, such as the DNR, the USFWS, or the private CRP landowner, worked with project personnel to identify potential geographic areas within and around plots that could cause problems for harvesting or surveying. In some plots, “species of concern” used the area. Therefore special experimental accommodations were made to ensure their sustainability.

A work plan was prepared. In spring 2009, plot maps were generated, including multiple GIS layer files to identify characteristics of each plot. Ground truthing was performed to ensure accuracy, boundary markers were posted at the corners and center of each plot, and field reference points for wildlife surveys were proposed (fig. 2). A layer file was generated to show the harvest treatment and harvest patterns for each year of each plot.

Figure 2. Boundary markers such as this were placed at the corners and center of the plots.

Vegetation and soil

Baseline vegetation data and soil samples were collected in summer of 2009 to accompany the land reports. In particular, vegetation surveys identified the plant species in each plot, how many species are present, and what fraction of the total plot area each species covered (fig. 3). The latter two are referred to respectively as species diversity and percent cover. Samples of biomass were cut from each plot to estimate biomass growth through summer. Soil samples were collected from each plot and analyzed for nutrient concentrations (N, P, K, Zn, Fe, Mn, Cu, Ca, Mg, pH, organic matter, and cation exchange capacity).

Using the supplemental funds from the NFWF, individual plants were identified and marked in the southwest plots, to be monitored for the timing of growth, bloom, seed development, and other phenological characteristics. Plant species chosen for

phenological monitoring were restricted to those cataloged in the U.S. National Phenology Network so that data from this project could be used by others.

Figure 3. Percent cover, or what fraction of an area a given species covered, was one measure of baseline vegetation.

Result 2: First growing season results (Mar 2009-Feb 2010)

Description: At each site a range of management methods were tested so that measurement protocols could be evaluated. For example, some plots were harvested completely, some were harvested leaving larger wildlife refuge (50% harvest), some leaving lesser wildlife refuge (75% harvest), and a control was not harvested. In addition, in the southwest region, harvesting in blocks was contrasted with strips, using NFWF supplemental funds. Wildlife benefits were determined by surveys of both general indicator species and specific species of interest, including birds, insects, and mammals. Indicator species include those that may be of no economic interest, but whose populations indicate a healthy habitat. Biofuel values were determined by harvest combined with estimates of economic costs. Ecosystem values were determined through measurements including soil samples, floral bloom surveys, and water assessments.

1. *Biomass, wildlife, and floral datasets.* The goal of this deliverable was the collection and compilation of initial small mammal, large mammal, bird, insect, reptile, and amphibian data, and the full collection of the plant inventory data. These data sets established benchmarks prior to experimental treatments. Initial harvested biomass data were also collected.

   The budget for this deliverable included
   - purchase of field supplies
   - personnel time for project and data management
   - supervisors
   - research interns (data collection)
   - transportation to sites and lodging

2. *Assessment of initial data and protocols.* The goal of this deliverable was assessment of the harvesting and sampling protocols after a full season's experience, and determination of compatible adjustments to be made in future harvesting and sampling. This included the initial assessment of the biomass data from fall-harvested plant material.

   Budgeting for this deliverable included funds for
   - personnel time for data management and analysis
   - professional services (harvest of prairie plant material)
   - personnel time for analysis of harvested prairie plant material

Summary Budget Information for Result 2:	**Trust Fund Budget:**	**$ 330,000**
	Amount Spent:	**$ 330,000**
Amendments approved [5/1/2010]	**Balance:**	**$ 0**

Deliverable	**Completion Date**	**Budget**	**Status**
1. Biomass, wildlife, and floral datasets.	Dec 15, 2009	$170,000	**Complete**
2. Initial assessment of best management practices.	Feb 15, 2010	$160,000	**Complete**

Completion Date: 6/30/2011

Final Report Summary for Result 2:

Multiple baseline surveys were conducted on every plot, each requiring collaboration with the respective wildlife experts. An outline of sampling techniques and procedures was documented, together with an initial list of supplies for the surveys and other tasks.

Grassland songbirds
Bird surveys started in spring of 2009. Audio and visual species identification and counts were conducted while observers walked a pre-designed path, called a transect, through each plot. The actual transect walked was recorded by handheld GPS (fig. 4). Surveys were started at a randomly selected corner of the plot, and each plot was surveyed twice. Surveys conducted no earlier than half hour past sunrise and no later than 12pm. Surveys began middle of May in the southwest region and ran through early June, ending in the northwest. A second round was conducted in the southwest from June 11-24. Each walked transect took approximately 15 to 30 minutes.

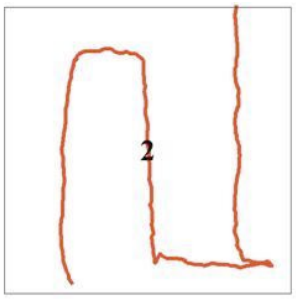


Figure 4. Baseline bird surveys took place in spring 2009 using audio and visual species identification. Data was collected by walking pre-selected transects, which was also recorded for data validation using handheld GPS (right panel).

Nesting surveys and predation

Searches for ground-level bird nests were conducted in select plots at the southwest site. A team of surveyors used chain-dragging methods to flush waterfowl and game birds from nests so that the research team could identify the species nesting, record egg development data, and mark the nest for continuous revisits to assess successful hatching and fledging (figs. 5 and 6). In some plots, false nests were created and baited with unfertilized chicken eggs, then monitored with motion sensing cameras. These data helped identify likely nest predators, including large mammals (fig. 7).

Figure 5. Surveyors used chain-dragging methods (right) to flush waterfowl and game birds from nests. They could then identify the species nesting, record egg development data (left), and mark the nest for continuous revisits.

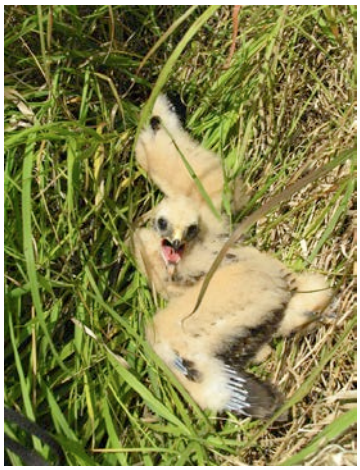


Figure 6. Continuous revisits to ground nests assessed successful hatching and fledging.

Figure 7. Motion sensing cameras helped identify likely nest predators, including birds (left) and mammals (right).

Small mammals

Small mammal data were collected in spring and fall of 2009 using Sherman catch-and-release traps in a seven by seven grid, with traps spaced 15 meters apart. Traps were set nightly for three consecutive nights and checked each morning (fig. 8). This was increased to four consecutive nights in 2010.

Figure 8. Sherman live traps (left) were set up in a grid for catch-and-release survey of small mammals, including 13-striped ground squirrel (right).

Herpetofauna

Reptiles and amphibians (herpetofauna) were surveyed during the spring and summer of 2009, using catch-and-release trap arrangements that incorporate funnel and pit-fall live traps (figs. 9 and 10). We have tested techniques for capturing herpetofauna in Minnesota grasslands and developed a method for a fenced pitfall array that works well. An array consists of some form of short impassable fencing sunk into the ground in the shape of a “Y” with a bucket sunk below the end of each arm and at the center (fig. 9). These array arms were initially made of silt fencing but were improved in 2010 to aluminum flashing to better withstand winds. This survey was done only in the southwest region, using special funding for that purpose from the NFWF matching grant.

Figure 9. Reptiles and amphibians were surveyed using catch-and-release trap arrangements in arrays (left and center panels) that incorporate funnel and pit-fall live traps (right). Silt fencing arms (center) were replaced with aluminum flashing in 2010. Green dots in the left panel indicate buckets, and red dots indicate funnel traps.

Figure 10. Reptile and amphibians found on Minnesota prairie, surveyed using catch-and-release methods.

Invertebrates

Invertebrates were surveyed throughout the growing season using sweep nets. Eight transects were selected from each plot and were sampled three times in one growing season, in June, July, and August. We designed a new process, called Quantitative Insect Sampling Technique (QuIST), for assessing sweep net collection comprehensiveness and efficiency. QuIST is an enclosed screened "tent" in which we attempt to capture all insects in its interior with vacuum equipment (fig. 11). QuIST was tested at the southwest sampling site and will be used to calibrate sweepnet sampling across sites. Insect samples were frozen and then sorted into taxonomic groups by laboratory specialists. To further complement the QuIST sampling, a trial session of pit-fall traps took place in 2009 to provide preliminary data used in selecting the best method.

Insects collected on the plots were properly stored and then sorted by project members in labs, both at Cedar Creek and on the St. Paul campus.

Figure 11. QuIST is a new technique developed for this project to assess insect sweep net collections, using a small "tent" and vacuum equipment.

Vegetation

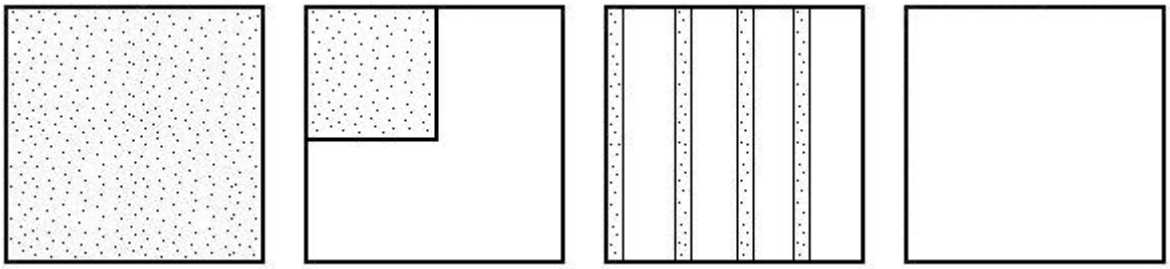
Vegetation surveys from 2009 are described in Result 1.

Harvest

A harvesting plan was developed. Potential local farmers/landowners were contacted about harvesting the biomass from the plots. Estimated harvesting costs and logistics were calculated and documented. One existing destination for harvested biomass was identified in Morris, Minnesota and one future destination in Shakopee, Minnesota. Estimates of transportation and associated costs from experimental sites to Morris were calculated, and the procedures for transportation and delivery of biomass were outlined and documented.

Each 20-acre plot received one of several treatments. The four treatments relevant to LCCMR funding were:

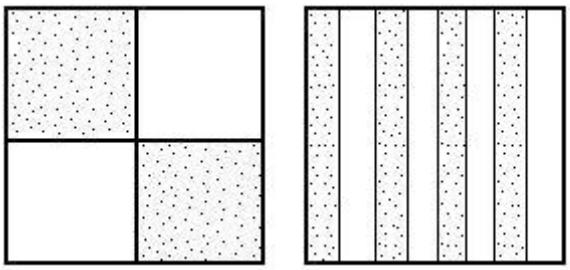
I.) Control - no harvest
II.) 75% harvest block
III.) 75% harvest strip
IV.) 100% harvest



I.) control II.) 75% harvest-block III.) 75% harvest-strip IV.) 100% harvest

After the search for plots began, the project team received award notice of a supplementary $300,000 grant from the National Fish and Wildlife Foundation (NFWF). The matching funds became available June 10, 2008, and supported the expansion of treatments in the southwest region for an additional twelve plots. Two additional treatments that were supported with the NFWF funding were:

V.) 50% harvest block
VI.) 50% harvest strip



V.) 50% harvest-block VI.) 50% harvest-strip

Please note the dual definition of “block” in this project, as one represents a group of four plots, and the other means harvesting in a “square” pattern.

A control plot is not harvested, leaving 100% refuge. In a 75% harvest-strip and 75% harvest-block, one quarter is left for refuge, either in separated lanes or one square, respectively. The 75% block harvest pattern consisted of a fifteen-acre harvested area and a five acre unharvested refuge block located in one corner of the plot. The 50% block harvest pattern consisted of two five-acre harvested blocks located opposite of each other in two corners of the plot. The unharvested area will rotate within the plot each harvest so that the previous year’s refuge gets harvested. A 100% harvest plot leaves no refuge grassland.

Harvest for 2009 began in October at the Crookston site and soon after was completed at the southwest site. All plots were harvested using commercial-scale farm machinery and tools. In the northwest, all scheduled plots were harvested, for a total of approximately 170 acres. At the west central site, one block (three plots) could not be harvested due to wet conditions. Two other plots at this site were partially harvested because of wet conditions. A total of about 125 acres were harvested in the central site. In the southwest, one plot was not harvested because of snow, while another was cut but not baled because of wet conditions. A total of about 310 acres was harvested in the southwest.

Once harvested, each plot was surveyed and GIS points were marked to record the actual area harvested, which may have differed from the planned treatment for several reasons, including harvesting around wet areas. The outlines were converted to a GIS layer for mapping and precise calculations of harvest areas. Stubble height was measured at randomized locations throughout the cut areas in each plot. Please see Result 3 for a further discussion of harvest methods and system, including dates and equipment.

Cores from a sample of bales were collected from each plot, dried, and analyzed for elements related to plant growth rates (N, P, K, S, Ca, Mg, Na, Zn, Fe, Mn, Cu, and B), protein concentrations, digestibility, and moisture content (fig. 12).

Figure 12. Bale core sampling takes place immediately following harvests.

Result 3: Combined multi-season results (Mar 2010-Jun 2011)

Description: The description for this result is the same as for Result 2 above, but includes the next growing season.

1*. Biomass, wildlife, and floral datasets*. The goal of this deliverable was the second collection and compilation of small mammal, large mammal, bird, insect, and plant data, and the first complete post-treatment survey. Datasets conform to standards established for Cedar Creek LTER archival storage of data.

Budgeting for this deliverable included funds for

- purchase of field supplies
- personnel time for project and data management
- supervisors
- research interns (data collection)
- transportation to sites and lodging
- professional services (harvest of prairie plant material)
- personnel time for analysis of harvested prairie plant material

2. *Final report, best management practices in working prairies*. The goal of this deliverable is to recommend best management practices that are compatible with wildlife conservation and ecosystem health. The report is being written and organized so that it can be used in policy decisions in government, industry, and non-governmental organizations. Related web pages have been designed for accessibility by the interested public. Because of continuation funding in 2011 from the Environmental and Natural Resources Trust Fund, this report will now cover the first half of a six-year study.

Budgeting for this deliverable includes funds for

- personnel time for data management and analysis
- personnel time for final report creation
- publication cost of the final report (now negligible because of the benefit of electronic publication)

3. *Final report, general protocols for evaluating biofuel production, wildlife conservation, and ecosystem services.* The goal of this deliverable is to recommend best methods for surveying wildlife responses. It specifically addresses bioenergy management practices, including effects on mammals, birds, insects, and potentially reptiles and amphibians, plus floral and soil sampling. The report was organized so that it can be used by specialists in planning and implementing future wildlife surveys, especially as they relate to bioenergy systems. Because of continuation funding in 2011 from the Environmental and Natural Resources Trust Fund, this report covers the first half of a six-year study.

Budgeting for this deliverable includes funds for

- personnel time for data management and analysis
- personnel time for final report creation
- publication cost of the final report (now negligible because of the benefit of electronic publication)

Summary Budget Information for Result 3: **Trust Fund Budget: $ 244,000**
Amount Spent: $ 244,000
Balance: $ 0

Deliverable	**Completion Date**	**Budget**	**Status**
1. Biomass, wildlife, and floral datasets.	Oct 15, 2011	$ 150,000	**Completed**
2. Final report, best management practices in working prairies.	Nov 15, 2011	$ 70,000	**In Progress**
3. Final report, general protocols for evaluating biofuel production, wildlife conservation, and ecosystem services	Dec 15, 2011	$ 24,000	**Completed**

Completion Date: 6/30/2011

Final Report Summary for Result 3:

2010 field season

The first post-treatment surveys began in spring 2010.

Grassland songbirds
Bird surveys were conducted in that spring with the same protocols as 2009.

Nesting surveys and predation
Nest searches also continued with the same protocols as 2009.

Small mammals

Small mammal catch-and-release trapping in 2010 was conducted only in the fall to improve allocation of labor and data collection from the previous year. However, trap nights were increased from 3 to 4 per region to collect more data. Weighing the animals continues to be an efficient use of time, but we discontinued more detailed measurements of the small mammals due to time restraints and to lessen any stress on the animals.

Overall there were more small mammals captured per trap-night in 2010. Initial analysis indicates an effect of harvest treatment, but it is not statistically significant with just one year of treatment. In Figures 13-17, data for 2009 represent the baseline numbers, before any harvest and data for 2010 shows numbers after one harvest. Noticeable trends are present in Figure 13, which shows all small mammals combined, though not statistically significant after one year ($df=3$, $p<0.4$). The trends, if they hold in future years, suggest that 50% harvest, which leaves open and covered area in equal measure, increases small mammal abundance compared with other treatments, including no harvest at all.

When looked at by individual taxonomic groups, results from *Peromyscus, Blarina, Microtus* and *Sorex* also show no significant effect of harvest so far (fig. 14-17). However, in order to have clearer resolution, data is needed from future years, including 2011. *Sorex* and *Microtus* indicate that a trend of an effect of harvest may be detected with more data. *Blarina* and *Microtus* and total small mammals data were analyzed with negative binomial distribution in a repeated measures before-after-control-impact (BACI) design. *Peromyscus* and *Sorex* used Poisson distribution in the same repeated measures BACI design.

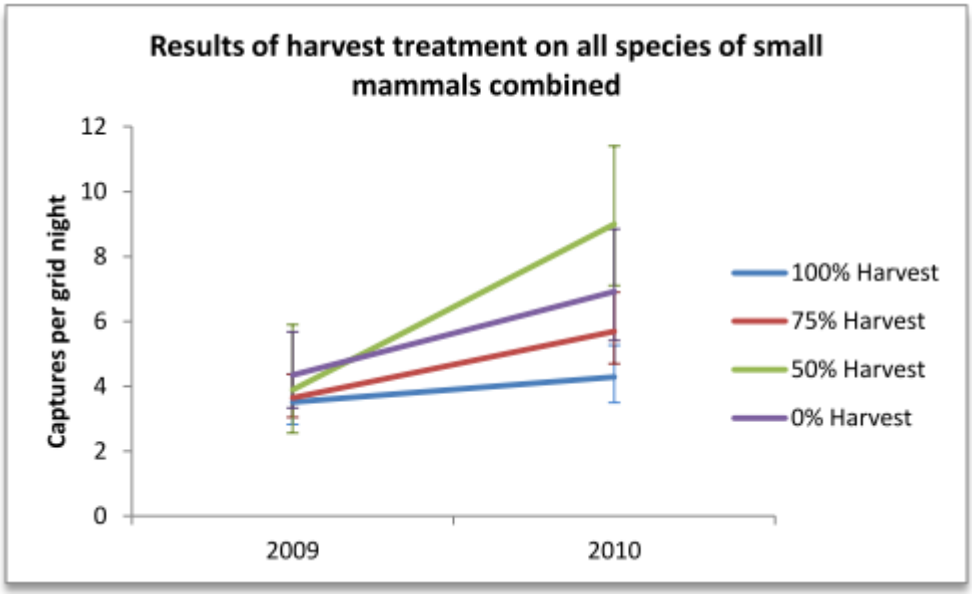


Figure 13. 2009 are baseline data, before any harvest. 2010 are results after one harvest. Noticeable trends are present though not statistically significant after one year (df=3, p<0.4). The trends suggest that 50% harvest, which leaves open and covered area in equal measure, may increase abundance compared with other treatments, including no harvest.

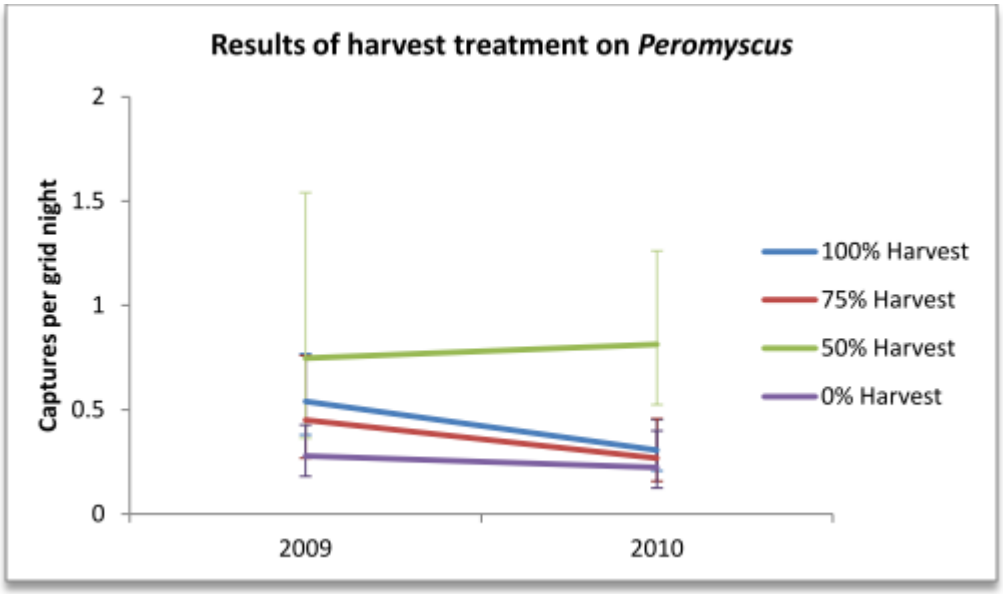


Figure 14. 2009 are baseline data, before any harvest. 2010 are numbers after one harvest. Trends show *Peromyscus* (species of mice) captures remaining unchanged on 50% and 0% harvest plots, but decreased slightly for 100% and 75% harvests, although results were not significant (df=3, p<0.70).

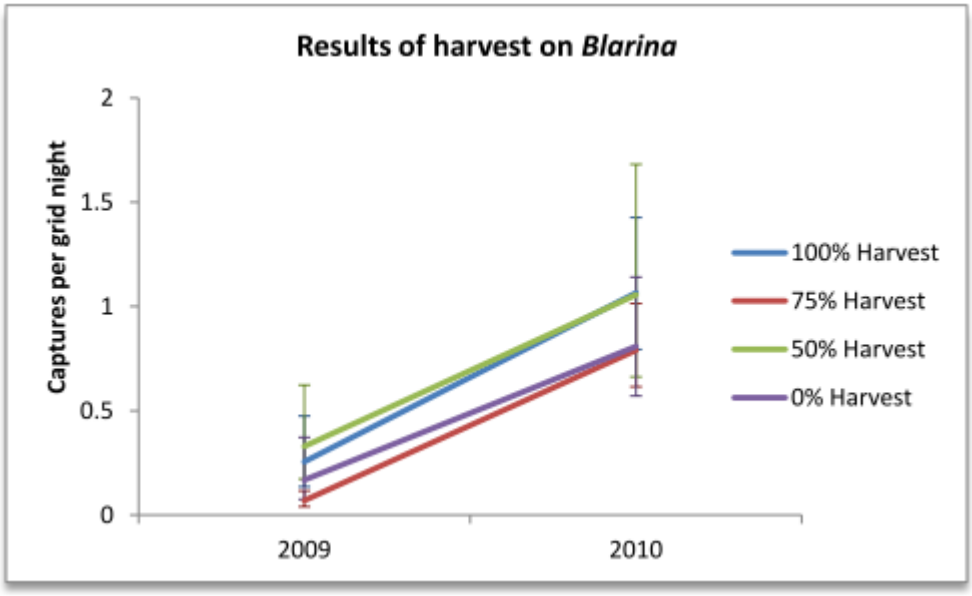


Figure 15. 2009 are baseline data, before any harvest. 2010 are numbers after one harvest. Trends show *Blarina* (species of shrews) captures do not differ due to treatments (df=3, p<0.30).

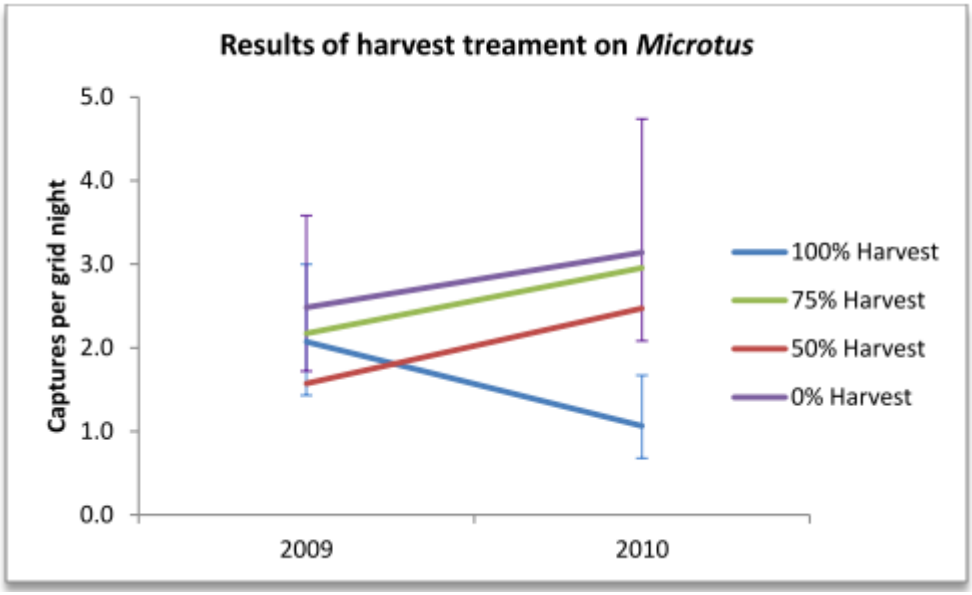


Figure 16: 2009 are baseline data, before any harvest. 2010 are numbers after one harvest. Trends show *Microtus* (species of voles) captures diverged after one treatment, with captures in 100% harvest plots decreasing while the plots with remaining refuges tended to increase in *Microtus* captures slightly. Results were not significant, however (df=3, p<0.28).

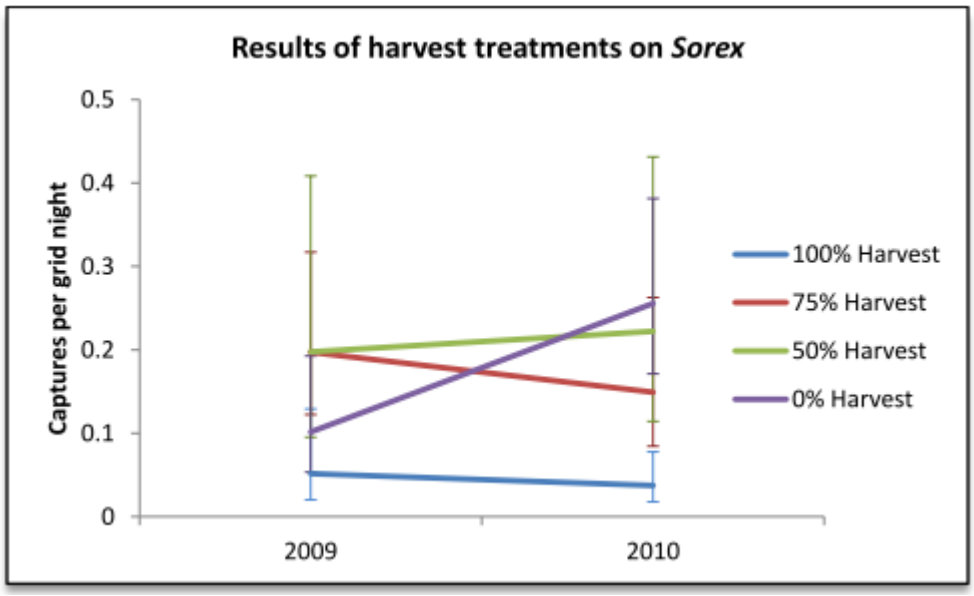


Figure 17: 2009 are baseline data, before any harvest. 2010 are numbers after one harvest. *Sorex* (including species of shrews) captures remaining more or less steady on 50%, 75% and 100% harvest plots, while areas that were not harvest increased in captures, although not statistically significantly (df=3, p<0.36).

Herpetofauna

Reptile and amphibian catch-and-release traps were improved from the 2009 design, installed in the spring of 2010, and operated into the fall. The fenced pitfall arrays were initially made of silt fencing (fig. 9). During the 2009 field season, it quickly became evident that this material was not strong enough to withstand the often windy conditions of the research area. The arms of the arrays would be torn by the wind, and have gaps, rendering that arm of the array ineffective in producing captures. Much time was spent repairing the arrays, however they were breaking down at a higher rate than repairs could keep up with.

In 2010, aluminum flashing was used instead of silt fence for the array arms. This material proved to be far better in the windy conditions. There were only a handful of times when the wind was able to cause damage that affected the capturing abilities of an array. This happened infrequently and the damage was minimal compared to that of the silt fencing. The damages were able to be repaired much more quickly. The shape of the arrays and location of buckets and funnel traps remained the same as 2009 (fig. 9). A second major improvement to the method was to check traps more frequently during peak frog activity (July). This helped minimize animal stress related to trapping.

In 2010, we also tested using buckets without the aluminum flashing. Flashing is expensive, and if buckets alone were effective it would save cost. For bucket arrays, buckets were sunk in the same formation as the fenced arrays, just without the

fencing. They were placed on the same plots as the fenced arrays, to compare catch capacity.

A total of eight species of herpetofauna were identified in the capture and release trapping program. The most frequent species was the Northern Leopord Frog, *Rana pipiens,* which accounted for just over half the total captures. Total captures in the fenced arrays from 2009 and 2010 is summarized in Table 1. Due to the frequent damage to silt fencing in 2009, there are large gaps in the data from that year and the total catch is low. The use of aluminum flashing in 2010 allowed much more thorough data collection. To confidently determine effects of harvest on herpetofauna, we will compare the 2010 and 2011 data sets using before-after-control-impact statistical analysis, during Phase II of the project.

Bucket arrays without fencing had a capture rate that was so much below that of fenced arrays that they are not considered by us to be a useful method (Table 2).

Table 1. Total herpetofauna captures on 0% and 100% harvest plots in fence arrays: **2009 vs. 2010**

Total Herp captures on 0% & 100% harvest plots in fence arrays: 2009 & 2010														
Array type	**Year**	**Percent Harvest**	**Northern Leopard Frog (*Rana pipiens*)**	**Western Chorus Frog (*Pseudocris triseriata*)**	**Plains Garter Snake (*Thamnophis radix*)**	**Common Garter Snake (*Thamnophis sirtalis*)**	**Tiger Salamander (*Ambystoma tigrinum*)**	**Prairie Skink (*Eumeces septentrionalis*)**	**Painted Turtle (*Chrysemys picta*)**	**American Toad/Great Plains Toad (*Bufo spp.*)**	**Total # of captures**	**# Species**	**trap nights**	**Specimens/trap night**
Fence	**2009**	**0%**	22	3	1	1	0	1	0	4	39	6	36	1.08
Fence	**2009**	**100%**	2	0	0	0	0	0	0	3	7	3	30	0.23
		2009 Total	**24**	**3**	**1**	**1**	**0**	**1**	**0**	**7**	**46**	**6**	**66**	**0.70**
Fence	**2010**	**0%**	315	13	62	25	18	4	1	46	484	8	569	0.85
Fence	**2010**	**100%**	142	5	52	15	17	3	0	92	326	7	573	0.57
		2010 Total	**457**	**18**	**114**	**40**	**35**	**7**	**1**	**138**	**810**	**8**	**1142**	**0.71**

Table 2. Total herpetofauna captures on 0% and 100% harvest plots in 2010: **Fence vs. bucket arrays**

Total Herp captures on 0% & 100% harvest plots in 2010: Fence arrays vs. bucket arrays														
Array type	**Year**	**Percent Harvest**	**Northern Leopard Frog (*Rana pipiens*)**	**Western Chorus Frog (*Pseudocris triseriata*)**	**Plains Garter Snake (*Thamnophis radix*)**	**Common Garter Snake (*Thamnophis sirtalis*)**	**Tiger Salamander (*Ambystoma tigrinum*)**	**Prairie Skink (*Eumeces septentrionalis*)**	**Painted Turtle (*Chrysemys picta*)**	**American Toad/Great Plains Toad (*Bufo spp.*)**	**Total # of captures**	**# species**	**trap nights**	**Total captures /trap night**
Fence	**2010**	**0%**	315	13	62	25	18	4	1	46	484	8	603	0.80
Fence	**2010**	**100%**	142	5	52	15	17	3	0	92	326	7	610	0.53
		Fence Total	**457**	**18**	**114**	**40**	**35**	**7**	**1**	**138**	**810**		**1213**	**0.67**
Bucket	**2010**	**0%**	5	0	0	0	3	0	0	5	13	3	603	0.02
Bucket	**2010**	**100%**	0	0	0	0	1	0	1	11	13	3	610	0.02
		Bucket Total	**5**	**0**	**0**	**0**	**4**	**0**	**1**	**16**	**26**		**1213**	**0.02**

Invertebrates

In 2010, insect protocols were adjusted to improve sampling efficacy in response to 2009 results. Pit-fall traps were fully implemented in 2010, with traps installed in 100% harvest and control plots in all regions, sampled in June, July, and August. QuIST sampling was also expanded to collect data throughout the summer. Sweepnet samples were again collected in eight transects per plot in all the 100% harvest and control plots. In the southwest region we continued sweep net sampling in plots with 75% and 50% harvest, but not in the other regions.

In addition, a pilot study was conducted to sample pollinators from experimental plots in the southwest region. These specimens were identified and stored for future study.

Sweepnet survey results were converted to biomass estimates to compare this important food source for songbirds, small mammals, and other animals in the plots (fig. 18). Preliminary analysis has been done using 2009-2010 sweepnet samples. This analysis separated invertebrates by phylogenetic order and focused on the difference between 0% and 100% harvest plots. Data show that harvesting plots correlated with an increase in invertebrate biomass (at pd0.10) of Hemiptera (true bugs), Coleoptera (beetles), Larvae (all soft caterpillar-like immature invertebrates), and Diptera (Flies) (fig. 19). Other groups of invertebrates show no difference in biomass between harvested and unharvested plots: Aranea (spiders), Hymenoptera (ants, bees and wasps), Orthoptera (grasshoppers), Lepidoptera (butterflies and

moths). Based on these numbers it appears that one year of harvest can increase invertebrate biomass of some taxonomic groups, and leaves others unchanged.

One hypothesis for the increase in some groups is that the removal of dead vegetation allows an increase in green vegetation the following year. This hypothesis and others will be tested in the second phase of this project.

Certain functional groups of invertebrates---i.e., groups defined by their roles in the ecosystem---are beneficial to humans. Pollinators enable seed production and parasites and predators help control certain crop pests. These functional groups were analyzed and show no degradation due to full harvest. That is, there was no significant difference between control and full harvest data (fig. 20). Insect pitfall data will be analyzed when the 2011 data are available.

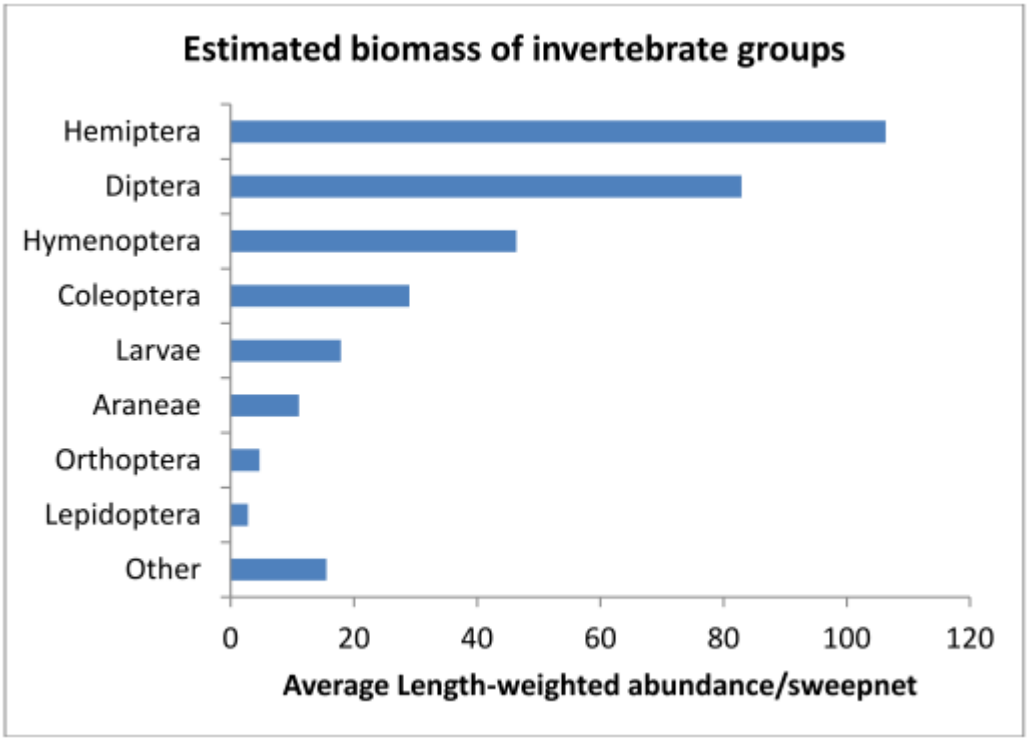


Figure 18: Calculated biomass by invertebrate order. 2009 and 2010 data was combined. “Other” includes taxonomic orders that had very few individuals collected. “Larvae” indicate all soft caterpillar-like immature insects.

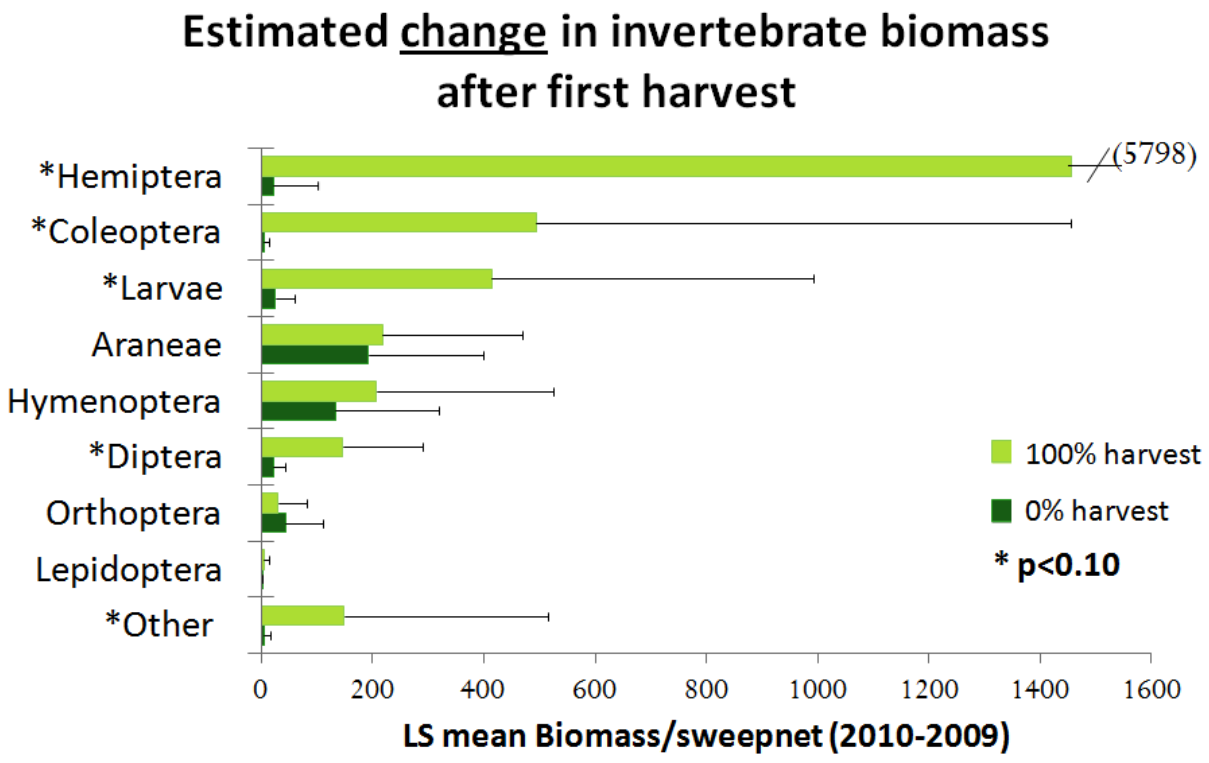


Figure 19: Biomass of invertebrate groups by harvest treatment. Biomass is presented as the difference between pre and post harvest surveys (ie. the biomass in 2010 minus biomass in 2009). Starred groups are significant at p<0.10.

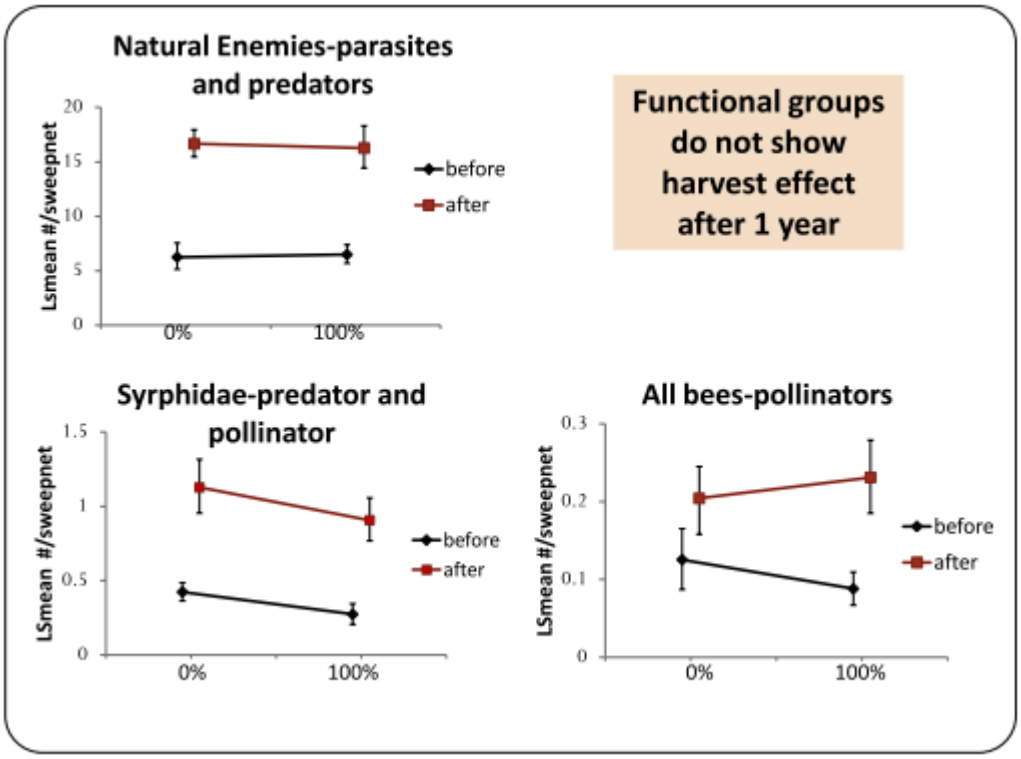


Figure 20: Functional group preliminary analysis showing no statistically significant treatment affect after 1 year of harvest.

Vegetation

Individual plants were monitored for height, leaf length, flowering time, seed time, and senescence, as well as other phenological characteristics in 2010. The same protocols were used in 2010 as in 2009, and matched surveying specifications set by the U.S. National Phenology Network. Logistical details of the monitoring process were examined to finalize a protocol for future use, within this project and beyond.

In 2010, we ran a pilot study surveying blooming time and quantity. Transects were walked once a week and blooming species were recorded, along with approximate numbers of flowering units (blooms). Monitoring for phenology was combined with surveys of flowers and other pollinator resources to maximize sampling efficiency. Emphasis was placed on the phenology of insect-pollinated plants because they provide supplemental food sources to insect pollinators of economically important crops and grasslands. The protocols for this survey were implemented in the spring of 2011.

Vegetation surveys were conducted to estimate plant species diversity and percent cover. The number of sample points within each plot was increased from 2009 to test the benefits of greater sampling precision, with the greatest number of samples in the 100% harvest and controls. Biomass yield was measured at each sample point. The adjusted protocols were assessed and recommendations were made for future surveys.

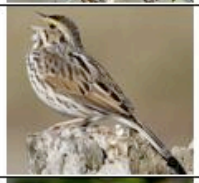
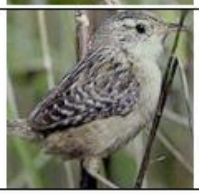
2011 field season

Grassland songbirds

Songbird surveys were conducted with the same protocols as previous years. Preliminary results are summarized and presented below (table 3). Data for 2011 is included for songbird surveys only, because it was completed before the project deadline of June 30, 2011. Note that while the data below offer insight into effects of harvest, they should not be taken as definitive until they can be fully analyzed and incorporate survey data from the second half of this study.

Many birds, especially sparrows, were detected primarily by their songs, but blackbirds and Bobolinks were detected by both sight and sound. Plots were surveyed in 2009 (pre-harvest data) and again in 2010 and 2011 (post-harvest). Bobolink were the most common songbird recorded overall (Table 3). This is a positive sign, as Bobolinks have been greatly affected by prairie loss. Other prairie songbirds that were also using plots frequently include Savannah Sparrow, Common Yellowthroat, Sedge Wren, Clay-colored Sparrow, Grasshopper Sparrow and the Swamp Sparrow.

Table 3. The top 10 bird species found across all surveyed plots and total number recorded through visual and audio surveys in 2009-2011.

Bird	Total no.		Bird	Total no.	
1. Bobolink	2124		6. Grasshopper sparrow	418	
2. Red-winged blackbird	1534		7. Clay-colored sparrow	352	
3. Savanna sparrow	888		8. Dickcissel	108	
4. Common yellowthroat	800		9. Song sparrow	85	
5. Sedge wren	572		10. Swamp sparrow	77	

Images: wikipedia.org

Two important measures of harvest effects are on total songbird abundance and number of species recorded in surveys. We used a repeated measures before-after-control-impact (BACI) statistical analysis, where survey results are compared before and after harvest on the same plot. Data from all grassland birds combined (21 species) are presented below in Figure 22. There were significantly fewer birds detected in 2010 and 2011 than in 2009 (P = 0.002) but there was no evidence that bird abundance differed between harvest and non-harvest plots (P = 0.72). There was a tendency for fewer birds to be detected in high-harvest plots, but this pattern was also present in the pre-harvest data and therefore does not reflect an effect of vegetation removal. This demonstrates the importance of using a BACI study design to establish baseline patterns before manipulating vegetation through biomass removal. We found similar results for the number of species (i.e., species richness), although in this case harvesting may have reduced the number of species while not affecting total number of birds. ($F_{3,144} = 2.58$, $P = 0.056$). We will refine these calculations using repeated-measures analysis as additional data are available.

We also have sufficient data to allow individual analysis of abundance for Grasshopper Sparrows, Savannah Sparrows, Clay-colored Sparrows, Sedge Wrens, Common Yellowthroats, Brown-headed Cowbirds, Red-winged Blackbirds, and Bobolinks. Scientific literature suggests that Grasshopper Sparrows may prefer short grass and therefore may be found more often in our harvested plots. Bobolink, Savannah Sparrow and Sedge Wren prefer taller grass and may be more often recorded in our unharvested plots (Sample and Mossman,1997). However, based on data collected through 2010, there was no evidence that any of these species had been affected by biomass harvest (fig. 24).

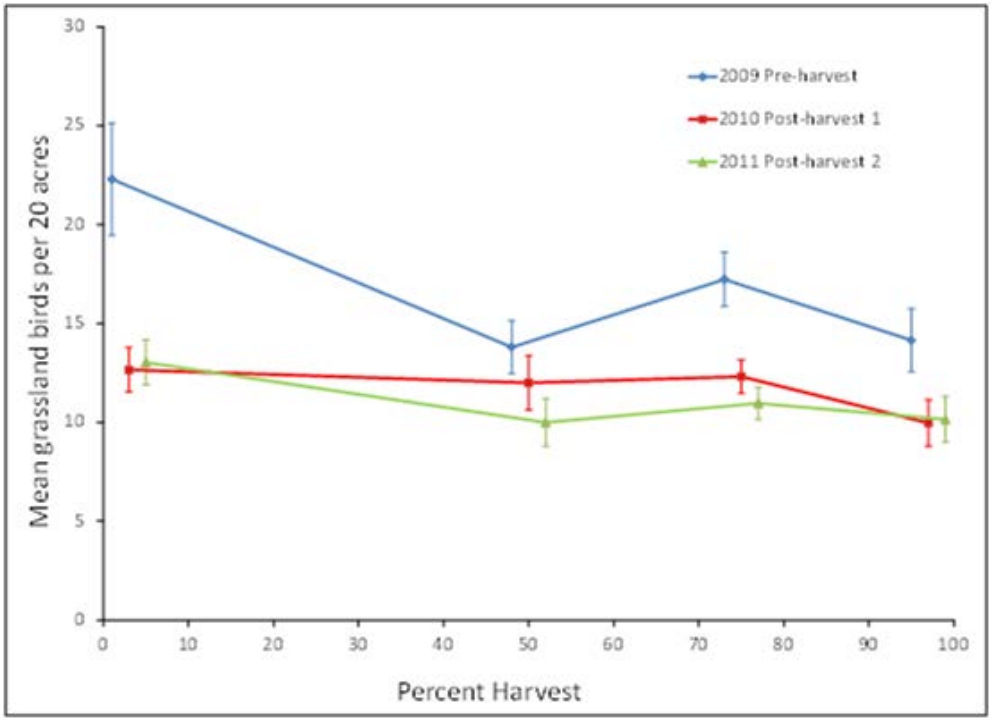


Figure 22: Grassland bird abundance as it relates to percent of plot harvested. The abundance of birds is shown along the y-axis and is measured as number of birds per 20 acres.

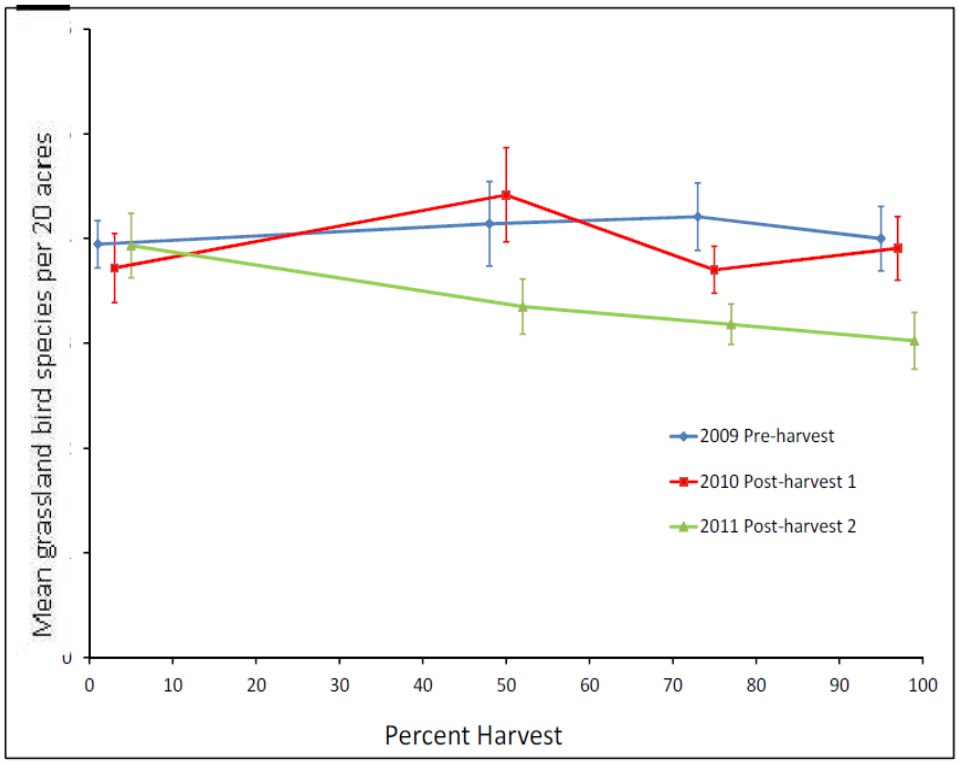


Figure 23: Comparison of number of grassland bird species as it relates to percent of plot harvested. Number of species per plot is shown on the y-axis.

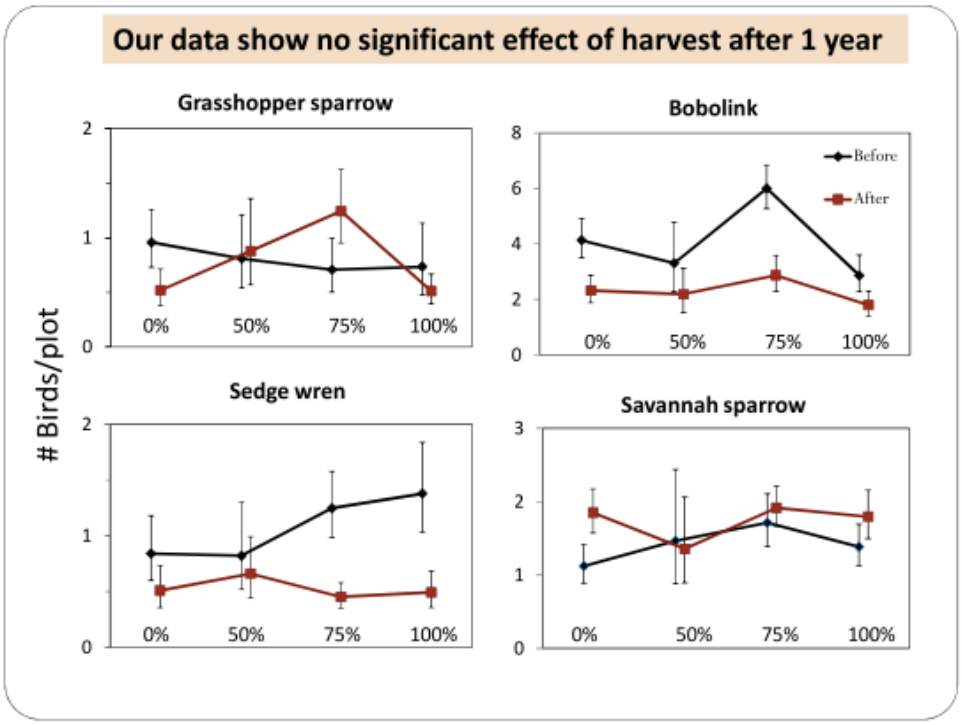


Figure 24: Analysis of harvest non-effect on the abundance of selected bird species.

In addition to BACI experimental design, it is important that treatment plots (100%, 75%, 50% harvest) are compared with each other and with control plots (0% harvest) in all years because inherent differences between plots can cause different survey results that do not have anything to do with harvest. For example, a plot close to a wetland may have more frogs than a dry plot, regardless of whether they are harvested or not. Geographic analysis will be conducted as part of Phase II.

Nesting surveys and predation
Nest and nest predation surveys were not conducted in 2011.

Small mammals
Small mammal surveys for 2011 were conducted after the ending date of this Phase and will be reported as part of Phase II.

Herpetofauna
In early spring 2011, catch and release trap arrangements for reptiles and amphibians were re-installed and operated throughout the summer using the same protocols as in 2010. Surveys were completed after the ending date of this Phase and will be reported as part of Phase II.

Invertebrates
Results of the 2010 pollinator pilot study were used to design a pollinator sampling program which was implemented in the 2011 sampling season. Sampling arrays were installed and monitored in the spring of 2011 in the control and full-harvest plots of the

southwest region. Figure 25 illustrates the survey method. Bee specimens were sorted and identified soon after collection.

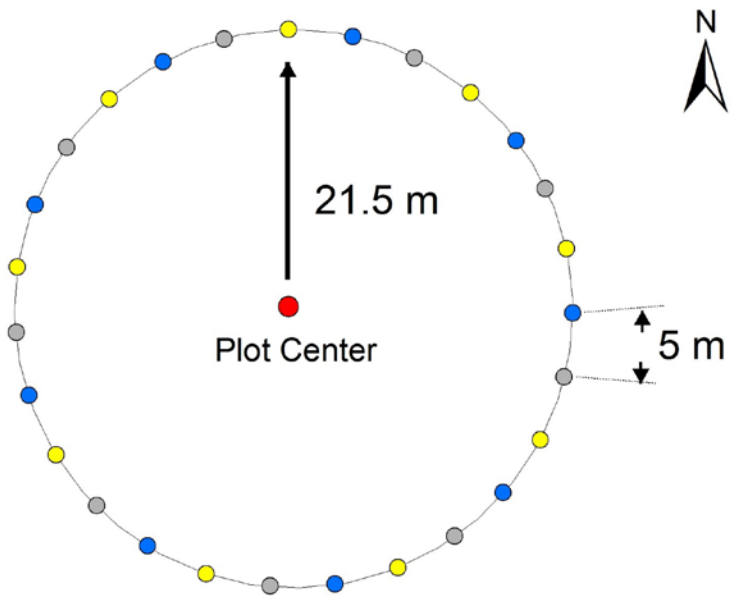


Figure 25: Bee bowl sampling layout. Circles indicate bamboo poles staked in the ground with color indicating the actual treatment vessel attached to the pole, painted either white, blue, or yellow. Vessels filled with soapy water to collect bees.

Insect sweep-net surveys were conducted in all control and full-harvest plots, and in intermediate harvest plots in the southwest region. QuIST was conducted in June 2011, also in the southwest region. Insect pitfall traps were run in the southwest region in the control and full-harvest plots.

Wildlife surveys in conclusion

Many types of wildlife and habitat surveys were performed to test potential differences in wildlife habitat due to biomass removal. Preliminary results from our methods do not show a negative effect of a single harvest of 20-acre plots on songbirds, small mammals, or insects. Some insect groups increased in biomass after 1 year of harvest. An increase in invertebrate biomass indicates more food for animals higher in the food chain. No negative impact on pollinators and agriculturally important invertebrates was detected.

Certain survey methods were not effective at the spatial scale used in this study (20-acre plots). Regarding nest searches, our plots do not encompass enough area to significantly affect the breeding territory of ducks and pheasants, given the landscape around plots. We did not get many sightings on predator cameras, so these were not able to be analyzed by treatment. Finally, pellet count surveys were conducted in February 2010 to determine use of our biomass plots by deer. Although we found two deer pellets in surveys, deer did not appear to be using plots, probably because of deep snow.

Harvest

In 2010, in the northwest region two plots were not harvested due to wet conditions. Two other plots received only a fraction of the proposed mowing for the same reason. A total of 108 acres was harvested in this region (fig. 26). In the central region, the block that was not harvestable in 2009 was accessed and harvested in 2010. All plots in this region were harvested, with only small fractions missing due to wet conditions. Nearly 175 acres were harvested in this central region. However, conditions grew increasingly wet, and nine plots in the southwest region became unharvestable. We were able to return to one plot in the spring and harvested prior to bird migration and nesting. This was only possible at one well-drained plot because recent snowmelt rendered the low-lying plots inaccessible.

Also in 2010, bale cores and stubble height data were collected from all harvested plots with same protocols as 2009. Analyses for mineral, elemental, cell-wall sugar, and forage were conducted on these biomass samples. Sugar ratios were also computed to estimate potential cellulosic ethanol yield.

Figure 26. Harvesting plots used commercial-scale equipment and followed GIS-generated maps to ensure coherence to the treatment pattern.

Bioenergy potential

A major objective of this study was to determine the bioenergy potential of restored grasslands in Minnesota. The project was designed to quantify the quantity and quality of biomass for energy production in multiple regions of the state. These results summarize biomass characteristics from the first two years of grassland biomass harvest, which took place in late autumn with production-scale harvest equipment. Samples were collected from all three study regions in Minnesota – Southwest, West-central, and the Northwest.

To determine if harvesting biomass in one year affects the amount of biomass available for harvest the following year, we compared yields from 2009 with those in 2010. There was no statistical difference between biomass yields in the two years sampled (p-value = 0.43). Although these results suggests that there was no effect of harvest on biomass yields the following year, there are other variables that influence grassland productivity, which could confound differences in yield values. Environmental variables such as rainfall, average growing season temperature, and

surrounding land use can influence grassland productivity differently year to year. Extending annual surveys will elucidate some of these effects.

This study was conducted on land managed by three different entities – the Minnesota DNR, the federal Fish and Wildlife Service, and private landowners. We hypothesized that bioenergy potential could be different from grasslands managed by different entities. Differences could come from the seed mixture that was used to establish the grassland, weed management techniques, and/or the schedule of disturbance regimes such as prescribed fire, grazing, or mowing.

Averaged across both years of sampling, there was no statistical difference between biomass yields in grasslands managed by the three entities tested in this study. Figure 27 shows a trend that suggests yields might be different, and a p-value of 0.14 was not overwhelmingly convincing that such a trend did not occur by chance. Future sampling to increase statistical power will determine if such a trend is indeed valid. Phase II of this project will provide data for such answers.

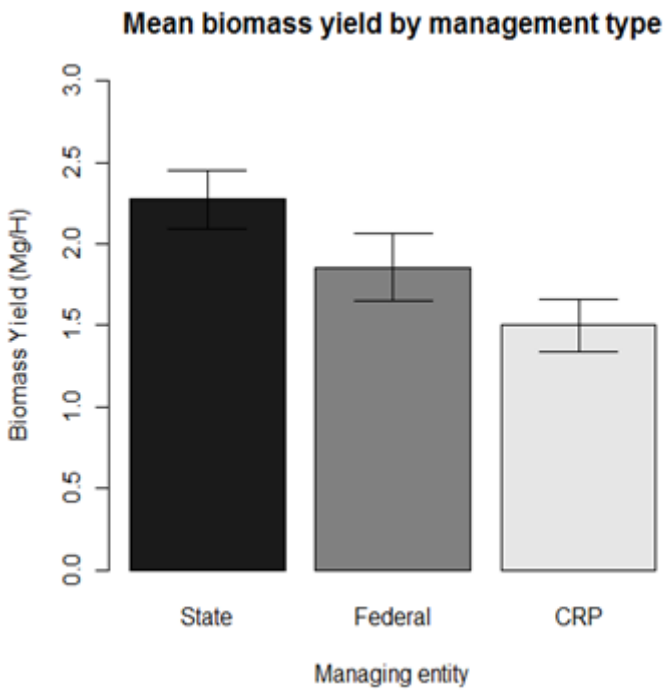


Figure 27: Mean biomass in grassland managed by different entities measured in metric tonnes per hectare (Mg/H) and averaged across 2009 and 2010. No significant differences in biomass yields were recorded (F stat = 2.01, d.f. = 2 and 69, p-value = 0.14).

Certain regions of Minnesota are expected to produce more biomass than others because of the difference in growing seasons. The northern portion of the state generally receives fewer growing-degree days, thus less energy for biomass production. Many other human-induced factors also influence biomass production which could interact with environmental drivers. Therefore, this study compared

biomass yields from grasslands harvested in three regions of Minnesota spanning the temperature gradient of the state.

Averaged over 2009 and 2010, biomass yields in the SW were 62% and 60% greater than yields in the WC and NW respectively (F stat = 7.59, d.f. = 2 and 69, p-value = 0.001). There was no difference in yields between the West Central and Northwest regions (fig. 28).

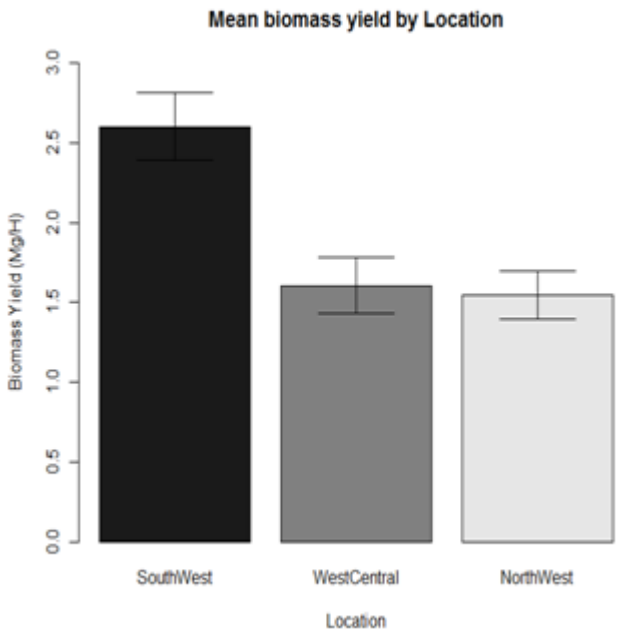


Figure 28. Mean biomass in metric tonnes per hectare (Mg/H) averaged across 2009 and 2010 by region. Error bars indicate ± 1 standard error. There was a significant difference in biomass yields between the Southwest region and the others.

This project also measured biomass quality in terms of characteristics that determine the efficiency to convert the material into energy. By measuring the proportion of certain sugars within the cell walls of plant material, a theoretical ethanol yield can be calculated. We measured the concentration of these sugars in biomass samples that were harvested to predict ethanol yield.

The average theoretical ethanol yield across all locations and years was 449.1 Liters/mg of biomass. There was no difference in bioenergy quality in biomass harvested in 2009 and 2010. There was a significant difference in predicted ethanol yield per unit of biomass in the southwest compared to the other regions (fig. 29). Ethanol yield reported here is not a function of biomass productivity, but rather of the plant species found in the grassland. Some plant functional groups are known to have higher concentrations of ethanol-deriving sugars than other plants. Warm-season grasses (those that use the C4 photosynthetic pathway) generally have higher concentrations of these sugars (Lee et al., 2007). Correlation studies suggest that there may be a relationship between the proportion of warm-season grasses and

potential ethanol yield in grasslands (Adler et al., 2009). We used data from summer plant cover surveys to study the relationship between plant species and theoretical ethanol yield.

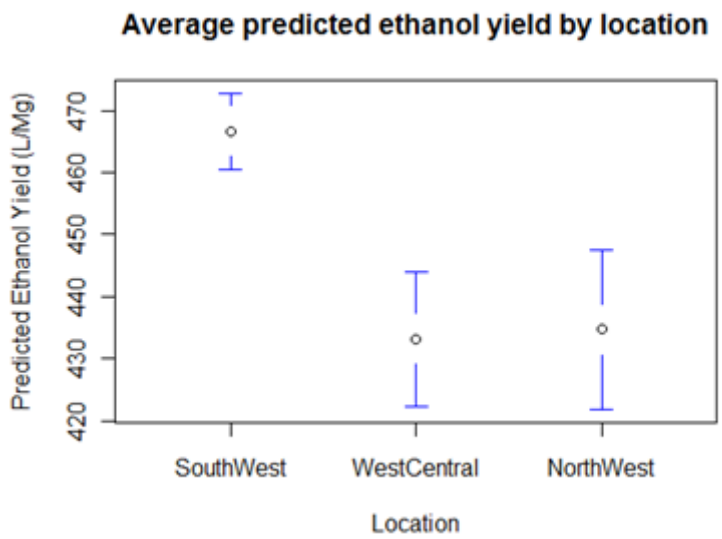


Figure 29. Mean predicted ethanol yield in liters per metric tonne of biomass averaged over two years of sampling. Grassland biomass from plots in the Southwest produce significantly higher theoretical ethanol yields that biomass from plots in the other locations.

Data from summer plant surveys was used to model theoretical ethanol yield. Figure 30 shows the mean ground coverage by warm season grasses in plots in all three regions, averaged across years. The amount of warm season cover is significantly greater in experimental plots located in the Southwest compared to those in the other locations.

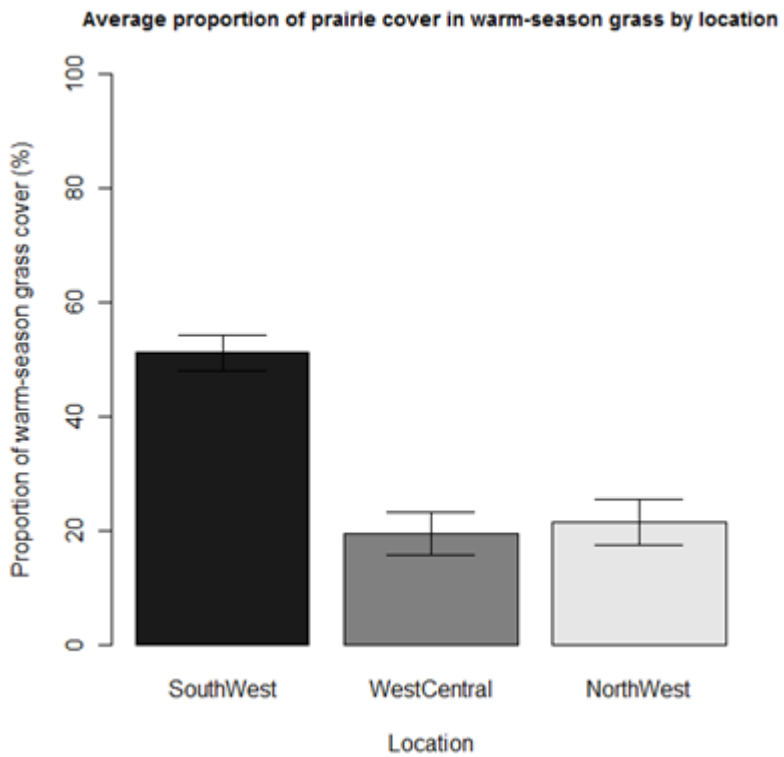


Figure 30. The difference in warm season grass coverage between locations. Error bars indicate ± 1 standard error.

A regression model was built using warm season grass cover as a predictor variable to explain potential ethanol yield. The model including a quadric term for warm season grass cover explains about 41% of the variation in potential ethanol yield (Table 4).

Table 4. Table of predicted model parameters, standard errors, and tests of significance.

	Estimate	Standard Error	t statistic	p-value
Y-intercept	416.23	5.46	76.19	$2 * 10^{-16}$
C4 cover	1.62	0.32	5.13	$2.54 * 10^{-6}$
$(C4\ cover)^2$	-0.013	0.0038	-3.39	0.0011
Adjusted r^2	0.41			
F-Statistic	25.89			
Degrees of Freedom	2 and 69			
p-value	$4.09*10^{-9}$			

In summary, our data show that more biomass can be harvest per unit of land in the Southwest portion of Minnesota compared to the other locations tested. Also, the biomass that is removed from this area can be more efficiently converted into ethanol than biomass from the other location. Since the cellulosic ethanol industry is in its infancy, it is possible that grassland biomass will first be used to produce other forms of energy, including heat, electricity, and/or syngas. Other biomass characteristics, besides cell-wall sugars, are evaluated to measure the quality of biomass for other conversion technologies. These can be found in Jungers et al. 2011.

We collected information on plant communities to characterize wildlife habitat and predict biofuel yield and animal populations. Baseline data on plant cover for each plot was produced in 2009. This information provides a general description of what plant species are most common in each plot. Such a description is especially valuable to land managers who are concerned with controlling invasive species. A summary of the most common species in terms of frequency and cover are presented in (fig. 31).

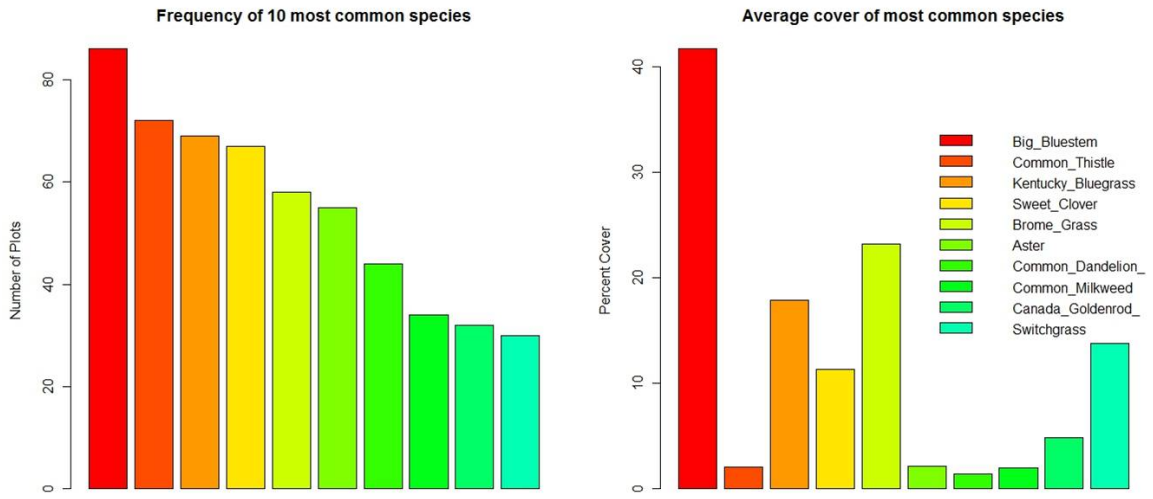


Figure 31. Left: the frequency of the 10 most common species measured by the number of plots in which each occurred. Right: the average cover that each species occupied in an average plot.

Methods used to monitor plant communities were altered to compare areas of grasslands that were harvested with those left standing. Previous studies suggest that changes in plant communities in response to harvest takes several years, if changes occur at all. Thus, data available at this time are not yet sufficient to show how biomass harvest affects plant community structure.

Harvesting process, equipment, and recommendations

The harvesting system used in this project was developed in concert with land owners, managers, and project personnel. Here we discuss harvest timing, location, equipment, advantages and disadvantages of our methods.

Site selection

An important factor in the feasibility and productivity of harvesting grassland biomass is initial field selection. Wet fields are an issue; they are difficult to consistently harvest a crop, impractical to drive heavy equipment on, and the material takes longer to dry for baling. Not only do wet fields result in down time and broken equipment, but it also results in rutting and leaving unacceptable conditions (see figure 32, from the 2010 harvest in the northwest study region). Fields that are rocky or exceptionally rough also cut into harvest productivity. Desired ground speeds cannot be attained, and expensive breakdowns are frequent on rough and rocky ground. Initial field selection is also essential to optimizing the harvest timing. Field conditions conducive to harvest occur during a small time frame in the upper midwest, and wetness may be a factor in most land not currently in row crop production.

Figure 32. Ruts from harvest equipment in the northwest study region.

Distribution of fields

Land managers with numerous harvest locations need to consider the geographical distribution of the fields. On a large-scale basis, spreading sites out over distances greater than 4 or 5 miles requires proper planning and equipment. Also, research plot distribution in the fields themselves needs to be considered. As plots get further away from roads into fields it makes removing the bales from the plots more difficult and expensive.

Timing

Harvests during this project had relatively short windows in which to be completed, due in part to regulations on the landowners. More biomass productivity could be attained with a similarly scaled operation if the harvest window were larger. The regions in which the harvests took place are typically done producing their annual growth by the first week in September. Fall weather in the harvested region can be tricky for proper drying of the material. Short days, cool temperatures, and snow or rain play a role in how much material can be harvested.

Timing of biomass harvesting for this project was determined by land managers (DNR, FWS), as well as weather conditions. Restrictions prohibit beginning harvest on DNR lands before November 1st. Harvesting began on the CRP plots at the Northwest site

in mid October (10/13/2009, 10/11/2010) and the FWS plots at the West central site one to two weeks later (11/1/2009,10/18/2010). Harvest began on the South west plots the first week of November (11/9/2009, 11/4/2010) and ended in early December (12/3/2009, 12/6/2010). Wet conditions prevented a complete fall harvest on the Northwest plots in 2009; harvest was completed in April of the following spring. Snow prevented a complete harvest on the Southwest plots in 2010 and two plots were harvested in May of 2011 (Table 5).

Table 5. Harvesting start dates for the northwest, west central, and southwest regions for the 2009 and 2010 field seasons.

Site	2009	2010
Northwest	10/13/2009	10/11/2010
West central	11/1/2009	10/18/2010
Southwest	11/9/2009	11/4/2010
	Spring	**Spring**
Northwest	4/2010	4/25/2011
	plots 63,64,65,67	plots 16,12

Cutting Biomass

A disc bine-type head was used for all cutting. This type of cutting head consists of multiple small spinning heads, resembling a lawn mower, as opposed to a sickle-type cutter. After the discs cut the material it is run through a roller-conditioner to form the windrow. The disc bine head works well for cutting the various types of material encountered on the project, and allows for cutting wet or dry material. It also permits increased ground speed if conditions allow for it. The main disadvantage to running a disc-bine header is that it is expensive and time consuming to make repairs if damage occurs during harvest (by unseen rocks or other debris). Rocks and obstructions were frequently encountered on the marginal lands where the experimental plots were located.

In 2009 the disc bine head was mounted on a self-propelled, swatter-type cutter. This is an effective machine, but has some inherent qualities that made it suboptimal for this project. It is a difficult machine to load on a trailer and requires a special trailer due to its wheel width. Because it is two-wheel drive it does not handle wet ground conditions very well, and is prone to getting stuck. This project required a significant amount of time spent moving the machine between plots via a trailer and the plots themselves tended to be wet.

Figure 33. A disc bine cutter mounted on a four-wheel drive tractor was used during the 2010 harvest and had several advantages, including ease of loading onto a trailer.

In 2010, the disc bine cutter was mounted on a four-wheel drive tractor (fig. 33). This configuration solved the problems associated with the self-propelled swatter cutter; it is easily loaded, can be driven on roads, and does not get stuck as easily. It was also handy to have another tractor around instead of the swatter, which could not be used for anything other than cutting.

Raking Biomass

A high capacity wheel V rake was used to combine two windrows of cut biomass into one windrow, and to flip the material to speed up the drying process. This type of rake worked well for this application. Raking two windrows together sped up the baling process and reduced the number of passes the baler had to make on the field, thus reducing rutting and the amount of fuel used.

Baling Biomass

In 2009, a large square baler was used, which produced a 4'x 4'x 8' bale that was twine-tied. These bales weighed around 1,000 pounds at 15% moisture and stack, haul, and transport better than a round bale. The square baler is very efficient to operate and handled most of the material and conditions. One disadvantage to this baler is how heavy it is compared to a round baler. This would not be much of an issue if the tire size was increased, and or if it were operated in dry conditions. Another disadvantage of this baler is the difficulty in loading it onto the semi for transport. The other inherent problem is that this type of square bale needs to be protected from rain. This was an issue for our operation, given the limited harvest window.

In 2010, a round baler was used. It produces a 4' wide by 6' high bale that is wrapped with a plastic net wrap material. This bale size was chosen because of the ability to haul them with a truck to their final destination. Round, net-wrapped bales can be left out in the elements without having to be covered for up to three years without losing much integrity or quality of the biomass. This introduces the possibility of storing the bales in the field where land costs are low, and allows for more time to be spent on the harvest.

Material handling

The best method for transporting bales from the field requires tractors with front and rear mounted bale spikes. When properly equipped, one tractor can remove up to six bales from the field on each trip. This speeds up the process, and minimizes traffic on the field. Bales can be placed road-side for future transport, or loaded directly onto trucks.

Sanitation to reduce spread of weeds and pests

Experimental plots are located some distance apart and often managed by different agencies or organizations. When moving equipment from site to site it is critical to maintain equipment in a sanitary condition to avoid the transport of unwanted plant propagules (e.g. weed seeds). To accomplish this, transportation equipment is outfitted with on-board air compressors and all equipment is cleaned before leaving any plot.

Personnel

Having people who are trained and familiar with land stewardship and harvesting equipment operation is of utmost importance. In this project, the variability of the sites and landowners involved required that harvesting personnel know what is acceptable and what is not. There is more to the harvest than just getting biomass from the field. Integrity of the prairie ecosystem that supports the biomass, of the wildlife that occupy it, of the services to society it provides, and the ethics in managing it are necessary to ensure sustainable opportunities in grassland biomass harvest.

Quality control

The harvesting equipment navigated the correct harvesting pattern based on placement of eight-foot bamboo poles with colored flagging. The pole placement was based on GPS points generated from GIS software. However, because rocks, wet areas, and other obstacles may be encountered, the actual harvested area was determined post-harvest. To record the harvested area, project personnel used ATVs and handheld GPS to mark the harvest tracks. An example for three plots after the 2010 harvest is shown in (fig. 34). These tracks also allow for quantification of the fidelity to planned harvest tracks, which varied based on plot conditions. Total acres harvested in 2009 and 2010 by treatment and area are presented in Table 6.

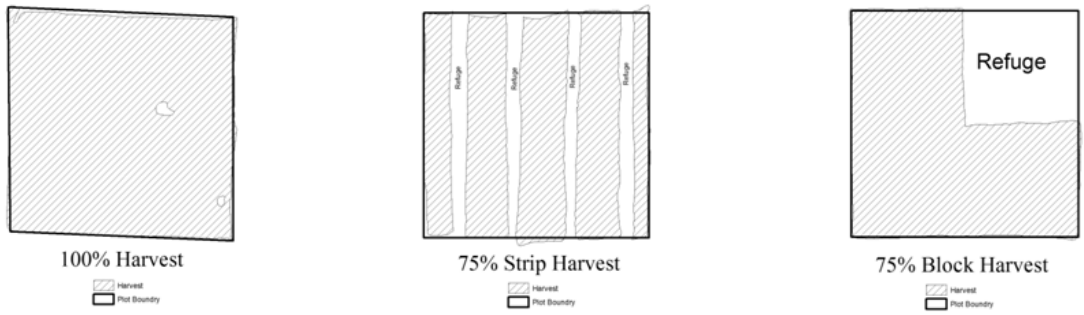


Figure 34. Actual harvest paths from plots 5, 4, and 16 using GPS tracks taken immediately post-harvest. These tracks were taken using handheld GPS while tracking the harvest paths on ATVs. Striped areas in the figures were harvested.

Table 6. Acres harvested, listed by study region and treatment. Total acres harvested in 2009 was 613.7 and in 2010 was 496.3. The decrease was due in part to unfavorable and wet harvest conditions.

Harvest treatment, by location	2009	2010
Southwest		
full	79.3	63.3
75% strip	54.6	41.3
75% block	54.5	34.3
50% strip	32.3	22.2
50% block	28.7	19.0
100% graze	62.7	34.3
West Central		
full	51.0	73.4
75% strip	33.9	44.0
75% block	39.4	56.3
Northwest		
full	72.4	45.6
75% strip	51.6	32.5
75% block	53.3	30.1

Outreach and demonstrations

Figure 35. Presentations and demonstrations to the public and stakeholders are integral to this project's success.

An exhaustive list of research dissemination is listed in Section VII below. Two examples are mentioned here. In September of 2010 we reported our findings to land managers, including DNR and USFWS personnel, at a specially organized conference in Lac Qui Parle, MN. We prepared multi-year data sheets for comparisons among years of data and conducted preliminary data analysis, which was presented in slides at the meeting.

A $500,000 Natural Resources Conservation Service (NRCS) Conservation Innovation Grant (CIG), solicited by the USDA-NRCS, was successfully leveraged using the LCCMR award as matching funds. This grant, awarded October 1, 2009, allowed the research team to demonstrate prairie harvest methods to the public and gain feedback from stakeholders on the current status of the bioenergy industry (fig. 35).

I. Total Trust Fund Project Budget:

Staff: $565,920

Wages and benefits:

- $130,500 for faculty time (C. Lehman 0.3 FTE, Roger Moon 0.08, D. Tilman 0.04, and D. Wyse 0.03. Figures cover two-year's time spread over three years of the project. Benefits range from 9.4% to 32.7% depending on appointment.
- $79,500 for two 0.67 FTE graduate students for organization, taxon identification, analysis, publications, and related activities.
- $355,920 for nine 0.4 average FTE undergraduate research assistants and research managers for sampling, data collection, coordination, and related tasks.

Contract services*:* $87,839

- $87,839 for professional/technical contracts to insect identification professionals, professional harvesting assistance, soil analyses, and other specialty services.

Equipment and tools: $43,920
(catch-and-release traps, sweep nets, binoculars, avian audio equipment, and other necessary gear. See attachment for details)

Development: $ 0
Restoration: $ 0
Acquisition, including easements: $ 0
Other (travel/printing. See attachment for details): $52,321

TOTAL TRUST FUND PROJECT BUDGET: $ 750,000

Explanation of Capital Expenditures Greater Than $3,500: *None planned*

II. OTHER FUNDS & PARTNERS:

A. Project Partners: This project partnered with organizations with substantial lands available who could help with the necessary arrangements. These included the following state, federal, and non-governmental organizations: (1) Minnesota Department of Natural Resources, (2) Minnesota Board of Water and Soil Resources, (3) The Nature Conservancy, (4) U.S. Fish and Wildlife Service, and (5) Rural Advantage.

B. Other Funds Proposed to be Spent during the Project Period: Funds from the National Fish and Wildlife Foundation supplemented LCCMR funding with $300,000, and a USDA Conservation Innovation Grant (CIG) provided an additional $500,000, to which the University of Minnesota College of Biological Sciences added $60,000. This more than doubled the original funding of $750,000 recommended by the LCCMR to $1,610,000. In addition, project partners allocated land for the duration of the project, which represents a substantial in-kind contribution equivalent to three year's rental on approximately two square miles of land.

C. Past Spending: This specific project was new, but it used restored prairie areas established with considerable past funding by the project partners. It was also directly related to (1) an ongoing on-campus project examining fertilizer and diversity management of prairie biofuel areas (UMN IREE funded, $43,000), (2) an ongoing Cedar Creek project examining below-ground water filtration by prairie biofuel areas (LCCMR/USGS funded, $1,069,000), and (3) to on-going biofuel surveys from the Mahnomen to Chisago County areas of the state (MN Legislature funded, $500,000). Finally, this project capitalized on scientific discoveries concerning productivity,

stability, and functioning of native plant ecosystems made with National Science Foundation and other federal funds of several million dollars during the past 12 years.

D. Time: This was a three-year project. The 2011 LCCMR recommended three years of continuation funding, which has now been approved by the legislature.

VII. DISSEMINATION: We have a project website available (www.cbs.umn.edu/wildlife) to make the ideas and results available world-wide. This website will continue to develop as the protocols for this project are refined and additional data become available. The project will also be featured in Cedar Creek educational programs for school-age and other groups. Presentations (oral and poster) to special interest groups, research groups, and other interested parties continued by project collaborators throughout the project. The first publication from this project in a peer-reviewed scientific outlet is now available. (Jungers et al., Characterizing Grassland Biomass for Energy Production and Habitat in Minnesota, *Proceedings of the 22nd North American Prairie Conference,* 2010). Further publications will be submitted as the project moves into its second phase.

(11/2008)
Ï Project information has been organized and posted on the web site.
Ï An informational poster has been created and is located at Cedar Creek Ecological Science Reserve and used for visitors.

(5/2009)
Ï Clarence Lehman prepared presentations that pertain to this study to deliver at conferences and workshops. These presentations have been delivered to audiences around the U.S. and Europe, including events such as the annual Pheasants Forever “Pheasant Fest” in Madison, WI, a small mammal conference in Atlanta, GA, and at a bioenergy conference in Sweden.

(9/2009)
Ï Clarence Lehman presented a talk included in the •What•s It to Me• series at Heron Lake Watershed District

(2/2010)
Ï Jacob Jungers was invited to explain this project and related grassland bioenergy efforts to the Board of Directors of the Missouri Prairie Foundation. (Trip was funded by a member of the Missouri Prairie Foundation)

(5/2010)
Ï Clarence Lehman and Jacob Jungers were invited to the Tallgrass Prairie for Biofuel Conference held at Guelph University in Ontario Canada. Clarence delivered a keynote speech on prairie bioenergy while Jacob presented a poster outlining the details of this project. (Trip was funded by the Ontario Ministry of Natural Resources)

(8/2010)

Ï Clarence Lehman and Jacob Jungers attended the North American Prairie Conference at the University of Northern Iowa where Jacob presented a poster describing the details of this project. (The travel portion was funded by the USDA-NRCS Conservation Innovation Grant, and this resulted in a peer-reviewed publication.)

(9/2010)
Ï In September of 2010 we reported our findings to land managers, including DNR and USFWS personnel, at a specially organized conference in Lac Qui Parle. We prepared multi-year data sheets for comparisons among years of data and conducted preliminary data analysis, which was presented in slides at the meeting.

(12/2010)
Ï Preliminary data was presented at the 71st Midwest Fish and Wildlife Conference, held in Minneapolis, by project entomologist Colleen Satyshur.

VIII. REPORTING REQUIREMENTS:

Following this final report, protocols will be delivered during the remainder of this calendar year, as called for in the original proposal.

IX. RESEARCH PROJECTS:

References Cited

Adler P, Sanderson M, Weimer P, and Vogel K. 2009. Plant species composition and biofuel yields of conservation grasslands. *Ecological Applications* **19**:2202–2209

Jungers, J. M., C. L. Lehman, C. C. Sheaffer, D. L. Wyse. In Press. Characterizing grassland biomass for energy production and habitat in Minnesota. *Proceeding to the 22nd North American Prairie Conference*.

Jungers, J. M., J. J. Trost, C. L. Lehman, G. D. Tilman. 2011. Energy and conservation benefits from managed prairie biomass. *Aspects of Applied Biology: Biomass and Energy Crops IV.* **112**: 147-151.

Lee D, Owens V, and Doolittle J. 2007. Switchgrass and soil carbon sequestration response to ammonium nitrate, manure, and harvest frequency on conservation reserve program land. *Agronomy Journal* **99**:462-468.

Sample D, and Mossman M. 1997. Managing habitat for grassland birds - a guide for Wisconsin. Wisconsin Department of Natural Resources, Madison, WI, PUBL-SS-925-97. 154 pp. Jamestown, ND: Northern Prairie Wildlife Research Center Online. Accessed online at: http://www.npwrc.usgs.gov/resource/birds/wiscbird/index.htm (Version 03JUN2002).

Attachment A: Budget Detail for 2008 Projects - Summary and a Budget page for each partner (if applicable)

Project Title: *Biofuel production and wildlife conservation in working prairies*

Project Manager Name: *Dr. Clarence Lehman*

Trust Fund Appropriation: $ *750,000*

1) See list of non-eligible expenses, do not include any of these items in your budget sheet

2) Remove any budget item lines not applicable

2008 Trust Fund Budget	**Revised Result 1 Budget:** 01/07/2010	**Amount Spent** *11/24/2010*	**Balance** *11/24/2010*	**Revised Result 2 Budget:** 01/07/2010	**Amount Spent** *11/24/2010*	**Balance** *11/24/2010*	**Result 3 Budget**	**Amount Spent** *11/24/2010*	**Balance** *11/24/2010*	**TOTAL BUDGET**	**TOTAL BALANCE**
BUDGET ITEM											0
PERSONNEL: *wages and benefits for Faculty[listed in work program] (32.3% Fringe), 1 Assistant Scientist (37% Fringe), 4 Junior Scientists (37% Fringe), 10 Interns (0% Fringe), 1 Graduate Student (25% fringe plus educational expenses)*	163,740	163,740	0	207,180	207,180	0	195,000	195,000	0	565,920	0
Contracts			0			0				0	0
Professional/technical: *Minnesota Conservation Corps to aid with sampling and lab services for graduate project*	6,000	6,000	0	66,839	66,839	0	15,000	15,000	0	87,839	0
Equipment / Tools: *Small mammal traps, Herp Trap Materials, General sampling equipment and maintainance, Plot Field Markers, GPS, Field Work First Aid Kits, Trail Cameras and Radios, Digital Cameras/memory cards, Small Mammal Trap Supplies, Insect Nets and sampling equ., Insect sorting tools, Graduate Student study expenses, Nest search equip., Field guides, Regional maps, Plant and animal identification books, and other general supplies.*	3,000	3,000	0	29,420	29,420	0	11,500	11,500	0	43,920	0
Printing:			0			0	1,500	1,500	0	1,500	0
Other Supplies: *ST Rents and Leases*	0	0	0	8,000	8,000	0			0	8,000	0
Travel expenses in Minnesota	3,260	3,260	0	18,561	18,561	0	21,000	21,000	0	42,821	0
COLUMN TOTAL	**$176,000**	**$176,000**	**$0**	**$330,000**	**$330,000**	**$0**	**$244,000**	**$244,000**	**$0**	**$750,000**	**$0**
Result 1 Ammendment Justification: Retroactive	**Ammendment Approved 05/01/2010**										
Transferred $240 from **Travel** to **Personnel** to cover additional staff hours.											
Result 2 Ammendment Justification: Retroactive	**Ammendment Approved 05/01/2010**										
Transferred $50,000 from **Personnel** to C**ontracts** for field work and lab services, including the Minnesota Conservation Corps (MCC), to take advantage of resources available from the contractors and to take advantage of times when hired interns were still attending classes											
Transferred $1739 from **Travel** to **Contracts** to cover cost of MCC travel rather than the originally budgeted intern travel, since MCC treats their travel as part of the contract.											

2008 Project Abstract
For the Period Ending June 30, 2010

PROJECT TITLE: The Future of Energy and Minnesota's Water Resources
PROJECT MANAGER: Sangwon Suh
AFFILIATION: University of California, Santa Barbara
MAILING ADDRESS: 3422 Bren Hall, University of California
CITY/STATE/ZIP: Santa Barbara, CA 93106-5131
PHONE: (805) 893-7185
E-MAIL: suh@bren.ucsb.edu
WEBSITE: [If applicable]
FUNDING SOURCE: Environment and Natural Resources Trust Fund
LEGAL CITATION: ML 2008, Chap. 367, Sec. 2, Subd. 4.

APPROPRIATION AMOUNT: $270,000

Overall Project Outcome and Results

Minnesota's water resources are poised to undergo significant changes in the coming decades. For example, with new bioenergy policies aiming to reduce fossil fuel dependency, Minnesota has become one of the top five bioethanol producers in the United States in the past two decades. Bio-energy production, together with increasing population, energy demand, and climate uncertainties present a great challenge for water authorities seeking to sustainable future water supply. There is an urgent need to integrate an analysis of demands on Minnesota's water resources with scenarios of future energy production. This project aimed to envision Minnesota's temporal and spatial water schemes by 2030 in response to population, energy, and climate scenarios, by integrating a system dynamics model with geographic information system (GIS) data. We developed an integrated spatial model that analyzes the future of MN's water budget with particular attention to changes in water demand under different scenarios. Key trends incorporated into the scenarios include (1) biofuel production (considering water needs for irrigation of the biofuel feedstock as well as for processing); (2) changes in the electricity grid mix considering Minnesota's Renewable Energy Standards; (3) demographic changes; and (4) climate change. Scenarios of water demand was combined with GIS mapping and water balance techniques, which can deliver spatially and temporally explicit water budget projections for each scenario.

The results indicate that population growth and increasing demand on electric power generation are two primary factors driving increasing future water demand in Minnesota. Water management should be coupled with urban development and planning to reduce water stress induced by population growth and electric power generation. Late summer and winter are two periods of time in which it is particularly challenging to support human demand of water without the potential of drawing down the water resources. This report produced by this project presents maps and regional monthly water availability graphs for various scenarios tested in this study. These system characteristics shown in the current scenario analysis can play an important part of future water conservation and management planning.

Project Results Use and Dissemination

The study results were presented in more than four national and international conferences hosted in the US and Portugal, in which a poster summarizing the findings of this study won the poster contest in the prestigious Gordon Research Conference in 2010. One paper was published in a high-impact journal, Environmental Science and Technology (ES&T) in 2009; the paper was one of the top-three most-cited and downloaded articles in September, 2009.

Another, follow-up article has been submitted to the same journal and is currently under reviewed. In 2008, a round-table forum was hosted at the University of Minnesota to discus water sustainability modeling and its application. Scholars from state agencies, research institutes, and NGOs attended the forum to brainstorm feasible frameworks for assessing Minnesota's water future under different uncertainties. Detailed information of the presentations in this forum and relevant supporting information can be found at http://www.iel.umn.edu/forum/waterforum.htm PI. Suh is participating in a publication by the United Nations Environmental Programme (UNEP) on biofuel's water implication as an author based on the knowledge and findings gathered from this project. The publication is expected to be released in early 2010.

Trust Fund 2008 Work Program Final Report

Date of Report: 11/28/2010
Date of Next Status Report: Final report
Date of Work program Approval: 6/10/08
Project Completion Date: 6/30/10

I. PROJECT TITLE: The Future of Energy and Minnesota's Water Resources

Project Manager: Dr. Sangwon Suh
Affiliation: University of California, Santa Barbara
Mailing Address: 3422 Bren Hall, Bren School of Environmental Science and Management
City / State / Zip : Santa Barbara, CA 93106-5131
Telephone Number: (805) 893-7185
E-mail Address: suh@bren.ucsb.edu
FAX Number: (805) 893-7612
Web Page address:
http://www.bren.ucsb.edu/people/Faculty/sangwon_suh.htm

Location: *Santa Barbara, CA*

Total Trust Fund Project Budget:	**Trust Fund Appropriation:**	**$ 270,000**
	Minus Amount Spent:	**$ 270,000**
	Equal Balance:	**$ 0**

Legal Citation: ML 2008, Chap. 367, Sec. 2, Subd. 4.

Appropriation Language: $270,000 is from the trust fund to the Board of Regents of the University of Minnesota to spatially model water demand in Minnesota under differing energy production scenarios and develop a Web-based tool for comparing policy scenarios impacts on water resources in the state.

II. and III. FINAL PROJECT SUMMARY AND RESULTS:

Minnesota's water resources are poised to undergo significant changes in the coming decades. For example, with new bioenergy policies aiming to reduce fossil fuel dependency, Minnesota has become one of the top five bioethanol producers in the United States in the past two decades. Bio-energy production, together with increasing population, energy demand, and climate uncertainties present a great challenge for water authorities seeking to sustainable future water supply. There is an urgent need to integrate an analysis of demands on Minnesota's water resources with scenarios of future energy production. This project aimed to envision Minnesota's temporal and spatial water schemes by 2030 in response to population, energy, and climate scenarios, by integrating a system dynamics model with

geographic information system (GIS) data. We developed an integrated spatial model that analyzes the future of MN's water budget with particular attention to changes in water demand under different scenarios. Key trends incorporated into the scenarios include (1) biofuel production (considering water needs for irrigation of the biofuel feedstock as well as for processing); (2) changes in the electricity grid mix considering Minnesota's Renewable Energy Standards; (3) demographic changes; and (4) climate change. Scenarios of water demand was combined with GIS mapping and water balance techniques, which can deliver spatially and temporally explicit water budget projections for each scenario.

The results indicate that population growth and increasing demand on electric power generation are two primary factors driving increasing future water demand in Minnesota. Water management should be coupled with urban development and planning to reduce water stress induced by population growth and electric power generation. Late summer and winter are two periods of time in which it is particularly challenging to support human demand of water without the potential of drawing down the water resources. This report produced by this project presents maps and regional monthly water availability graphs for various scenarios tested in this study. These system characteristics shown in the current scenario analysis can play an important part of future water conservation and management planning.

IV. OUTLINE OF PROJECT RESULTS*:*

Result 1: Current spatial water budget in map form

Description: *We produced GIS map layers of current water demand and water supply in Minnesota. These maps were combined to generate a map of Minnesota's water budget, and to identify potentially water-scarce regions and the supply and withdrawal factors that contribute to this water scarcity.*

Summary Budget Information for Result 1: **Trust Fund Budget: $ 76,714**
Amount Spent: $ 76,714
Balance: $ 0

Deliverable	Completion Date	Budget	Status
1. *Background document summarizing current knowledge on groundwater resources and withdrawals*	*9/30/08*	*$ 12,679*	*complete*
2. *List of key factors regulating water supply And demand*	*1/31/09*	*$ 35,737*	*complete*
3. *GIS layers of current water demand and supply, and map of current state water budget*	*6/30/09*	*$ 28,298*	*complete*

Completion Date: *6/30/09*

Final Report Summary: We grouped individual watersheds into 9 zones based on Minnesota's climate divisions defined by NOAA. On the temporal scale, study results were presented per monthly spans in order to highlight seasonal variations. The results show that water availability is governed mainly by climate in all regions, except for the Mississippi River watershed, where its anthropogenic withdrawals could already be influential enough to alter the local water hydrograph. In general, water availability ranks significantly differently from 84 mm/yr (north-west MN) to 280 mm/yr (north-east MN).
****

Result 2: Maps of future state water budgets under different scenarios

Description: *We modeled various scenarios of water demand and water supply under dynamic combinations of ethanol production trends, , demographic growth, and climate change. By overlaying a map of water demand under different scenarios with a map of water supply under these scenarios, we generated a spatial water budget for the state, which can reveal areas of potential water scarcity.*

Summary Budget Information for Result 2: **Trust Fund Budget: $ 108,891**
Amount Spent: $ 108,891
Balance: $ 0

Deliverable	Completion Date	Budget	Status
1. *Description of modeled scenarios and GIS layers for water supply and demand in all scenarios*	*6/30/09*	*$ 59,735*	*complete*
2. *Maps for each scenario depicting future water budget*	*12/31/09*	*$ 49,156*	*complete*

Completion Date: *12/31/09*

Final Report Summary: As a result of climate change, western Minnesota continues to be more arid than the eastern part of the state. However, the amount of water available, which is defined as precipitation minus run-off, is expected to increase more significantly in the west (34%~70%) than in the east (-2%~18%) under climate change effects by year 2030. Population change is expected to increase water withdrawal in almost every category, except for the irrigated water

category that responds primarily to climate change. In general, water withdrawal increases significantly under the extreme scenario (Extreme) as expected, in which population change played the most important role in driving future water withdrawals. Electricity demand could also considerably amplify water withdrawal in the locations where power plants are currently located. The effects caused by increasing ethanol production became marginal as compared with the changes induced by population and power generation increase. Climate change, on the other hand, contributed trivial impacts on water withdrawal compared with the forces of population and energy in the short term. However, water withdrawal would still peak during summer in every region while the relative magnitude of increase in withdrawals compared to water availability would be more significant during the winter. In contrast, available water would increase notably in spring but decrease in summer. Using water stress index (WSI, total water withdrawal/total available water) as an indicator, there were eight watersheds classified as high water stress (WSI>0.2) during 2000 to 2009, which would increase to 12 watersheds under the extreme scenario by 2030. If each driver of change is tested separately, population change and change in electric power grid-mix can elevate state average WSI from 0.14 up to 0.18 and 0.19, respectively. On the other hand, climate can slightly lower WSI down to 0.11. For detailed results, please refer to the Chapter 6 of the final report.

****

Result 3: Interpretation and dissemination of research results

Description: *We derived policy implications from the analysis, which can be released in a format useful to planners and local citizens. To disseminate this information around the state, we created an online tool that embeds the modeling results in an interactive website, searchable by future scenario and by location. We also conducted seminars at various locations around the state to inform local citizens and policymakers about the results of our analysis.*

Summary Budget Information for Result 3: **Trust Fund Budget: $ 84,394**
Amount Spent: $ 84,394
Balance: $ 0

Deliverable	**Completion Date**	**Budget**	**Status**
1. *Policy recommendations Informed by research results*	*3/31/10*	*$ 33,538*	*complete*
2. *Seminars and online Information tool*	*6/30/10*	*$ 50,856*	*complete*

Completion Date: *6/30/10*

Final Report Summary: The study results were presented in more than four national and international conferences hosted in the US and Portugal, in which a poster summarizing the findings of this study won the poster contest in the prestigious Gordon Research Conference in 2010. One paper was published in a high-impact journal, Environmental Science and Technology (ES&T) in 2009; the paper was one of the top-three most-cited and downloaded articles in September, 2009. Another, follow-up article has been submitted to the same journal and is currently under reviewed. In 2008, a round-table forum was hosted at the University of Minnesota to discus water sustainability modeling and its application. Scholars from state agencies, research institutes, and NGOs attended the forum to brainstorm feasible frameworks for assessing Minnesota's water future under different uncertainties. Detailed information of the presentations in this forum and relevant supporting information can be found at http://www.iel.umn.edu/forum/waterforum.htm PI. Suh is participating in a publication by the United Nations Environmental Programme (UNEP) on biofuel's water implication as an author based on the knowledge and findings gathered from this project. The publication is expected to be released in early 2010.

V. TOTAL TRUST FUND PROJECT BUDGET:

Staff or Contract Services: $266,700
Equipment: $3,300
Other: $ 0

TOTAL TRUST FUND PROJECT BUDGET: $ 270,000

Explanation of Capital Expenditures Greater Than $3,500: *N/A*

VI. OTHER FUNDS & PARTNERS:

A. Project Partners: Anne Kapuscinski, Peter Reich (both faculty, co-PI's of University of Minnesota Ecosystem Science and Sustainability Initiative)

B. Other Funds Proposed to be Spent during the Project Period: *The faculty P.I.'s will spend time on this project that is not paid for by LCCMR.*

C. Past Spending: *The Sustainability Initiative has been funded through a $900,000 Bush Foundation grant that expires in the fall of 2008. This grant is being used to conduct a participant scenario development process, which will provide critical input to our water model. The water balance modeling will also receive input from a project under P.I. Suh to explore the impacts of climate change on state water resources, with funding from the University of Minnesota Agricultural Experiment Station.*

D. Time: 7/1/08 – 6/30/10

VII. DISSEMINATION: *The dissemination of research results is built into the project timeline and budget, as described above.*

VIII. REPORTING REQUIREMENTS:

Periodic work program progress reports will be submitted not later than 1/15/09, 6/30/09, 1/15/10, and 6/30/10. A final work program report and associated products will be submitted between June 30 and August 1, 2010 as requested by the LCCMR.

IX. RESEARCH PROJECTS: n/a

Attachment A: Budget Detail for 2010 Projects - Summary and a Budget page for each partner (if applicable)

Project Title: *Future of energy and Minnesota's Water Resources*

Project Manager Name: *Sangwon Suh*

Trust Fund Appropriation: $ *270,000*

1) See list of non-eligible expenses, do not include any of these items in your budget sheet

2) Remove any budget item lines not applicable

2010 Trust Fund Budget	**Result 1 Budget:**	**Amount Spent** *(date)*	**Balance** *(date)*	**Result 2 Budget:**	**Amount Spent (date)**	**Balance** *(date)*	**Result 3 Budget:**	**Amount Spent** *(date)*	**Balance** *(date)*	**TOTAL BUDGET**	**TOTAL BALANCE**
	Current Spatial Water Budget in Map Form			*Maps of Future State Water Budgets under Different Scenarios*			*Interpretatin and Dissemination of Research Results*				
BUDGET ITEM											
PERSONNEL: wages and benefits *(List individual names, amount budgeted and %FTE; add rows as needed)*	76,714		0	100,519		-3	81,094		-1,040	258,327	-1,043
Schmitt, Laura, Research Associate, .3 FTE		11,826									
Suh, Kyo, Post-doctoral Associate, .4 FTE		18,172						24,099			
Suh, Sangwon, Asst Prof - Summer, .03 FTE		5,261			$ 2,075.25						
Walseth, Brian, Research Specialist, .06 FTE		4,962									
Walseth, Brian, Research Assistant, .4 FTE		19,519						18,292			
Yang, Yi, Research Assistant, .5 FTE		16,974			$ 31,862.65						
Kim, Jae Youn, Visiting Professor, .02 FTE					$ 51.34			4,385			
Kim, Junbeum, Research Assistant, .6 FTE					$ 42,100.18			14,612			
Bae, Jung Han, Research Assistant, .1 FTE					$ 1,171.99			7,048			
Yee, Scott, Research Assistant, .1 FTE					$ 7,246.07						
Chiu, Yi-Wen, Research Assistant, .3 FTE					$ 16,014.25			13,698			
Contracts											
Professional/technical *Michigan State University - Co-PI Schmitt-Olabisi, Laura*				8,373	$ 8,370.28	3				8,373	3
Non-capital Equipment / Tools - Stella Software used for data analysis exclusively for this project							2,300	2,056	244	2,300	244
Travel expenses in Minnesota							1,000	204	796	1,000	796
COLUMN TOTAL	**$76,714**	**$76,714**	**$0**	**$108,892**	**$ 108,892.01**	**$0**	**$84,394**	**$84,394**	**$0**	**$270,000**	**$0**

The Future of Energy and Minnesota's Water Resources

July 1
2010

Sangwon Suh[1*], Yi-Wen Chiu[2], and Laura Schmitt Olabisi[3]

1 Assistant professor, Bren School of Environmental Science and Management, University of California, Santa Barbara.
2 Graduate student, Water Resources Science, University of Minnesota, Twin Cities.
3 Assistant professor, Department of Community, Agriculture, Recreation, and Resource Studies, Environmental Science & Policy Program, Michigan State University.
∗ Corresponding author. 3422 Bren Hall, University of California, Santa Barbara, CA 93106-5131. Email: suh@bren.ucsb.edu. Office Phone: (805) 893-7185.

This study was funded by Legislative-Citizen Commission on Minnesota Resources (LCCMR), 2008 – 2010.

Recommended citation:

Suh, S., Chiu, Y.-W., Olabisi, L.S., 2010. The Future of Energy and Minnesota's Water Resources, Report to Legislative Citizen's Commission on Minnesota Resources, Saint Paul, Minnesota.

Glossary and definitions

Water use: withdrawal of water for specific sectoral purpose, i.e. industrial, agricultural or domestic (can be applied to describe either water withdrawal or water consumption)

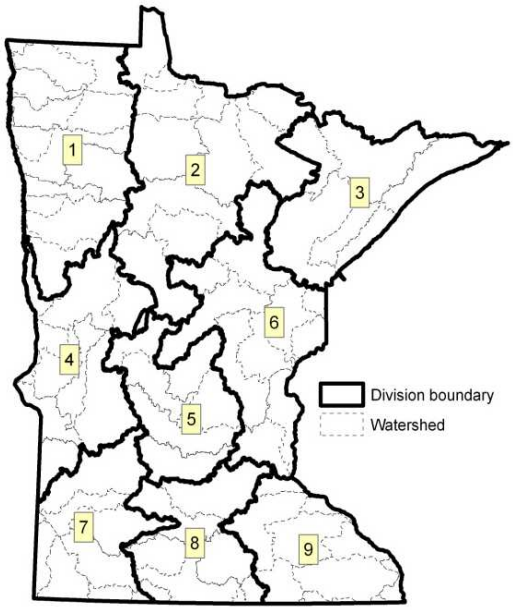
Water withdrawal: the removal of freshwater from water resources or reservoirs for use in agriculture, industry or domestic purposes, in which part of the water returns to the origin water source of extraction and the rest is lost through evaporation or due to significant quality degradation

Water consumption: the use of water by humans from natural water resources or reservoirs for agriculture, industry or domestic purposes, which is consequentially lost and not available for other consumers or biota through evaporation or due to significant quality degradation

Water availability: the amount of water entering surface water bodies and groundwater systems, which is the maximum theoretical water quantity available in a certain area during a specific time period

Water demand: the need for water in supporting agricultural, industrial, public or domestic activities, which is presented as water withdrawal

Water stress index: the fraction of total water withdrawal in total available water



Map of divisions (1 – 9) used in this report.

Divisions 1 – 3: North
Divisions 4 – 6: Central
Divisions 7 – 9: South

Divisions 1, 4, 7: West
Divisions 2, 5, 8: Central
Divisions 3, 6, 9: East

Summary of scenarios tested in this study

Scenario	Description of assumption				
	Description	Climate	Population	Ethanol	Power
BL	Baseline case in year 2000	—	—	—	—
CnBAU	Business-as-usual scenario by 2030	—	N	N	N
CxBAU	Business-as-usual plus climate change scenario by 2030	X	N	N	N
Cx	Climate scenario by 2030	X	—	—	—
PPn	Population scenario by 2030	—	N	—	—
EtOHn	Ethanol production scenario by 2030	—	—	N	—
PWn	Power generation scenario by 2030	—	—	—	N
Extreme	Extreme scenario by 2030	X	X	X	X

—: current average status in 2000s
N: business-as-usual scenario
X: extreme scenario

Executive summary

With new bioenergy policies aiming to reduce fossil fuel dependency, Minnesota has become one of the top five bioethanol producers in the United States in the past two decades. Bio-energy production, together with increasing population, energy demand and climate uncertainties, present a great challenge for water authorities seeking to sustainable future water supply. This report aims to envision Minnesota's temporal and spatial water schemes by 2030 in response to population, energy, and climate scenarios, by integrating a system dynamics model with geographic information system (GIS) data. The results indicate that population growth and increasing demand on electric power generation are two primary factors driving increasing future water demand in Minnesota. Water management should be coupled with urban development and planning to reduce water stress induced by population growth and electric power generation. Late summer and winter are two periods of time in which it is particularly challenging to support human demand of water without the potential of drawing down the water resources. This report presents maps and regional monthly water availability graphs for various scenarios tested in this study. These system characteristics shown in the current scenario analysis can play an important part of future water conservation and management planning.

1. Background

Minnesota's water resources are critical to the state's economy, ecology and culture. There is a common perception that Minnesota is a water-rich state, but in fact the state's water resources are highly heterogeneous. Rates of groundwater recharge, precipitation, and evapotranspiration, which determine the amount of water available for human and ecosystem use, vary considerably throughout the state. Furthermore, there are several major changes that are likely to occur or are already occurring in Minnesota, which will impact the water budget in a spatially heterogeneous manner. These include demographic change, climate change, biofuel development, and electricity grid-mix change.

Another rapid change with significant implications for water is biofuel development. Water for ethanol production is currently a very small portion of overall water use in Minnesota, but if ethanol production expands, water demands could exceed supply in some regions of the state. Under the ethanol blending mandates in place, Minnesota will need to produce (or import) over 2 million m^3 of ethanol annually by 2013, according to the state Department of Agriculture [1]. Economic incentives could drive this production number even higher. This corresponds to approximately 8 million m^3 of water needed for processing, assuming the ethanol is made from corn grain; it becomes 13 million m^3 of water if the ethanol blending mandate is met using cellulosic feedstock processed via enzymatic methods [2]. There are some technological options for reducing these water requirements by up to 20%, but these innovations are associated with a higher capital cost [3]. If irrigation needed for corn production is factored into ethanol water requirements, Minnesota's water demand for ethanol production climbs to over 40 million m^3 by 2013 [4]. Currently, only a small percentage of Minnesota corn is irrigated, but this could change if corn expands onto marginal lands. In the United States, energy crops for biofuel production are currently not irrigated. However, irrigation may be necessary as biofuel feedstock demand expands depending on the type of crops and the location of production. Miscanthus, for example, requires more water than corn [5].

Considering the 5.3 billion m^3 of state water use budget, water demand for biofuel production (which is only several million m^3) may not be significant. However, for certain localities ethanol production may be enough to overwhelm local groundwater resources when combined with other competing industrial and municipal uses. This is a serious possibility, given the fact that most current and proposed ethanol plants are located in relatively water-poor

regions of the state, particularly southwest and south-central Minnesota. Plans to construct a corn-based ethanol plant near Pipestone were stopped in 2005 because of concerns over water supply [6]. Mixed prairie grasses, another option being considered for ethanol feedstock in Minnesota, may have fewer impacts on local water resources, but it is important to test this hypothesis with a model [7]. All biofuel options involve some degree of land cover change, which impacts the hydrology of local systems [8].

Another important change relevant to the state's water future is demographic change. Population growth in Minnesota is slowing overall, but like other trends it will occur in a spatially heterogeneous manner. The Central Lakes and greater Metro region is expected to experience population growth, while many rural areas of the state may lose population [9] (Figure 1.1). Municipal water use per capita has increased in Minnesota since the 1950's, implying that the efficiency of water use by people and households in urban areas is not improving. This trend is opposite to the pattern seen in most parts of the United States, where water consumption rates are not growing as fast as the population [10]. Minnesota's increasing water consumption, combined with spatial patterns of population growth, may lead to significant stress on water resources [11].

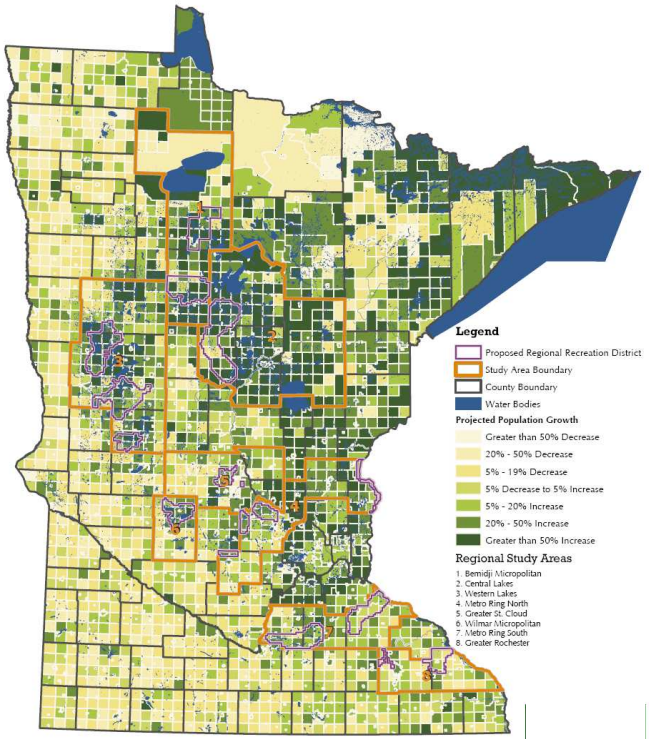


Figure 1.1 Map of expected population growth between 2005 and 2030 (Source: MN State Demographer's Office. Map prepared by Mike Wietecki).

These important changes that the state is likely to undergo will by and large shape the future of the state's water environment. Given that these changes are spatially heterogeneous, it is important to account for spatial dimensions when analyzing the implications of these changes on water resources.

An important dimension of complexity in understanding the state's water availability is seasonality; water availability of a region depends on seasonal

changes of water supply and demand. Therefore, an explicit temporal dimension is essential in understanding future water availability. For instance, climate change is projected to increase overall precipitation in Minnesota, with a disproportionate amount of this increase occurring during the late fall and early winter [12, 13]. This may not be an unqualified boon for the state's water resources, however, as more of this precipitation is expected to occur during heavy rains and storm events, potentially increasing rates of drought and flooding [14]. Additionally, evapotranspiration, which is highly seasonal, is expected to increase in the upper Midwest, which may negate the precipitation water gains [15].

Given these rapid changes that are taking place in Minnesota with spatial and temporal dimensions, there is a need to develop a tool for evaluating the impacts of these changes on the state's water resources. Such a tool would enable integrated and holistic water planning as recommended in the Minnesota Statewide Conservation and Preservation Plan and previous documents [16].

In this report we analyzed the combined effect of future changes in demographics, energy environment and climate on Minnesota's water resources using a state-wide water balance approach coupled with a spatially and temporally explicit modeling framework. Our modeling approach was established to help envision the future of water resources in Minnesota for policy development and planning.

2. Major trends

2.1. Overall water use in Minnesota

Overall water use in Minnesota has been generally increasing for the last two decades (Figure 2.1). The largest increase in water use in Minnesota has been due to an increase in electricity generation. Industrial water use and irrigation water use are relatively small in the overall picture of the state's water use.

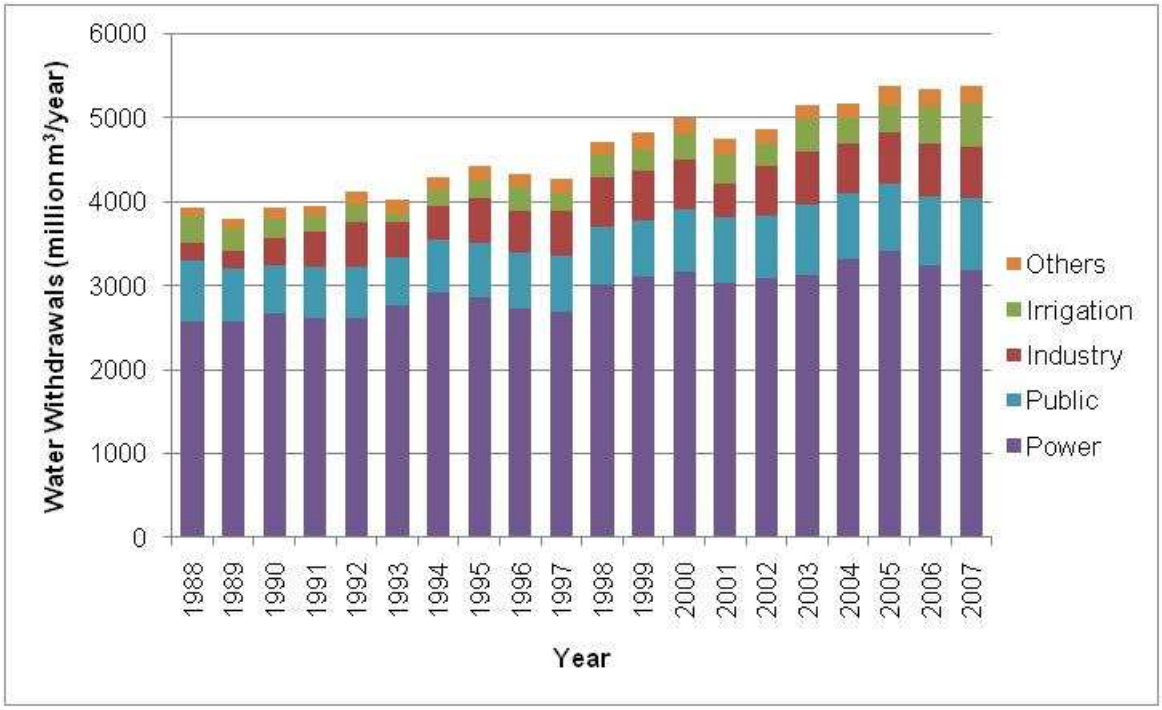


Figure 2.1 Trend of water withdrawals in Minnesota by user category [17].

2.2. Power generation and water consumption

Electric power is responsible for over 36% of national total fresh water use, of which thermoelectricity (water cooling associated with coal and nuclear electricity) requires the largest portion [18]. Estimated water use for thermoelectric power production showed steady increase from 1950 to 1980, and declined more than 11% from 1980 to 1985. The trend has remained relatively stable with less than 3% change since 1985 (Figure 2.2).

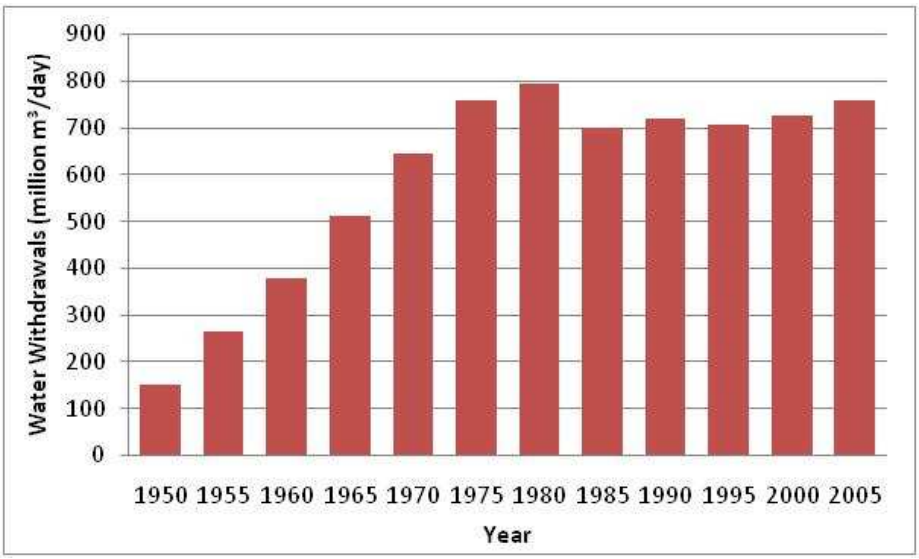


Figure 2.2 Water withdrawal trend in the thermoelectric power category in the U.S. [18].

Water use efficiency of a power plant varies widely depending on the driving fuel and cooling systems. A prior study claimed that hydroelectric power has the highest water use efficiency, consuming 0.4 m^3 of water per MWh [19]. Fossil fuel thermoelectric power, whichrepresents the largest segment of U.S. electricity production, consumes 14 – 28 m^3 of water per MWhr. Nuclear power, on the other hand, is the least water efficient type of power generation, consuming 30 – 75 m^3 of water per MWh. However, these figures are valid only under certain assumptions. For example, if water loss through evaporation from reservoirs is included in the diagram, hydropower would consume 27 times more water than nuclear power and 34 times more than coal-fired power [20].

2.3. Biofuel and water consumption

With a strong U.S. national interest in energy independence, biofuels have become important transportation fuels. Therefore, the production and use of biofuels is growing rapidly in the U.S. from 5 million m^3 in 1995 to 34 million m^3 in 2008 (Figure 2.3). The Energy Independence and Security Act (EISA) of 2007 set biofuel production goals through 2022. The bill mandates that “conventional biofuels” such as corn grain ethanol attain maximum production of 57 million m^3 per year by 2015. Beginning in 2016, the production capacity of “advanced biofuels”, which use non-food sources such as cellulosic biomass and algae, should be increased by 11 million m^3 , reaching 79 million m^3 by 2022.

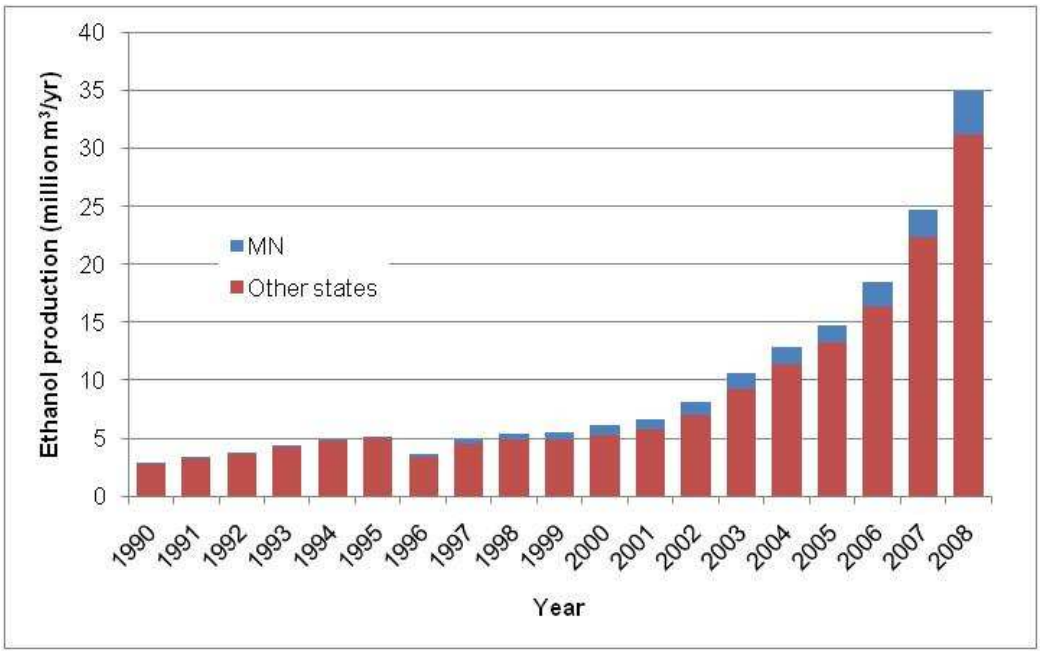


Figure 2.3 Historical U.S. Bioethanol and Biodiesel Production [21].

Existing studies are inconsistent regarding the implications of biofuel development for state water consumption. These inconsistent results are largely the result of the spatial scale selected in an assessment. For example, on a national average, one m^3 corn ethanol may require 263–780 m^3 of water, in which only 3.3–40 m^3 of water are attributed to process water and the rest is acquired for irrigation [22, 23]. On a regional scale, a prior study concluded that corn ethanol consumes 10–324 m^3 of water per m^3 production with significant regional differences [24]. However, if the data are broken down to a state level, the variances can be much greater than what was previously estimated and result in a wide spectrum of water consumption estimates from 5 to 2,100 m^3 of water per m^3 ethanol production (using two significant digits) [4].

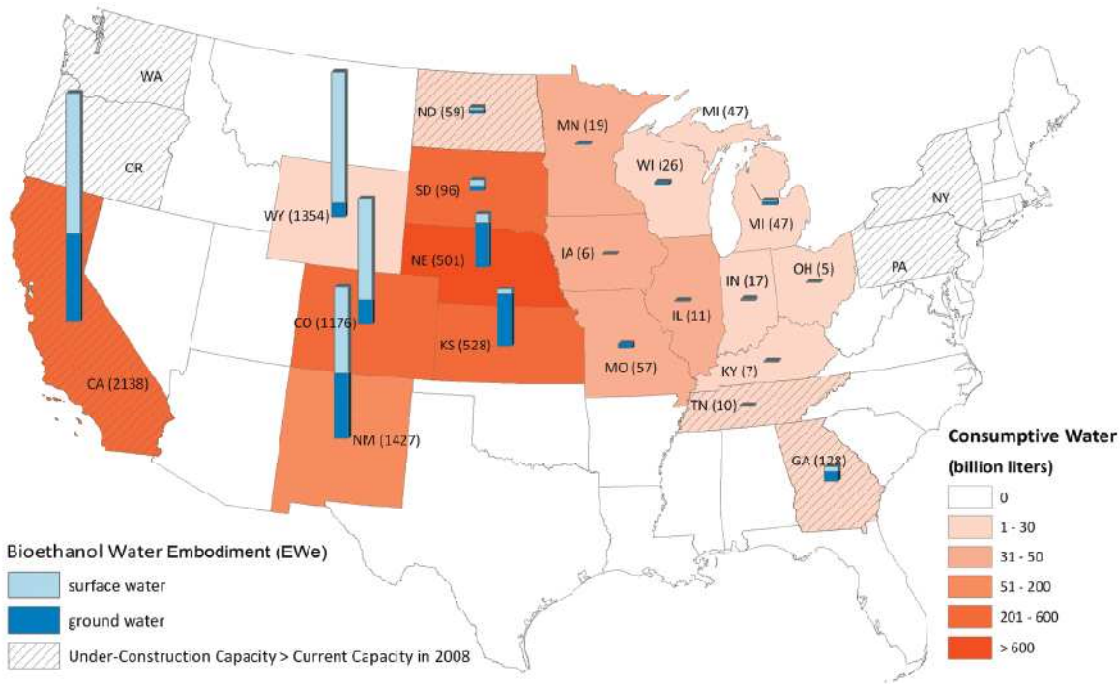


Figure 2.4 Water embedded in corn-based ethanol (denoted in parentheses, in m^3 water/m^3 ethanol or liter water/liter ethanol) by state. Background color indicates the total water consumed by ethanol in year 2007 (the original map was published in *Environmental Science and Technology* [4]).

3. Water balance method and data

Water balance is a system level analysis based on total water inflow and outflow of a region, which determine the change in water stock of the region over time. Water balance is based on themass balance principle. Water as a compound can be created or destroyed as a result of biochemical reactions, such as combustion. Therefore, strictly speaking, water mass is not a conserved quantity. However, the amount of water created or destroyed via chemical reactions is relatively small compared to major water flows such as precipitation and evapotranspiration, and is negligible in the natural water cycle diagram [25-29]. In this case, water balance can be expressed using an equation:

$$\Delta S = P - ET - Q,$$

where *P* is precipitation, *ET* is evapotranspiration, *Q* is net surface water outflow, and ΔS is the change in water storage in top soil and aquifers. On a long-term basis over a large area, ΔS is minimal if the system reaches its equilibrium without significant disturbance [25]. Positive ΔS

indicates that the system is accruing water stock over time, and negative ΔS indicates that the system is draining water stock over time.

The water balance calculation helps us to understand water availability in a region [26, 27]. The amount of precipitation, which is a major water inflow, minus the amount of evapotranspiration, which is a major water outflow, is often referred to as “water supply index” [28]. Water supply index indicates the amount of maximum available water for a region, and this approach has been widely applied in studying global water availability since the 1980s. The ratio of regional anthropogenic water withdrawal to the maximum available water is widely referred to as “water stress index”, which has been used to indicate the water scarcity of a region [29, 30].

An alternative approach of maximum water availability calculation is based on stream flow. Total stream flow is the sum of surface runoff and the base flow discharged from groundwater. As stream flow occurs when a region cannot hold or use incoming water to the region, total stream flow is indicative of the maximum available water [31].

In traditional hydrological models, anthropogenic water withdrawals were often left out of the modeling framework [32]. However, prior studies found that human appropriation of renewable water resources can be as significant as 35% to 42% of total renewable water available to the region [33, 34]. Therefore, instead of simulating the “natural” status of the water balance, we integrated anthropogenic water supply and demand in the modeling framework in order to present a more realistic water balance (Figure 3.1).

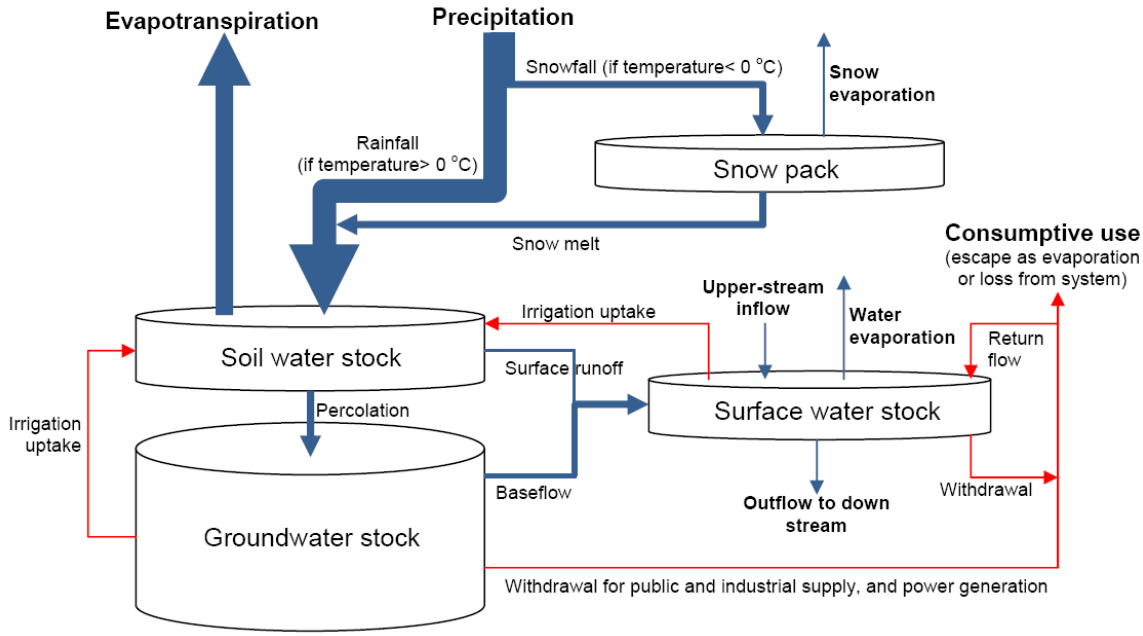


Figure 3.1 Conceptual water stocks and flows diagram. Bold-font flows indicate the primary flows entering and leaving a watershed, which is the spatial unit and system boundary considered in this report (lines in red color indicate anthropogenic flows).

3.1. Maximum available water

Minnesota receives little surface water from adjacent states and sends more surface water to neighboring states than it receives. Therefore, the maximum available water within the state boundary is made up of the surface water runoff generated in Minnesota and the ground water recharge occurring in Minnesota. Theoretically, water availability can be estimated by computing water balance in the soil layer and using the sum of surface runoff and percolation occurring in the soil as an indicator (Figure 3.2). This approach describes the maximum water occurring in the system before anthropogenic water use.

Water percolating through the soil layer becomes the primary recharging flow to groundwater stocks, which can significantly influence stream flow by discharging groundwater into stream systems as baseflow. Thus, prior large-scale studies have often selected stream flow as an indicator of maximum available water [26, 35, 36]. However, this method is only applicable when anthropogenic withdrawals from groundwater stocks are negligible.

For the purpose of verification, we compared historical stream flow data and estimated water availability, and both approaches yield a total amount of annual water availability of 151

to 159 mm per year in Minnesota (Figure 3.3). However, the difference between stream flow and estimated available water is expected to increase as human influence on hydrology increases.

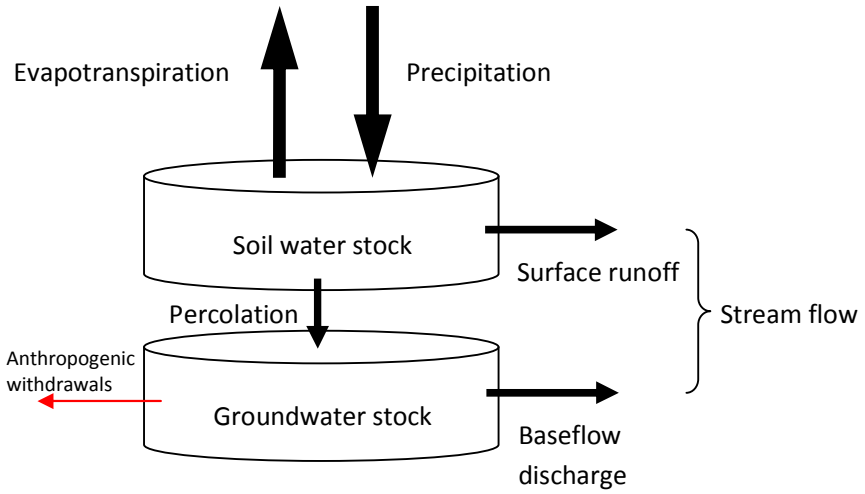


Figure 3.2 Conceptual diagram of estimating water availability. The sum of runoff and percolation indicates the maximum theoretical available water by eliminating the anthropogenic effects caused by water withdrawals from the groundwater systems.

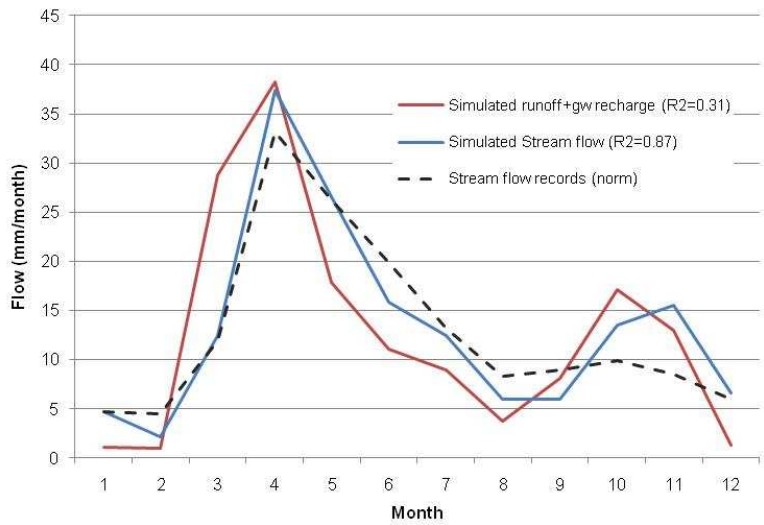


Figure 3.3 Comparison of results from different approaches in determining water availability. Both approaches show similar temporal trends and differences in the annual sum are less than 5%.

3.2 Seasonal dynamics of water withdrawals

In this report, the terms, “water consumption” and “water withdrawal” are distinguished. Water consumption is defined as the amount of water withdrawn which does not return to its original source in a watershed due to evaporation, transpiration, or significant degradation in quality and is no longer available for biological uses in the same watershed. Water withdrawal, on the other hand, accounts for the total water volume extracted from a watershed from rivers, lakes, man-made reservoirs, and aquifers. Therefore, water withdrawal should be equal to or greater than consumption. For description purposes, all results are grouped into 9 divisions based on Minnesota climate characteristics (Figure 3.4).

Historical data indicate that Minnesota’s water withdrawal has gradually increased in almost every use category since the 1980s [17], and has shown little sign of decline (Figure 3.5). Spatially, different regions show significant variance in each use category, and Minnesotans withdraw 2% to 30% of available water on average (Figure 3.6). For instance, water extracted for supporting power generation is one of the top withdrawal categories, especially in south-east Minnesota. This region (Division 5, 6, 8, and 9 in Figure 3.4) is also responsible for 51%, 80% and 82% of state total irrigated, public and domestic, and power generation water withdrawals, respectively. However, industrial withdrawal plays an important role in north-east Minnesota, where Division 2 and 3 alone withdraw more than 81% of state industrial water.

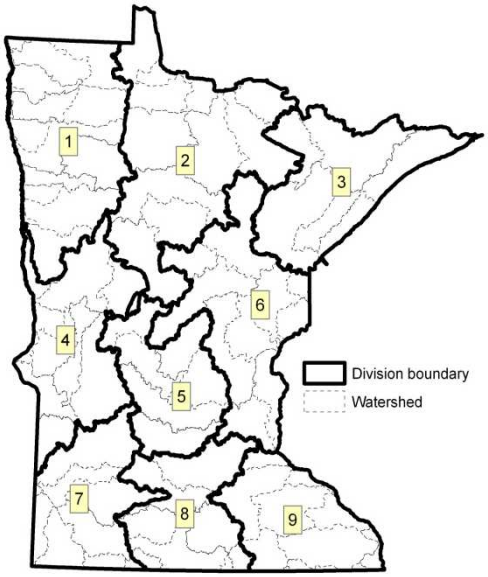


Figure 3.4 Division numbering and location.

As Figure 3.4 illustrated, the peak water availability normally occurs around spring, whereas water withdrawal peaks in summer due to the intensive water withdrawal from power, residential and agricultural sectors [37-39]. The impacts of this withdrawal may seem to be minimal and unrecognizable unless significantly dry years occur in Minnesota. The 1988 summer drought in Minnesota, for example, forced the water authority to suspend irrigation water permits in 13 watersheds which primarily extracted water from surface water sources [40]. The drought caused an average reduction of 41% in crop yield from previous year, and destroyed

80% of newly planted trees in central Minnesota [40]. Power generation also declined by 26% [40].

Therefore, to understand the relationship between the aspects of water withdrawal and water availability on both spatial and temporal scales, it is necessary to establish a holistic framework coupling these two aspects. In the next section, we introduce a modeling framework which takes water demand and supply into account with detailed spatial and temporal resolution.

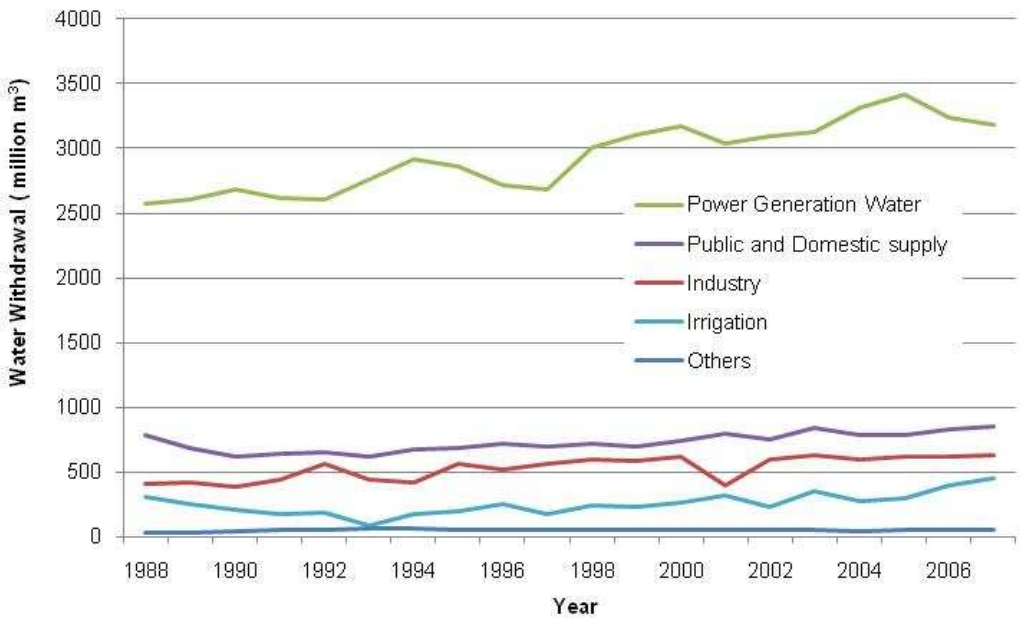


Figure 3.5 Water withdrawals have been climbing gradually in every use category. Power generation has been the major withdrawal category, r demanding five times more water than the others.

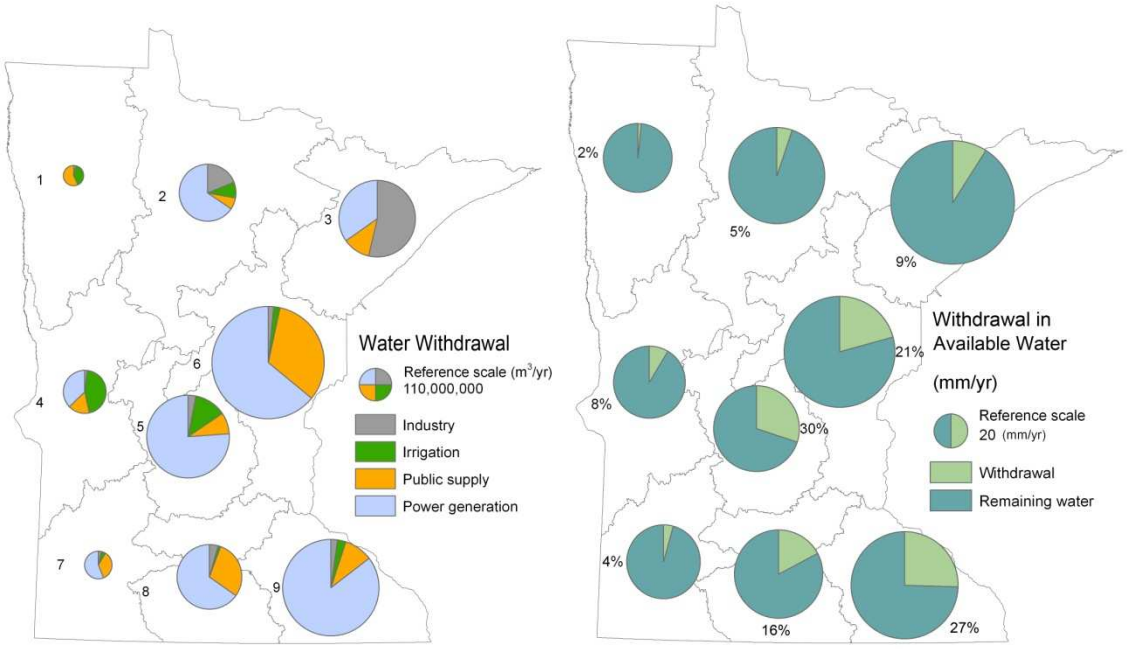


Figure 3.6 Water withdrawal (left) and water withdrawal as a percentage of total available water (right) in different divisions. The pie size indicates the total volume of annual water withdrawal in a division on the left and total available water on the right. The spatial distribution is highly correlated with population distribution and local economic activities.

4. Integrated analytical framework incorporating system dynamics

A modeling framework integrating system dynamics modeling and GIS was established to assess regional water availability in the future. In this section, we derive several key drivers which shape regional water regimes, and describe the tool we established to assess the change in regional water regimes under different scenarios.

4.1. Drivers of change

Several major changes are likely to occur or already occurring in Minnesota that can potentially impact the water budget. These include demographic change, climate change, biofuel development, and electricity demand. The modeling framework established in this study was developed specifically to evaluate the impacts these changes will have on water resources, so that water use planning may become more integrated and holistic with a focus on sustainability, as recommended in the Minnesota Statewide Conservation and Preservation Plan and previous documents [16].

4.2. System dynamics model

To transform the conceptual diagram in Figure 3.1 into a numerical matrix, a series of hydrological, climatic, socio-economic, and stochastic models were connected as a holistic modeling framework by using system dynamics software as a platform. The framework was further divided into four modules including climate, energy demand, water demand, and water balance (Figure 4.1). The model is described in detail below, and a programming structure developed in Vensim® can be found in Appendix I.

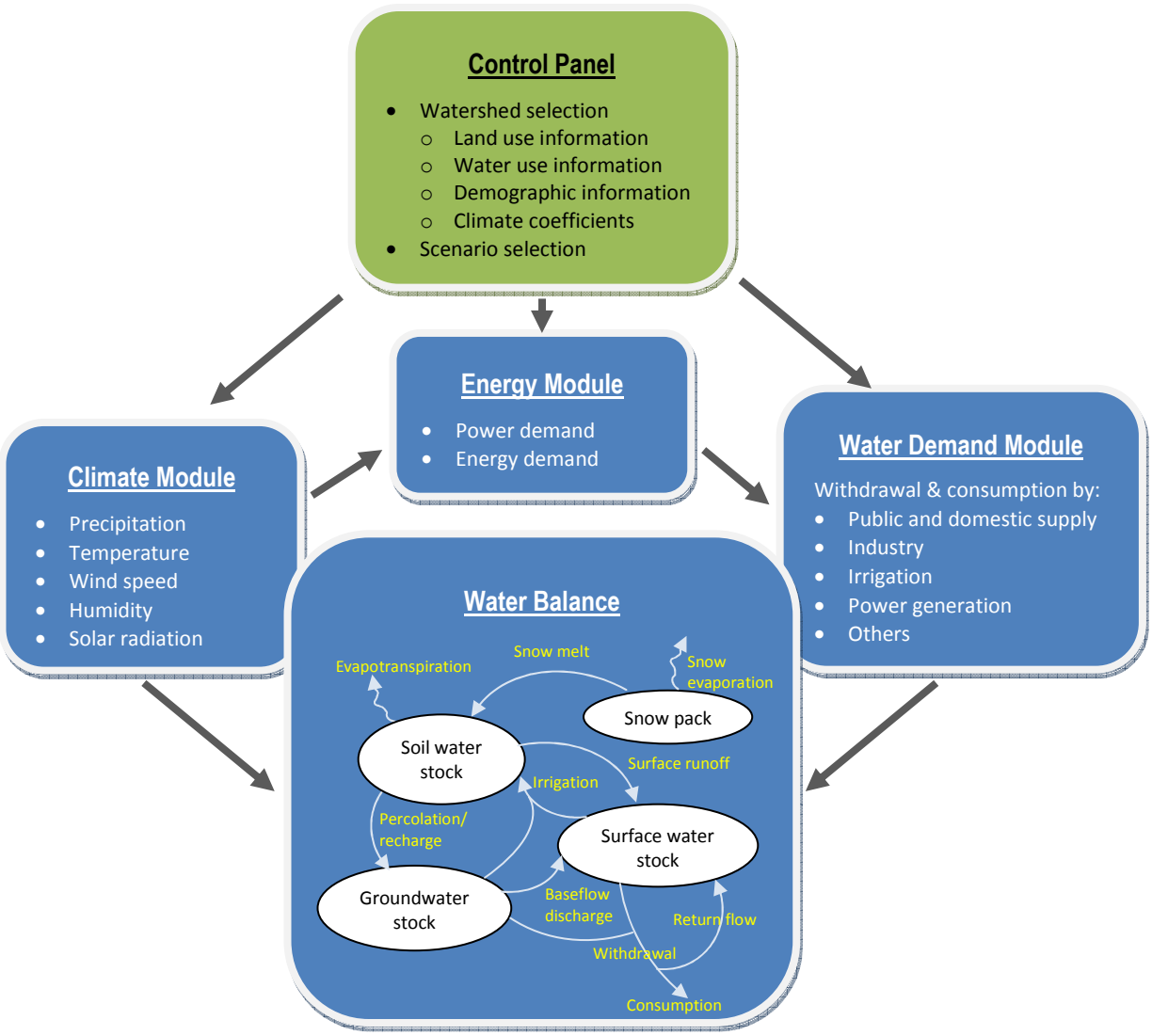


Figure 4.1 Architecture of the modeling framework. The system behavior is governed by the control panel (green block) and synchronized through the functional connections (gray arrows). Water stocks (blue blocks) and flows (blue arrows) then fluctuate accordingly in responding to the selection of target watersheds and scenario.

System dynamics modeling is a valuable tool for investigating complex systems with many interacting components, which change over time [41]. It has been used frequently since its development in the 1960's to conduct forecasts of natural resource systems for management and decision-making purposes [42-44].

4.2.1. Climate and water availability modules

When daily mean temperature is higher than 0 °C, precipitation flows into the soil compartment as rainfall (P_{RAIN}); otherwise, snow falls (P_{SNOW}) and accumulates as snow pack. Temperature patterns are established based on historical data coupled by Richardson's method [45]:

$$
\begin{aligned}
T_t &= \mu_T + \rho(T_{t-1} - \mu_T) + \varepsilon\sigma_T\sqrt{1-\rho^2} \\
\mu_T &= C_{0\mu_T} + C_{1\mu_T}\cos(\frac{i}{365/2\pi} + \theta_{\mu T}) \\
\sigma_T &= C_{0\sigma_T} + C_{1\sigma_T}\cos(\frac{i}{365/2\pi} + \theta_{\sigma_T})
\end{aligned}
\qquad \text{eq.4}
$$

where T_t represents T_{max} or T_{min} at time t, and is determined by its previous state (T_{t-1}), historical average at a given day of T_{max} or T_{min} (μ_T) and the standard deviation of each (σ_T). In eq. 4, coefficients C_0, C_1, and θ are estimated individually based on historical data, and the term ε is a randomly generated standard normal deviate.

Several other minor climate inputs are also required for further use in computing water flows of evapotranspiration and snow evaporation, including extraterrestrial radiation (R_a, MJ $m^{-2}day^{-1}$), wind speed (V_w, m sec^{-1}), and relative humidity (R_h, percent).

$$
\begin{aligned}
R_a &= \frac{118.08dr}{\pi}(\omega s \times \sin(LAT)\sin(\delta) + \cos(LAT)\sin(\omega s)) \\
dr &= 1 + 0.033\cos(\frac{2\pi}{365} \times t) \\
\omega s &= a\cos(-\tan(LAT)\tan(\delta)) \\
\delta &= 0.409\sin(\frac{2\pi}{365} \times t - 1.39) \\
LAT &= \frac{\pi}{180} \times \text{latitude of a watershed in decimal degree}
\end{aligned}
\qquad \text{eq.5}
$$

where dr is the inverse relative distance between the sun and earth on the given day t, and ωs is the solar time angle defined by the sun's declination above the celestial equator (δ) and the latitude of a studied watershed in radians (LAT). To obtain wind speed and relative humidity (R_h, percent) values for each watershed over time, the same procedure previously introduced for computing temperature is applied again.

All these climate factors are then used to regulate hydrological flows in the water balance module, including evaporation, evapotranspiration, percolation, baseflow and runoff, in which the sum of percolation and runoff is employed to illustrate local water availability. To simulate the water balance in each compartment, a series of water stock and flow relationships were established based on linear-reservoir dynamics.

4.2.2. Water demand module

The water demand model in this study places water withdrawal (WU_T, m^3) and consumption (WC_T, m^3) in five categories, including industrial water (WU_{IND}, WC_{IND}), irrigation water (IRG), public supply (WU_{PB}, WC_{PB}), water for power generation (WU_E, WC_E) and other special usages (WU_{SP}, WC_{SP}). Except for power generation, the other four categories are computed based on the per-capita usage rate and climate characteristics of each watershed. Power generation water usage is estimated using state wide electricity demand. Thus, for some watersheds, the water extracted for power generation can be zero if there is no power plant in that watershed.

$$WU_T = \sum (IRG + WU_E + WU_{IND} + WU_{PB} + WU_{SP}) \qquad \text{eq.6}$$

For each water demand category, a consumption and withdrawal ratio (r_{cw}) is determined based on literature review, and water demand is determined in the same fashion.

4.2.2.1. Industrial water

Industrial water demand relies heavily on economic and manufacturing activities, and often can be estimated together with domestic water demand as a function of population [46, 47]. However, industrial water withdrawal per person can vary widely from 0 m^3 per capita per year ($m^3 capita^{-1} yr^{-1}$) in some watersheds, such as the Nemadji River or Redeye River watersheds, to 27,196 $m^3 cap^{-1} yr^{-1}$ in the North Lake Superior watershed with an average of 825 and standard

deviation of 4,152. Demand for public water supply varies much less, with an average rate of 170 $m^3cap^{-1}yr^{-1}$ and standard deviation of 502 [17]. Therefore, industrial water should be separated from public water use.

In addition, a watershed-based withdrawal rate is adopted to incorporate local climate characteristics instead of applying a state-averaged industrial withdrawal rate.

$$WU_{INDij} = PP_i \times cap_{INDij} \qquad \text{eq.7}$$

where PP_i is the annually averaged population in watershed i, and cap_{INDij} is the watershed-explicit per capita industrial water withdrawal rate ($m^3captia^{-1}day^{-1}$) in day j of a year. Data indicate that the per-capita-basis industrial withdrawal rate is highly correlated with temperature. Therefore, the cap_{IND} value was adjusted based on annual industrial withdrawal rate ($avgcap_{IND}$, $m^3cap^{-1}yr^{-1}$) and maximum temperature ($T_{\max_{ij}}$, °C) to fit the climate- driven trend using the following equation, in which all the coefficients were derived from historical data:

$$cap_{INDij} = avgcap_{INDi} \times (1 + 0.1156 \times T_{\max ij}) \times 0.0012 \qquad \text{eq.8}$$

4.2.2.2. Public and residential supply water

Public and residential supply water (WU_{PR}) is made up of public supply systems and self-supplied water from wells, and is highly regulated by seasonal climate patterns and population [48]. On an annual basis, data indicate that WU_{PR} may be estimated by using population information [17]. Data also show an increase in annual per-capita public and residential water supply from 1990 to 2007.

Temperature is the most significant factor regulating the fluctuation of daily WU_{PR} [49]. Therefore, daily WU_{PR} (m^3) of watershed i at day j can be computed by using the following equation:

$$\begin{aligned} WU_{PRij} &= PP_i \times cap_{PRij} \\ cap_{PRij} &= avgcap_{PRi} \times (1 + 0.1156 \times T_{\max ij}) \times 0.0012 \end{aligned} \qquad \text{eq.9}$$

where cap_{PB} indicates daily per-capita withdrawal rate ($m^3 captia^{-1} day^{-1}$) and $avgcap_{PRi}$ ($m^3 captia^{-1} yr^{-1}$) is the per-capita annual WU_{PR} derived from historical data. Constant a is the coefficient of daily maximum temperature ($T_{\max ij}$, °C) and b is the coefficient for scaling. In this study, a and b were set to 0.1156 and 0.0012, respectively.

4.2.2.3. Irrigation water

Irrigation water demand associated with climate change in a large-scale study can be estimated based on changes in crop evapotranspiration, and is often expressed as the deficit between local rainfall and evapotranspiration [50-52].

$$IRG = \sum (P_{RAIN} - ET_{cropi}) \times f_{A-irg} \qquad \text{eq.10}$$

where IRG ($mmday^{-1}$) is the total irrigation water demand in a watershed, and is the sum of the water deficit of local rainfall (P_{RAIN}, $mmday^{-1}$) and the evapotranspiration of a certain crop i (ET_{cropi}, $mmday^{-1}$) times the fraction of area in a watershed where irrigation is applied (f_{A-irg}, percent). The fraction factor of irrigated area is taken into account in the study to overcome the difference in irrigation schedule resulting from crop growth and planting distribution. Both variables of rainfall and evapotranspiration of difference crops will be computed based on the method described in the water supply model, and f_{A-irg} can be compiled based on empirical data.

4.2.2.4. Water for power generation

In this study, it is assumed that power generation schemes will remain the same throughout the study period. Thus, the location of existing power plants will remain the same without geographical expansion and with no changes in fuel source, and water efficiency will remain stable across the studied period. Water for power generation is modeled using the change in state total population (PP_{MN}) and climate in this study. Water for power generation is represented as:

$$WU_{Ej} = (PP_{MN} \times cap_E) \times \sum (f_{fi} \times f_{Eij}) \qquad \text{eq.11}$$

where WU_{Ej} is the total water withdrawn ($m^3 day^{-1}$) for power generation at a given watershed at day j for power fuel type i, cap_E is the daily power demand per capita (MWhr $capita^{-1} day^{-}$

[1]), f_{fi} is the fraction of fuel type i used in generating power at the given watershed, and f_{Eij} is the power generation seasonal weighting factor of fuel i at day j. The fuel types are categorized into four groups in the study, including steam power (thermal), hydropower, nuclear power, and others which are solar, wind, and other power generation technologies.

Integrating state population change from 1990 to 2007 with power generation data, the cap_E shows an increasing trend in the past two decades [53] and has been found highly correspondent with climate change, yet with significant regional variances [54, 55]. A prior study proposed estimating monthly power demand as a function of temperature [56, 57]. Minnesota's historical data also show evidence of electricity demand being leveled by seasonally fluctuating electricity retailer prices (EP). Therefore, to overcome regional differences and establish a numerical method to illustrate power demand dynamics specific to Minnesota , the following equation was derived from historical data (R^2=0.9) and adopted in estimating total power demand over time:

$$\begin{aligned} cap_E = & -3.95\times10^{-5}T_{\max} + 1.10\times10^{-3}T_{\min} + 3.49\times10^{-3}EP \\ & -1.16\times10^{-6}T_{\max}{}^2 + 3.90\times10^{-5}T_{\min}{}^2 - 2.60\times10^{-5}EP^2 - 8.38\times10^{-2} \end{aligned} \quad \text{eq.12}$$

In this study, the seasonal fluctuation of electricity price (EP) is embedded in the model, but the annual average price remains constant over time. By employing this procedure to estimate power generation, the computed result showed high accuracy with only 0.1% error when compared with the official electricity demand data from 2000 [53].

4.2.2.5. Energy and refinery

The only refineries in Minnesota that consume significant water in producing energy fuels are ethanol plants and petroleum refineries. Historical data indicates that ethanol refineries derive water from both industrial and public supply systems, whereas petroleum refineries' water withdrawal is listed under the category of industrial water. Thus, in this study, energy water accounts for processing water acquired by ethanol and petroleum refineries. We assumed that processing one cubic meter of ethanol and petroleum requires 3.6 and 1.47 m^3 of water, respectively [58-61].

4.2.2.6. Special water withdrawal

This category of water withdrawal accounts for occasional usage including air conditioning, snow making, water level maintenance, or temporary withdrawal. This category only accounts for 0.42 % of state withdrawals on average. Therefore, it is treated as a fixed percentage of the total withdrawal from the other categories estimated based on each watershed's historical data.

4.2.2.7. Withdrawal, consumption and water sources

Due to the lack of consumptive water tracking, a set of conversion factors (r_{cw}) to estimate consumptive water from withdrawal by different water demand categories is employed in this study. For industrial consumption, a prior study states that industrial water shows relatively similar reuse ratios in the U.S. among different industries, and ranks from 53.9% to 74.5% [62]. Therefore, a rational withdrawal and consumption ratio is randomly selected from a normal distribution with an average of 63% and standard deviation of 3%. For consumptive public supply and irrigation, r_{cw} values of 86% and 73% of total withdrawal in each category is applied [63, 64], whereas consumptive water volume is set to equal the total withdrawal for the special demand category.

However, the estimation of power water consumption is more complicated due to the wide variance of cooling methods. For instance, water loss can range between 0.26% to 91.6% from an open-loop cooling system to a wet-tower cooling one [10]. To overcome the difference, a set of fuel-type weighted conversion factors taking cooling system types into account is calculated and applied to individual watersheds based on the electrical plant types located in that watershed. The conversion factors remain consistent over time because, as previously mentioned, the fraction of each driver fuel contributing to total power generation is assumed to be the same as in years 2000 to 2008.

Within each watershed, humans derive water from water stock either stored in surface reservoirs or in aquifers. The ratios of withdrawal from surface water and groundwater are explicitly calculated watershed by watershed for each water demand category. The ratio of surface water and groundwater extraction in supporting a demand category of a watershed is assumed to remain consistent over time.

4.3. Indicators

This study used water withdrawal, water consumption, and water stress index (water withdrawal as a proportion of total available water) as indicators for interpreting water resource status under different climate and energy scenarios. The total available water accounts for the surface runoff and groundwater recharge before anthropogenic withdrawal takes place. It is important to realize that this maximum water availability does not imply the maximum allowance for anthropogenic usage, and a certain fraction of water should remain available for ensuring ecological integrity.

Both water withdrawal and consumption are in cubic meters. Water stress index, on the other hand, is dimensionless and normally falls in between 0 to 1. However, in some populated areas, the water stress index may be greater than 1 indicating that withdrawal patterns exceed what the system can naturally supply. The water stress index values of 0.1, 0.2 and 0.4 are the thresholds of low, mid-high, and severe water stress, respectively [30, 65]. Each indicator was computed on a daily basis within a watershed, but may be aggregated monthly for presentation purposes.

5. Development of scenarios

This study focused on a series of scenarios related to potential changes in corn-based bioethanol production, population, electricity demand, and climate. In establishing each scenario, we derived projections based on cases relevant to Minnesota's social and economic background, energy policies.

5.1. Increase of biofuel production

According to the Annual Energy Outlook 2007 reference case published by the U.S. Energy Information Administration, ethanol was projected to account for 7.6% of the total gasoline consumption by 2030, in which the latter was projected to increase by 34% from 2007 to 2030 on a volume basis [66]. This can be translated into a total ethanol demand of 41.2 million m^3 by 2030. Therefore, we developed Minnesota's ethanol business-as-usual scenarios by 2030 using the national figures of 41.2 million m^3, and assumed Minnesota would produce 10% of the national ethanol pool, as was the case in 2007 [21, 67]. To create the extreme ethanol scenario, we assumed 20% more production compared with this base case.

5.2. Increase of population

The State Demographer has population projections published up to the year 2035 by county [9]. The state demographer estimates a population of 6,297,300 in 2030, which was selected to be the business-as-usual scenario in this study. To develop the extreme scenario, an additional 20% of the business-as-usual population figure was used.

5.3. Electricity use

The business-as-usual power scenario derived from historical data (denoted as Power(N)), assumes that power demand per person would reach 17.3 MWh by 2030[53, 68]. The extreme case, or Power(X) scenario, assumed 20% additional increase in power demand per person, which would lead to 20.76 MWhr per person by 2030.

5.4. Climate change

To generate climate scenarios, data were generated and downloaded from exogenous sources developed by the U.S. Bureau of Reclamation Technical Service Center, Santa Clara University, and the Lawrence Livermore National Laboratory [69]. Various global climate models and emission scenarios are available for downscaling through this data site, and we have chosen one of them that represents the case of extreme use of energy (IPCC A2 emission scenario) [69] Climate under business-as-usual was set to stay the same as the normal climate patterns of 2000s. Climate data for the extreme climate change scenario (2030CE scenario in this report) were acquired from MRI CGCM (2-3-2A).

The combination of assumptions under each scenario is summarized in Table 5.1.

Table 5.1 Summary of scenarios tested in this study.

Scenario	Description of assumption				
	Description	Climate	Population	Ethanol	Power
BL	Baseline case in year 2000	—	—	—	—
CnBAU	Business-as-usual scenario by 2030	—	N	N	N
CxBAU	Business-as-usual plus climate change scenario by 2030	X	N	N	N
Cx	Climate scenario by 2030	X	—	—	—
PPn	Population scenario by 2030	—	N	—	—
EtOHn	Ethanol production scenario by 2030	—	—	N	—
PWn	Power generation scenario by 2030	—	—	—	N
Extreme	Extreme scenario by 2030	X	X	X	X

—: current average status in 2000s

N: business-as-usual scenario
X: extreme scenario

6. Results

We grouped individual watersheds into 9 zones based on Minnesota's climate divisions defined by NOAA (Figure 3.4). On the temporal scale, study results were presented per monthly spans in order to highlight seasonal variations. Because the study is aiming to illustrate how Minnesota's water resources would respond to different scenarios, it is important to highlight the magnitude of water flow change departing from the baseline.

The results show that as a result of climate change, western Minnesota continues to be more arid than the eastern part of the state. However, the amount of water available, which is defined as precipitation minus run-off, is expected to increase more significantly in the west (34%~70%) than in the east (-2%~18%) under climate change effects by year 2030 (Table 6.1).

Population change is expected to increase water withdrawal in almost every category, except for the irrigated water category that responds primarily to climate change (Figure 6.1).

In general, water withdrawal increases significantly under the extreme scenario (Extreme) as expected, in which population change played the most important role in driving future water withdrawals. Electricity demand could also considerably amplify water withdrawal in the locations where power plants are currently located. The effects caused by increasing ethanol production became marginal as compared with the changes induced by population and power generation increase. Climate change, on the other hand, contributed trivial impacts on water withdrawal compared with the forces of population and energy in the short term. However, water withdrawal would still peak during summer in every region while the relative magnitude of increase in withdrawals compared to water availability would be more significant during the winter. In contrast, available water would increase notably in spring but decrease in summer.

Unlike water withdrawal, water availability is governed mainly by climate in all regions, except for the Mississippi River watershed (No. 20), where its anthropogenic withdrawals could already be influential enough to alter the local water hydrograph. Using water stress index (WSI, total water withdrawal/total available water) as an indicator, there were eight watersheds classified as high water stress (WSI>0.2) during 2000s, which would increase to 12 watersheds under the extreme scenario by 2030.

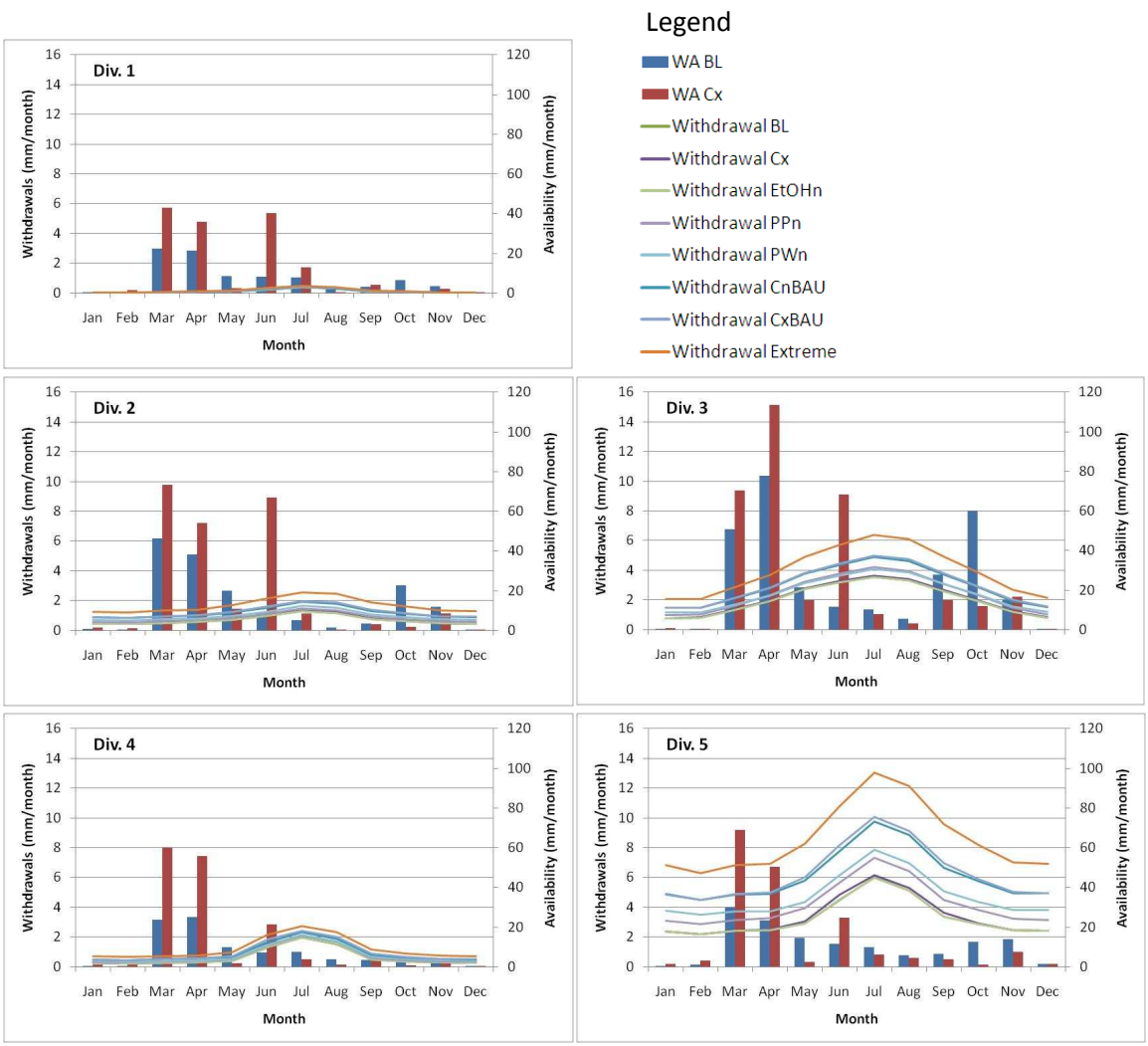
If each driver of change is tested separately, population change and change in electric power grid-mix can elevate state average WSI from 0.14 up to 0.18 and 0.19, respectively. On the other hand, climate can slightly lower WSI down to 0.11. Table 6.2 provides a snapshot indicating which areas might be more vulnerable under demographic and power demand change in the future.

Table 6.1 Water availability, withdrawal, and consumption under different scenarios. BL = Baseline case in year 2000; Cx = Climate scenario by 2030; PPn = Population scenario by 2030; PWn = Power generation scenario by 2030; EtOHn = Ethanol production scenario by 2030; CnBAU = Business-as-usual scenario by 2030; CxBAU = Business-as-usual plus climate change scenario by 2030; and Extreme = Extreme scenario by 2030.

Water Availability (mm/month)								
Division	BL	Cx	PPn	PWn	EtOHn	CnBAU	CxBAU	Extreme
1	84	144	81	81	82	84	139	136
2	161	231	161	162	161	161	229	228
3	280	323	273	276	276	276	320	317
4	91	154	84	89	88	90	150	147
5	132	175	127	126	128	130	174	170
6	218	257	213	216	214	215	255	251
7	92	124	91	91	91	91	125	125
8	145	163	140	150	147	151	156	157
9	191	187	186	190	188	191	186	185

Consumption (mm/month)								
Division	BL	Cx	PPn	PWn	EtOHn	CnBAU	CxBAU	Extreme
1	1	1	1	1	1	1	1	2
2	4	4	5	6	4	7	7	9
3	15	16	18	17	15	21	21	27
4	3	4	4	4	4	5	5	6
5	20	21	26	28	20	36	37	49
6	18	18	23	24	18	30	31	41
7	1	1	1	1	1	1	1	2
8	13	13	18	17	13	23	23	30
9	28	28	36	41	28	52	53	73

Withdrawals (mm/month)								
Division	BL	Cx	PPn	PWn	EtOHn	CnBAU	CxBAU	Extreme
1	1	2	2	1	1	2	2	2
2	8	9	10	12	8	14	15	20
3	24	25	29	29	24	36	36	47
4	8	8	9	9	8	11	12	14
5	39	40	50	57	39	74	75	103
6	45	46	57	63	45	79	81	110
7	4	4	5	5	4	7	7	9
8	24	24	32	33	24	44	45	60
9	51	52	66	78	51	100	102	142



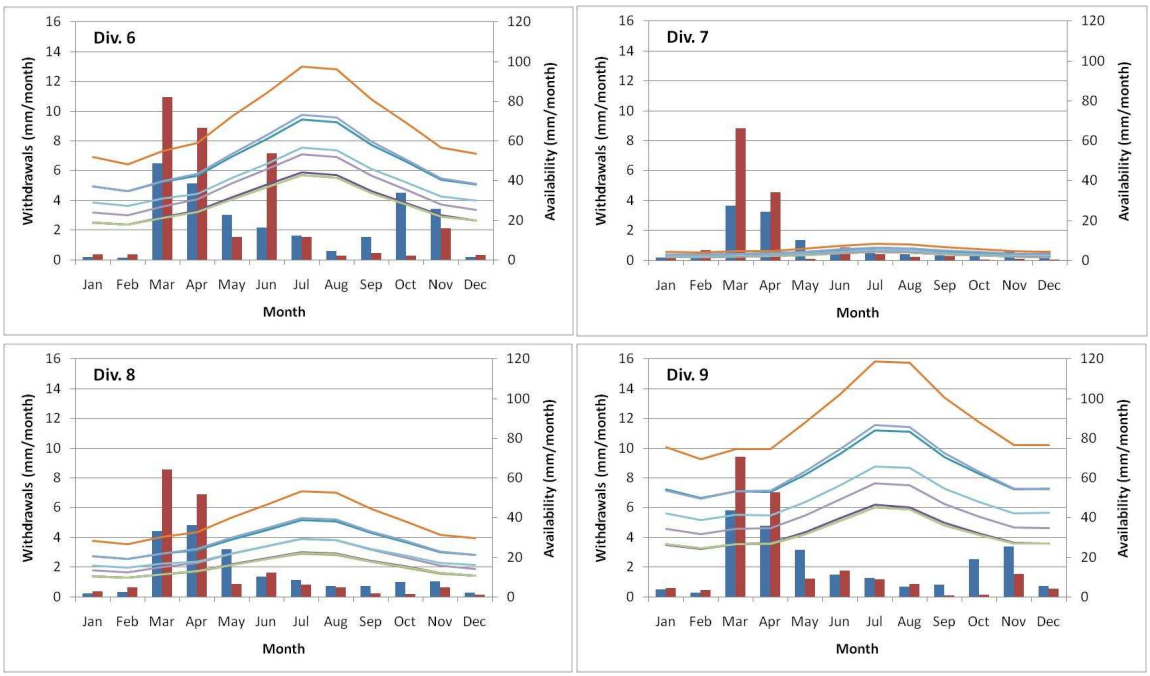


Figure 6.1 Water demand and supply under different scenarios by geographic division over time. Each region responds to the designated scenarios differently while sharing common seasonal trends.

Table 6.2 Water stress index under different scenarios. Climate change scenario may reduce WSI primarily due to the increase in available water. During summer time, excessive water withdrawals would outpace the increase of available water and result to severe water stress under the climate change scenario. Notably, many divisions are under water stress during summer time, which would be worsened under every scenario.

Scenario	BL	Cx	PPn	EtOHn	PWn	CxBAU	CnBAU	Extreme
Watershed Count	8	6	9	9	10	9	11	12
Annual Average WSI	0.14	0.11	0.18	0.14	0.19	0.19	0.24	0.27
Division	Average Summer (June – August) WSI by Scenario by Division							
1	0.06	0.27	0.07	0.06	0.06	0.27	0.06	0.30
2	0.39	1.17	0.45	0.39	0.49	1.79	0.59	2.32
3	0.41	0.54	0.54	0.44	0.51	0.79	0.61	1.04
4	0.28	0.75	0.32	0.30	0.31	0.94	0.34	1.06
5	0.63	0.80	0.77	0.63	0.84	1.40	1.05	1.87
6	0.65	1.15	0.86	0.68	0.87	1.99	1.14	2.72
7	0.12	0.19	0.13	0.12	0.15	0.29	0.18	0.38
8	0.37	0.43	0.50	0.37	0.46	0.84	0.62	1.11
9	0.73	0.67	0.95	0.74	1.09	1.30	1.36	1.83

*Red colored numbers indicate WSI > 0.5

The results also show that the amount of water withdrawals in Divisions 5, 6, and 9 is already approaching the amount of water available in those Divisions during the winter and summer

months, and all scenarios except for Cx (extreme climate change only) exacerbate the situation considerably. In other words, these divisions represent the most likely regions where significant water stress (WSI of near 1 or even over 1) may be reached temporarily during the winter and summer months, indicating absolute shortage of renewable water during those periods. During these months, freshwater or groundwater stocks will have to be drawn down to supply regional water needs.

6.1. The case of increased biofuel production

Biofuel production is the least influential driver of the state's future water withdrawal and water stress. Under ethanol production scenarios, we assumed that ethanol refineries acquire 100% of corn feedstock from locally grown corn. This would require 7.3 million m^3 of irrigation water under the EtOHn scenario, and 10.6 million m^3 under the Extreme scenario. These represent an increase of 38% and 101%, respectively, in ethanol-appropriated irrigation compared with the BL scenario. Combining irrigation and process water, the ethanol industry would withdraw 22.1 million m^3 or consume 20.4 million m^3 of water a year under the EtOHn scenario (Figure 6.2). This scenario assumed that ethanol would be produced in existing and currently proposed facilities, and that corn would be sourced from the same regions from which it is currently. We found that, in order to satisfy the ethanol production under both EtOHn and Extreme scenarios, approximately 34% and 41% of state corn production would be acquired by the ethanol industry if both yield rate and planted acreage remain the same into the future.

With this site-specific assessment, we also found that the total water withdrawal needed to produce ethanol spans from 3 m^3 water/m^3 ethanol to 19 m^3 water/m^3 ethanol with an average of 5.4, which is lower than the previous state-level estimation of 19 [4] or national average of 263 to 784 m^3 water/m^3 ethanol [23, 70, 71]. The average figure would increase slightly to 6.3 m^3 water/m^3 ethanol in the future due to the proportional increase of appropriating corn from irrigation-fed areas.

Though ethanol production is less likely to deplete Minnesota's overall water resources than population growth or electricity demand [4], it can induce local water stress. The bottom-right map in Figure 6.2 highlights potential water stress corresponding to ethanol plant location and local water availability under the Extreme scenario. As shown in the lower right figure, higher stress would be expected around the southern region of Minnesota if current production

expansions continue. In some areas in the southern region, extreme ethanol production is expected to require up to about 4% of the available water in the region (Fig. 6.2 bottom right).

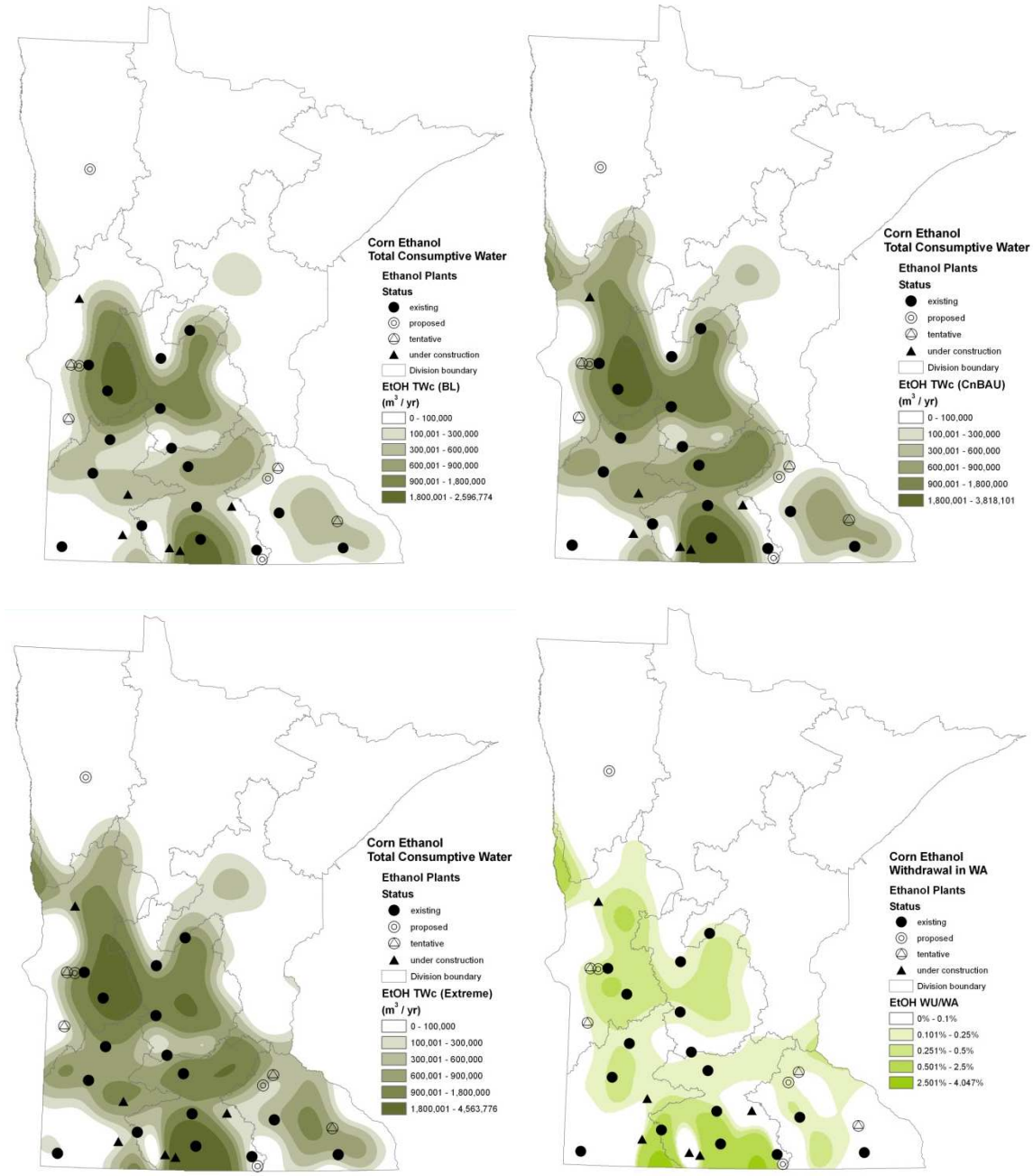


Figure 6.2 Total consumptive water (TWc) in ethanol under three production scenarios: 2000 baseline (BL), 2030 business-as-usual (CnBAU), and 2030 extreme (Extreme). TWc accounts for both process water and irrigated water in ethanol. The bottom-right map shows the total ethanol withdrawal in total available water.

6.2. The case of increased electricity demand

Water withdrawal in each Division for power generation ranges from 26 thousand m^3 (Division 1) to 815 million m^3 (Division 6), with an average of 309 million m^3 in 2000 – 2009. Under the PWn scenario, the power industry would withdraw 61% more water than under the BL scenario. Due to the various capacities and fuel sources of power plants by region, extreme water demand would be observed in the upper-central and east-central areas of Minnesota (Figure 6.3, left).

The difference between withdrawal and consumption implies different regions may respond to water shortage differently (Figure 6.4, right). For instance, if a drought occurs, Division 6 and 9 may experience difficulties in meeting electric power demand due to the lack of sufficient water supply. In the long term, water balance in Division 6 and 9 could be significantly altered due to the considerable portion of water withdrawn by power industries in these regions.

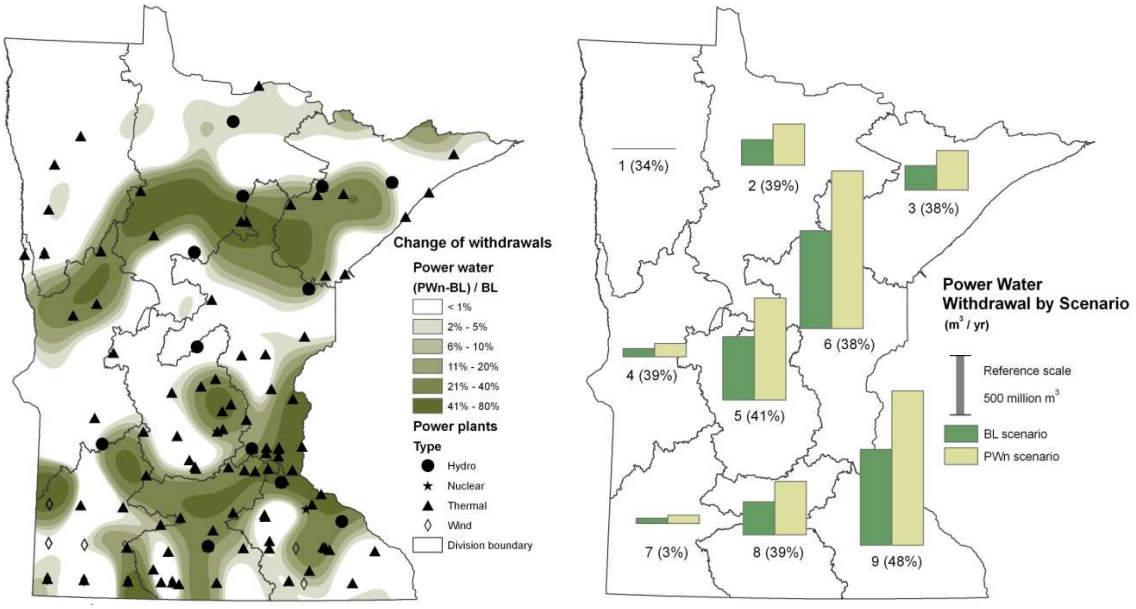


Figure 6.3 Change of water withdrawal under PWn scenarios as compared to that under BL (left). The percentages shown on the map (right) indicate the share of water withdrawn by power plants as a fraction of total available water in each division.

6.3. The case of increased population

The results show that population change can be the most powerful driving force in altering water withdrawal volume and affecting multiple usage categories. Changes in

population can elevate not only water withdrawal by public supply systems, but also increase power demand which also has a positive feedback on amplifying water withdrawals. Due to the historical positive correlation between population change and industrial water use, the change of population also implies increased consumption of water classified for industrial supply.

Therefore, under the population growth scenario (PPn), the state would withdraw 5.9 billion m^3 of water in order to support the communities and economic activities associated with this population growth, which would amount to 3.2 billion m^3 of water consumption. This would add an additional 1.2 billion m^3 of water withdrawal from what was needed under the BL scenario. On average, water withdrawals for industrial, public, and power usage would range from 23% to 28% under the sole effect of population growth.

The increase would primarily affect those regions with significant population growth or where power plant density is higher (Figure 6.4). As Minnesota's cities and population sprawl from the south-east region toward the north-east corner of the state, water demand shows asimilar pattern.

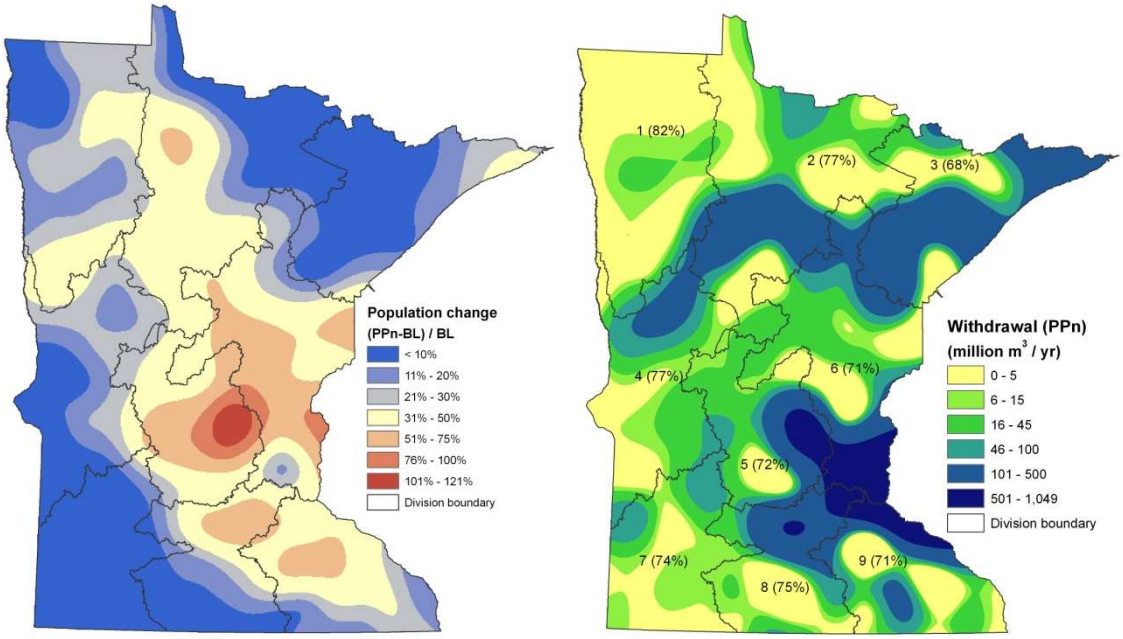


Figure 6.4 Total water withdrawal under the sole effect of population growth (PPn, right) and its spatial correlation with population change magnitude by 2030 from 2000 (left). Numbers in parentheses represent the percentage of consumptive water in withdrawal.

As shown previously in Table 6.2, water withdrawals for industrial, public supply, and power generation usage driven by population growth could create uneven water stress in different regions in the state. Though most of the "hot-spot" regions currently receive more

precipitation than the rest of the state, the ratio between withdrawal and availability may soon reach parity if water use patterns remain unchanged.

6.4. The case of climate change

Climate change ranks third in affecting total water consumption following population and power demand. Even considering the short time span of this modeling effort, climate change impacts on Minnesota's water resources can be seen within the next 20 years. This implies climate change should be taken into account not only for making long-term but also short-term policies on sustaining water resources.

The climate scenario (Cx) would substantially increase irrigation needs by 5% to 18% with an average of 11% above what Minnesota currently applies. Though the climate effects on other usage categories would be relatively marginal compared with the effects on irrigation, industrial and public water withdrawals could increase by 8%, public supply by 4% and power generation water by 1% (Figure 6.5). Though the climate scenario may increase water availability in all divisions (except for Division 9) by 14% to 67% from BL, the increase in water withdrawals driven by the growth of population and energy by 2030 would still outpace the net gain of available water volume from climate change and result in an increase in water stress.

In terms of increasing irrigation demand, the central part of Minnesota, where irrigation rates are currently higher than in the rest of the state, would be the primary region affected by this scenario. Areas with higher increases in irrigation, however, would be located in the north due to the relatively significant increases in evapotranspiration in these regions.

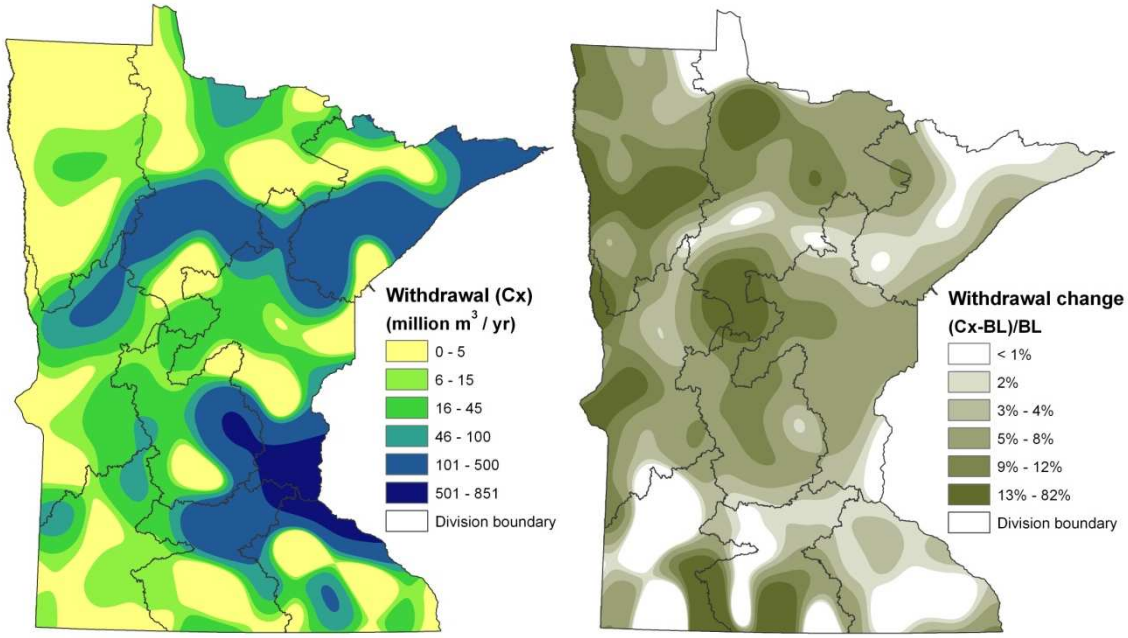


Figure 6.5 Total withdrawals under climate scenario (left) and proportional increase above BL scenario (right).

6.5. Extreme scenario

Under the extreme scenario, in which Minnesota would reach the highest population, energy consumption, and ethanol production growth under climate change effects, water withdrawal would increase to around 141% above BL levels by 2030. During the same time, water consumption is expected to increase to around 120% of the 2000 level. By then, Minnesota is expected to withdraw 11 billion m^3 of water which accounts for 27% of what is available, and nearly 50% of withdrawals would be consumed. Spatially, eastern and upper-central Minnesota would experience substantial increases in water withdrawal compared with the 2000s (Figure 6.6).

By use categories, water withdrawn to support power generation would increase the most (196%) followed by public and domestic supply (63%) (Table 6.3). Particularly, water used for energy-related industries would surpass any other industries proportionally in terms of growth rate. For example, an average of 1.9% of irrigated water, 0.4% of industrial water, and 0.7% of public supply water was attributed to the ethanol production sector during the 2000s. By 2030, these fractions would rise to 3.4%, 0.6%, and 0.9%, respectively. Together with traditional oil refineries, fuel industries would be responsible for nearly 3% of industrial water

withdrawal. Though the fraction might not be significant compared with total water use, ethanol water demand would increase by 116% from 2000s to 2030, and oil refineries' water demand would grow 67%; whereas other industries would raise their water demand by 46% under the same scenario.

Under the extreme scenario, while the total water withdrawal would increase by 141%, water availability would only increase by 26% during the same period of time, resulting in a substantial increase in water stress from 0.14 to 0.27 (Figure 6.7). Compared to the current global average water stress of 0.1 [34], this implies that human activities in Minnesota are likely to surpass what the system could sustainably support if no strict actions will be taken in the future.

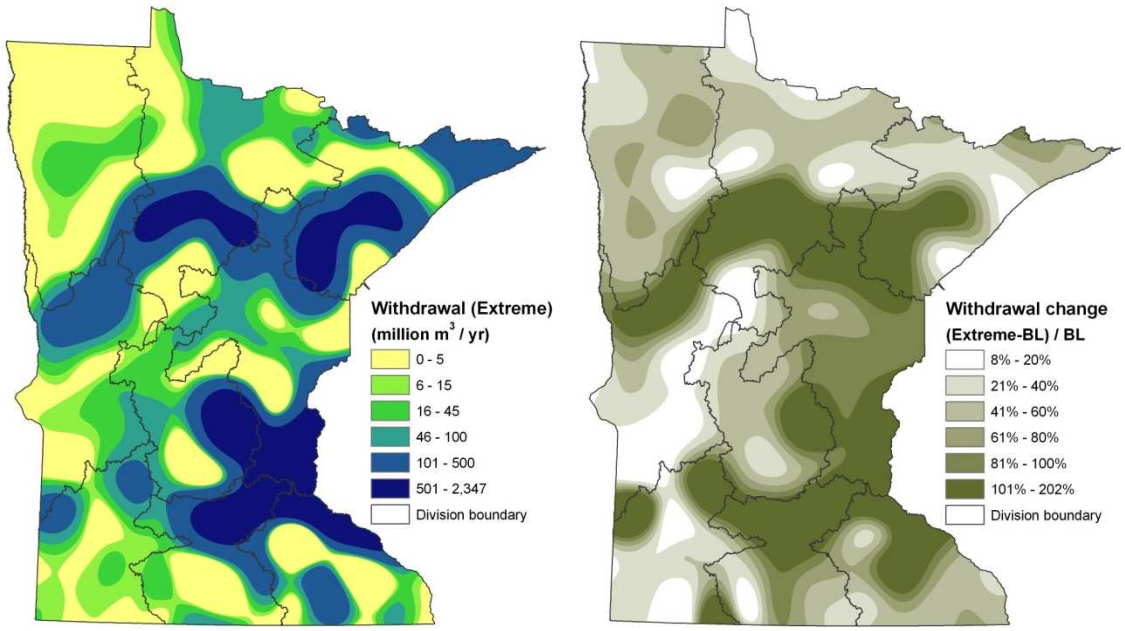


Figure 6.6 Total water withdrawal under the Extreme scenario by 2030 (left). Significant increase in withdrawal would occur in areas with high population growth (left) [72].

Table 6.3 Summary of water withdrawal by different user categories.

User category	Withdrawal (million m^3/yr)		Change
	2000 Baseline scenario	2030 Extreme scenario	%
Total irrigation	275	308	12%
Irrigation for ethanol	5	11	101%
Irrigation for other crops	270	297	10%
Total industrial water	479	706	47%
Ethanol process water	2	5	116%
Petroleum water	10	17	67%
Other industry	467	684	46%
Total Public & Domestic supply	855	1,390	63%
Ethanol process water	6	13	1%
Other users	848	1377	62%
Total water for power generation	2,946	8,720	196%
Other water withdrawal	168	256	53%
Total withdrawal (A)	4,724	11,379	141%
Total available water (B)	*34,114*	*42,837*	*26%*
Water stress index (A/B)	*0.14*	*0.27*	*93%*

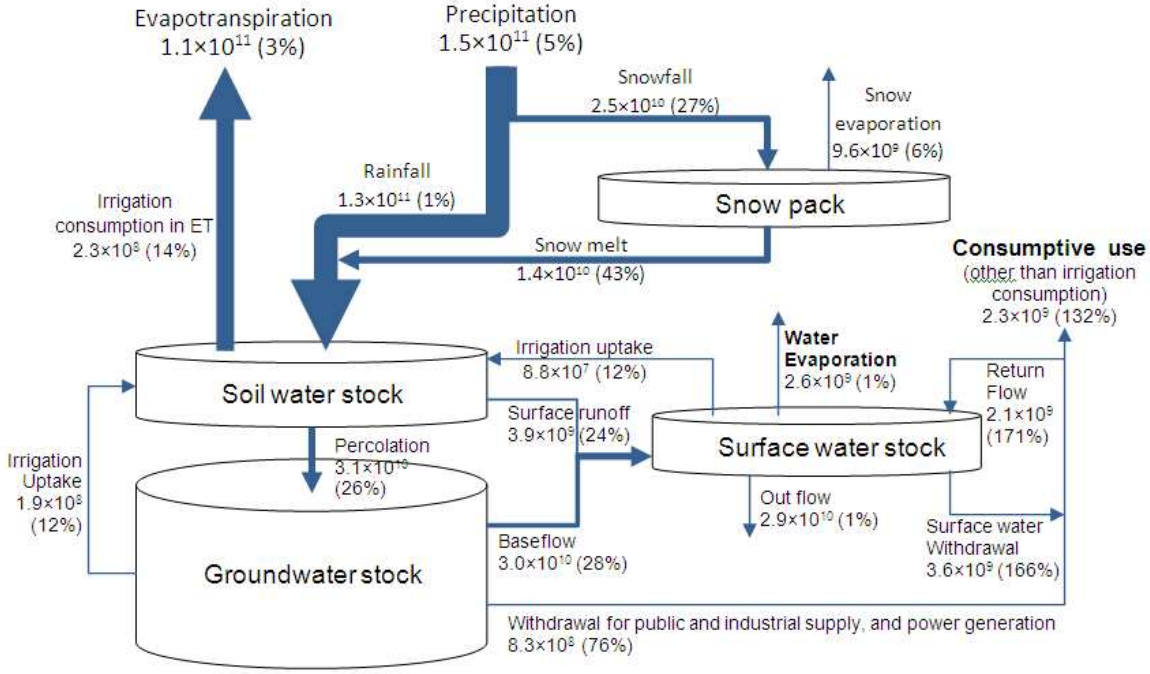


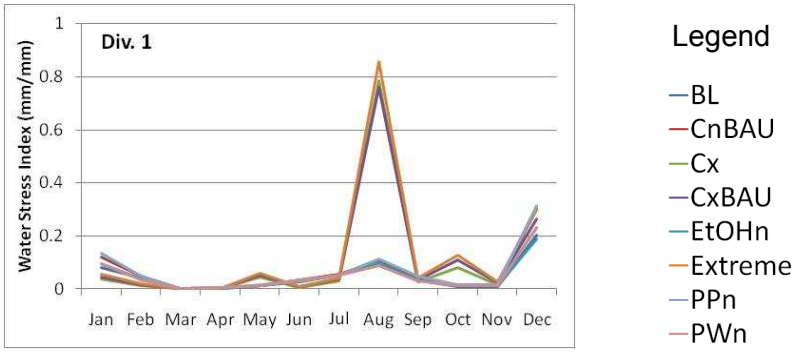
Figure 6.7 Snapshot of overall water balance under normal conditions (in m^3/yr) and flow change percentage from BL to Extreme scenario (in brackets). Figures may not add up due to rounding.

6.6. Seasonal water stress

Previous studies adopted the water stress index (WSI) to represent regional variation in potential water shortage under different combinations of water withdrawal and availability [30, 73]. It is also important to picture the seasonal dynamics of water demand and supply. The results from this study indicate that water stress mostly occurs between August and October, with regional variation (Figure 6.8). A cross examination showed that the stress taking place in August is normally driven by water withdrawal, whereas that in fall and winter results from low water availability. Though in most divisions, the Extreme scenario would significantly exacerbate water stress. The CnBAU scenario also showed that following current growth and consumption patterns could put Minnesota in potential water stress in winter time by 2030. Population growth would have the tendency to hasten the appearance of water stress, particularly in winter time. The climate scenario had a similar effect of worsening water stress as did population growth in the central and south regions of Minnesota, primarily in summer time.

During fall and winter time, the southern region might encounter relatively high water stress due to the low water supply coupled with higher water demand than the northern areas. Benefiting from the development of water allocation infrastructures and buffering functions provided by natural hydrological systems, the public may not physically experience water shortage in summers and winters unless a severe drought occurs. However, it is clear that Minnesota becomes especially vulnerable to unexpected water shortages during these periods of high WSI.

Populated regions including Division 5 and 6, in particular, extract over 100% of the water supplied by natural systems over 1/3 of the year under every scenario and over 3/4 of the year under the Extreme scenario. The results indicate that we are highly dependent on the buffering function or freshwater stock during these periods, or else we would experience drought.



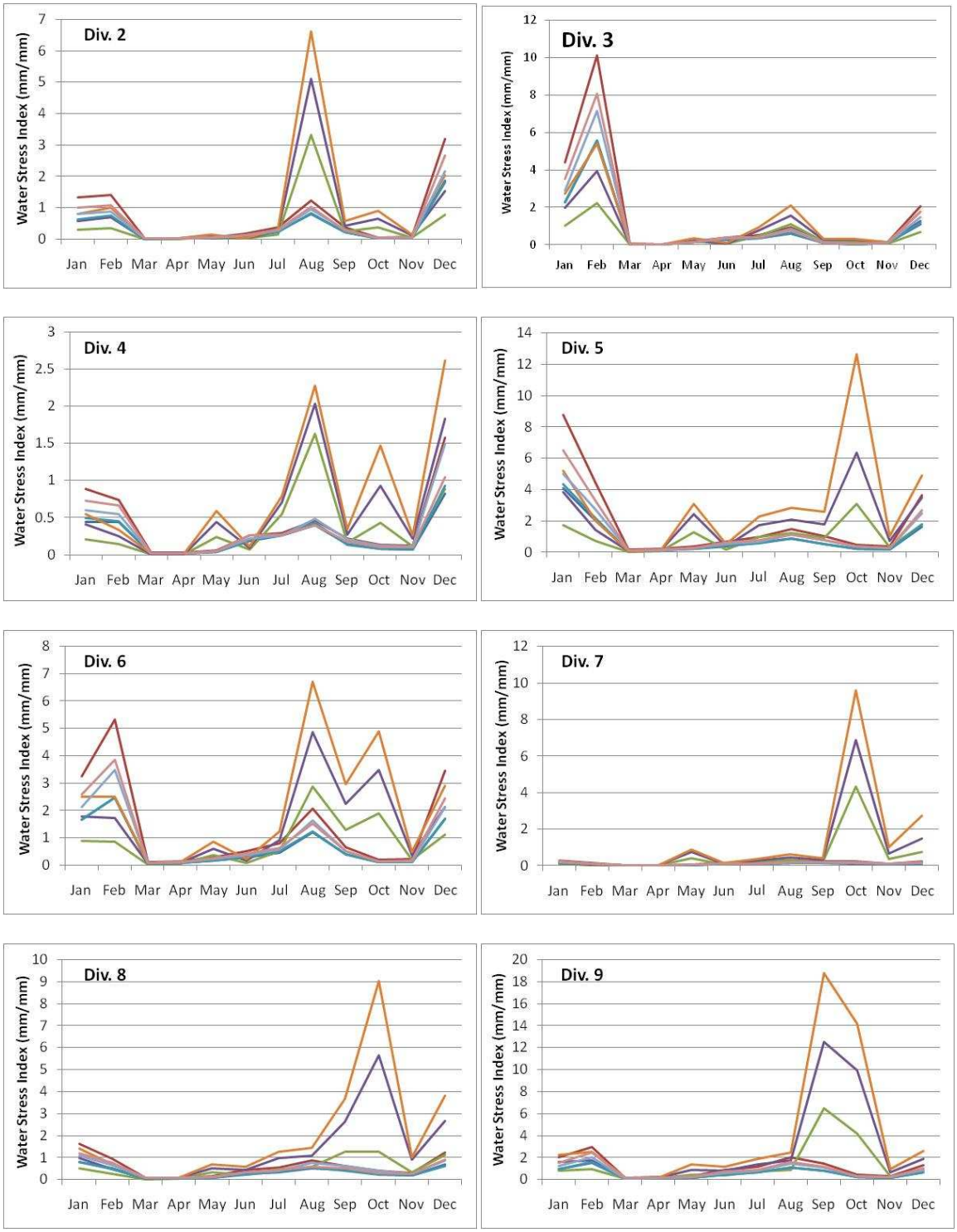


Figure 6.8 Water stress index over time in different divisions under designated scenarios.

7. Implications for sustainability

By coupling water demand and supply with system dynamics and GIS modeling tools, this study analyzed how Minnesota's water regimes might respond to various scenarios of population, energy, and climate change. Instead of identifying the absolute amount of water we have "in stock," this study forecasts the quantifiable relationships between water resources, social, and climate factors. This approach connects major drivers of change and their potential consequences in terms of water stress with explicit temporal and spatial dimensions, which allows us to envisage potential futures of the state's water environment.

Without a holistic analysis connecting various parts of the water supply-demand network together, water planning and policy may rely on anecdotal evidence, which is highly dependent on context. For instance, bioethanol's water use has been publicized in recent years, raising concerns about its implications for future water resources. Nevertheless, the results of the current study show that the ambitious target set by the ethanol blending mandate imposes a relatively small burden on the State's water environment, whereas population growth and increase in electricity consumption have the potential to significantly increase water stress in the future. In particular, Minnesota is expected to become significantly more vulnerable to late summer and late winter drought under the population and energy scenarios examined in this study.

Climate change is expected to supply more water to the State through increase in precipitation. However, the magnitude of increase in water availability due to climate change is relatively small as compared to the amount of water consumption increase under the population and energy scenarios. Moreover, most of the increase in precipitation due to climate change is realized during early spring, when flooding instead of drought has been the problem in Minnesota. Our model used a monthly time-step, while accurate characterization of climate change impacts on water availability may require daily or even hourly time-steps in order to take the precipitation intensification impact on run-off into account.

The results highlight the importance of recognizing the connections between energy, population and water use in planning Minnesota's water future. Aligning urban and energy planning activities with water planning will be essential to avoid potential water shortage in the future. Conserving electrical energy, improving electrical energy efficiency and increasing the share of wind and solar power in the State's grid-mix are recognized as important considerations

in reducing future water demand. On the other hand, potential increase in electricity demand without substantially increasing wind and solar power portion in the State's grid-mix will also increase future water demand. For instance, replacing internal combustion engine-powered vehicles by plug-in battery electric vehicles may substantially increase the State's water demand in the future.

The results also show that urban planning—especially in Divisions 5, 6, 8 and 9—should take potential water limitations into account. In doing so, considering the seasonality of water availability is critical. Using annual water balances for urban planning may seriously underestimate seasonal water shortage potential in later summer and winter.

8. Limitations of the model framework

The results and the conclusions drawn in this report cannot be generalized to other states, because all the parameters, models and scenarios are drawn for the case of Minnesota. For instance, Minnesota uses very little irrigation water for biomass feedstock production, and therefore, an increase in biofuel production has relatively small impact on water consumption. Ethanol production may induce significant change in water regimes in states that are relying on irrigation water for ethanol feedstock production.

The model framework built in this report is not meant to simulate physical water routing under storm events, but to quantify the magnitude of water demand and supply in various future scenarios. Though water regimes can be highly sensitive to additional changes associated with anthropogenic activities, some of the driving variables were assumed consistent. For example, under the population scenario, certain land use change is expected, while we did not take the land use change effect into account. When modeling climate change, only precipitation and temperature were altered leaving other factors including rainfall patterns and intensity as constants.

The current study took only water quantity into account. Future studies may take water quality and sensitivity of local ecosystems on water availability into account, to more fully measure the impacts of human activities on water resources.

References

1. Minnesota Department of Agriculture Minnesota ethanol: Production, consumption, and economic impact. http://www.mda.state.mn.us/renewable/ethanol/productionimpact.aspx (10/22),
2. Keeney, D.; Muller, M. *Water use by ethanol plants: Potential challenges*; Institute for Agriculture and Trade Policy: Minneapolis, MN, 2006; pp 1-8.
3. Aden, A., Water usage for current and future ethanol production. *Southwest Hydrology* **2007,** *6*, (5), 22-23.
4. Chiu, Y. W.; Walseth, B.; Suh, S., Water embodied in bioethanol in the United States. *Environmental Science & Technology* **2009,** *43*, (8), 2688-2692.
5. McIsaac, G.; David, M.; Mitchell, C., Biomass crop effects on soil nitrogen and water fluxes. In *4th annual Special Research Initiative Symposium on Biomass Energy*, University of Illinois, 2007.
6. Gordon, G., Water supply can't meet thirst for new industry. *Star Tribune* 12/26/2005, 2005.
7. Tilman, D.; Hill, J.; Lehman, C., Carbon-negative biofuels from low-input high-diversity grassland biomass. *Science* **2006,** *314*, (5805), 1598.
8. Reed, P.; Brooks, R.; Davis, K.; DcWalle, D.; Dressler, K.; Duffy, C.; Lin, H.; Miller, D.; Najjar, R.; Salvage, K., Bridging river basin scales and processes to assess human-climate impacts and the terrestrial hydrologic system. *Water Resources Research* **2006,** *42*, (7), 7418.
9. Minnesota State Demographic Center *Minnesota population projections 2005 – 2035*; Minnesota Department of Administration: St. Paul, MN, 2007.
10. US DOE *Energy demands on water resources*; US DOE: Washington, DC, 2006; p 80.
11. VanBuren, P.; Wells, J. *Use of Minnesota's renewable water resources: Moving toward sustainability*; Minnesota Environmental Quality Board: St. Paul, MN, 2007.
12. Donner, S.; Kucharik, C., Evaluating the impacts of land management and climate variability on crop production and nitrate export across the upper mississippi basin. *Global Biogeochem. Cycles* **2003,** *17*, (3), 1085.
13. Center for Watershed Protection *Precipitation frequency analysis and use*; Center for Watershed Protection: St. Paul, MN, 2005.
14. Seeley, M., Climate change in Minnesota: Measurement evidence, consequence, and implications. In *Water Resources Science Seminar Series*, Water Resources Science, U. o. M., Ed. St. Paul, MN, 2007.
15. Jackson, R. B.; Carpenter, S. R.; Dahm, C. N.; McKnight, D. M.; Naiman, R. J.; Postel, S. L.; Running, S. W., Water in a changing world. *Ecological Applications* **2001,** *11*, (4), 1027-1045.
16. Otterson, P.; Sabel, G.; Tietz, M. *Charting a course for the future: Report of the state water program reorganization project*; Minc3o1ta Planning, and EQB Water Resources Committee: St. Paul, MN, 2002.

17. MN DNR Water appropriations permit program. http://www.dnr.state.mn.us/waters/watermgmt_section/appropriations/feerates.html (09/01),

18. Kenny, J. F., Barber, N.L., Hutson, S.S., Linsey, K.S., Lovelace, J.K., and Maupin, M, A, *Estimated use of water in the United States in 2005*; U.S. Department of the Interior, U.S. Geological Survey: Reston, VA, 2009.

19. Younos, T., Hill, R., and Poole, H. *Water dependency of energy production and power generation systems*; VWPRC Special Report SR46-2009; Virginia Polytechnic Institute and State University: Blacksburg, VA., 2009.

20. Morrison, J.; Morikawa, M.; Murphy, M.; Schulte, P. *Water scarcity and climate change: Growing risks for businesses and investors*; Ceres: Boston, MA, 2009.

21. Renewable Fuels Association Ethanol biorefinery statistics. http://www.ethanolrfa.org/ (01/10),

22. NRC *Water implications of biofuels production in the United States*; National Research Council: Washington, D.C., 2008; pp 19-25.

23. Pimentel, D., Ethanol fuels: Energy balance, economics, and environmental impacts are negative. *Natural Resources Research* **2003,** *12*, (2), 127-134.

24. Wu, M., Mintz, M., Wang, M., and Arora, S. *Consumptive water use in the production of ethanol and petroleum gasoline*; **ANL/ESD/09-1**; Center for Transportation Research Energy Systems Division, Argonne National Laboratory: 2009.

25. Zhang, L.; Dawes, W. R.; Walker, G. R., Response of mean annual evapotranspiration to vegetation changes at catchment scale. *Water Resources Research* **2001,** *37*, (3), 701-708.

26. Cai, X.; Rosegrant, M. W., Global water demand and supply projections. Part 1. A modeling approach. *Water International* **2002,** *27*, (2), 159-169.

27. Chapagain, A. K.; Hoekstra, A. Y., The global component of freshwater demand and supply: An assessment of virtual water flows between nations as a result of trade in agricultural and industrial products. *Water International* **2008,** *33*, (1), 19-32.

28. Hinzman, L. D.; Bettez, N. D.; Bolton, W. R.; Chapin, F. S.; Dyurgerov, M. B.; Fastie, C. L.; Griffith, B.; Hollister, R. D.; Hope, A.; Huntington, H. P.; Jensen, A. M.; Jia, G. J.; Jorgenson, T.; Kane, D. L.; Klein, D. R.; Kofinas, G.; Lynch, A. H.; Lloyd, A. H.; McGuire, A. D.; Nelson, F. E.; Oechel, W. C.; Osterkamp, T. E.; Racine, C. H.; Romanovsky, V. E.; Stone, R. S.; Stow, D. A.; Sturm, M.; Tweedie, C. E.; Vourlitis, G. L.; Walker, M. D.; Walker, D. A.; Webber, P. J.; Welker, J. M.; Winker, K.; Yoshikawa, K., Evidence and implications of recent climate change in northern alaska and other arctic regions. *Climatic Change* **2005,** *72*, (3), 251-298.

29. Falkenmark, M.; Lundqvist, J.; Widstrand, C., Macro-scale water scarcity requires micro-scale approaches - aspects of vulnerability in semi-arid development. *Natural Resources Forum* **1989,** *13*, (4), 258-267.

30. Rijsberman, F. R., Water scarcity: Fact or fiction? *Agricultural Water Management* **2006,** *80*, (1-3), 5-22.

31. FAO AQUASTAT glossary. http://www.fao.org/nr/water/aquastat/data/glossary/search.html (01/15),

32. Doll, P.; Kaspar, F.; Lehner, B., A global hydrological model for deriving water availability indicators: Model tuning and validation. *Journal of Hydrology* **2003,** *270*, (1-2), 105-134.

33. Postel, S. L.; Daily, G. C.; Ehrlich, P. R., Human appropriation of renewable fresh water. *Science* **1996,** *271*, (5250), 785-788.

34. Oki, T.; Kanae, S., Global hydrological cycles and world water resources. *Science* **2006,** *313*, (5790), 1068-1072.

35. Alcamo, J.; Döll, P.; Henrichs, T.; Kaspar, F.; Lehner, B.; Rösch, T.; Siebert, S., Development and testing of the watergap 2 global model of water use and availability. *Hydrological Sciences Journal* **2003,** *48*, (3), 21.

36. Anderson, M. T.; Lloyd H. Woosley, J. *Water availability for the western United States-key scientific challenges*; U.S. Geological Survey: Reston, VA, 2005; p 85.

37. Arbués, F.; García-Valiñas, M. Á.; Martínez-Espiñeira, R., Estimation of residential water demand: A state-of-the-art review. *Journal of Socio-Economics* **2003,** *32*, (1), 81-102.

38. Agthe, D. E.; Billings, R. B., Dynamic models of residential water demand. *Water Resources Research* **1980,** *16*, (3), 476-480.

39. Polebitski, A. S.; Palmer, R. N., Seasonal residential water demand forecasting for census tracts. *Journal of Water Resources Planning and Management-Asce* **2010,** *136*, (1), 27-36.

40. MN DNR Division of Water *Drought of 1988*; MN DNR: St. Paul, MN, 1989; p 65.

41. Newig, J.; Haberl, H.; Pahl-Wostl, C.; Rothman, D. S., Formalised and non-formalised methods in resource management-knowledge and social learning in participatory processes: An introduction. *Systemic Practice and Action Research* **2008,** *21*, (6), 381-387.

42. Hall, C. A. S.; Jourdonnais, J. H.; Stanford, J. A., Assessing the impacts of stream regulation in the flathead river basin, montana, u.S.A. 1. Simulation modeling of system water balance. *Regulated Rivers: Research & Management* **1989,** *3*, 61-77.

43. Beall, A.; Zeoli, L., Participatory modeling of endangered wildlife systems: Simulating the sage-grouse and land use in central washington. *Ecological Economics* **2008,** *68*, 24-33.

44. Van den Belt, M., *Mediated modeling: A system dynamics approach to environmental consensus building*. Island Press: Washington D.C., 2004.

45. Richardson, C. W., Stochastic simulation of daily precipitation, temperature, and solar radiation. *Water Resour. Res.* **1981,** *17*, (1), 182-190.

46. Vörösmarty, C. J.; Green, P.; Salisbury, J.; Lammers, R. B., Global water resources: Vulnerability from climate change and population growth. *Science* **2000,** *289*, (5477), 284-288.

47. Seckler, D.; Amarasinghe, U.; Molden, D.; de Silva, R.; Barker, R. *World water demand and supply, 1990 to 2025: Scenarios and issues*; International Water Management Institute: Colombo, Sri Lanka, 1998; p 40.

48. Frederick, K. D.; Major, D. C., Climate change and water resources. *Climatic Change* **1997,** *37*, (1), 7-23.

49. Goodchild, C. W., Modelling the impact of climate change on domestic water demand. *Water and Environment Journal* **2003,** *17*, (1), 8-12.

50. Adams, R. M.; Fleming, R. A.; Chang, C.-C.; McCarl, B. A.; Rosenzweig, C., A reassessment of the economic effects of global climate change on U.S. Agriculture. *Climatic Change* **1995,** *30*, (2), 147-167.

51. Döll, P., Impact of climate change and variability on irrigation requirements: A global perspective. *Climatic Change* **2002,** *54*, (3), 269-293.

52. Alcamo, J.; Henrichs, T.; Rosch, T. *World water in 2025*; A0002; 1999; p 49.

53. U.S. Energy Information Administration. Monthly data in net generation by energy sources. http://www.eia.doe.gov/cneaf/electricity/epm/table1_1.html

54. Amato, A. D.; Ruth, M.; Kirshen, P.; Horwitz, J., Regional energy demand responses to climate change: Methodology and application to the commonwealth of massachusetts. *Climatic Change* **2005,** *71*, (1), 175-201.

55. Scott, M. J.; Wrench, L. E.; Hadley, D. L., Effects of climate change on commercial building energy demand. *Energy Sources* **1994,** *16*, (3), 317-332.

56. Sailor, D. J., Relating residential and commercial sector electricity loads to climate--evaluating state level sensitivities and vulnerabilities. *Energy* **2001,** *26*, (7), 645-657.

57. Cartalis, C.; Synodinou, A.; Proedrou, M.; Tsangrassoulis, A.; Santamouris, M., Modifications in energy demand in urban areas as a result of climate changes: An assessment for the southeast mediterranean region. *Energy Conversion and Management* **2001,** *42*, (14), 1647-1656.

58. Romanow, S., Biofuels production in U.S. Impacts water resources. *Hydrocarbon Processing* **2007,** *86*, (12), 23-25.

59. King, C. W.; Webber, M. E., Water intensity of transportation. *Environ. Sci. Technol.* **2008,** *42*, (21), 7866-7872.

60. Mubako, S.; Lant, C., Water resource requirements of corn-based ethanol. *Water Resour. Res.* **2008,** *44*, W00A02.

61. Keeney, D.; Muller, M. *Water use by ethanol plants - potential challenges*; The Institute for Agriculture and Trade Policy: Minneapolis, Minnesota, October, 2006, 2006; p 8.

62. Liaw, C. H.; Chen, L. C., Rational industrial water reuse ratios. *Journal of the American Water Resources Association* **2004,** *40*, (4), 971-979.

63. FAO, U. N. *Crop water requirements and irrigation scheduling*; FAO: Harare, Zimbabwe, 2002; p 132.

64. Torcellini, P.; Long, N.; Judkoff, R. *Consumptive water use for US power production*; National Renewable Energy Laboratory: Golden, Colorado, 2003; p 12.

65. Oki, T.; Agata, Y.; Kanae, S., Global assessment of current water resources using total runoff integrating pathways. *Hydrological Sciences–Journal–des Sciences Hydrologiques* **2001,** *46*, (6), 983-995.

66. U.S. Energy Information Administration. *Annual energy outlook 2007 with projections to 2030*; DOE/EIA-0383; U.S. EIA: Washington, DC, 2007.

67. Nebraska Energy Office Energy statistic. http://www.neo.ne.gov/ (01/10),

68. Energy Information Administration. Electric power annual 2006. http://www.eia.doe.gov/cneaf/electricity/epa/epa_sum.html (10/18),

69. Santa Clara University & LLNL The world climate research programme's (WCRP's) coupled model intercomparison project phase 3 (CMIP3) multi-model dataset. http://gdo-dcp.ucllnl.org/downscaled_cmip3_projections/#Welcome (05/25),

70. de Fraiture, C.; Giordano, M.; Liao, Y., Biofuels and implications for agricultural water use: Blue impacts of green energy. *Water Policy* **2008,** *10*, (S1), 67-81.

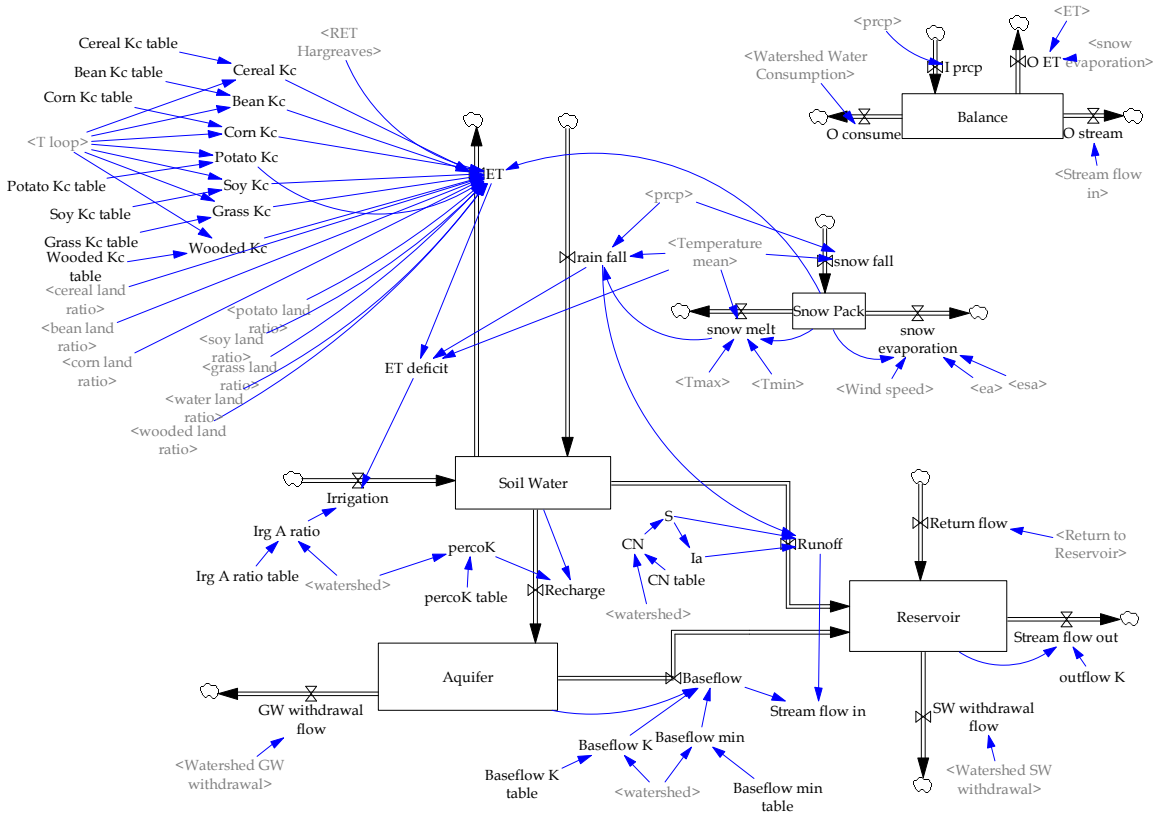
71. National Research Council., *Water implications of biofuels production in the United States*. National Academies Press: Washington, D.C., 2008; p 19-25.

72. Orning, G.; Wietecki, M. *Regional parks for Minnesota's outstate urban complexes*; MN LCCMR: St. Paul, MN, 2007; p 200.

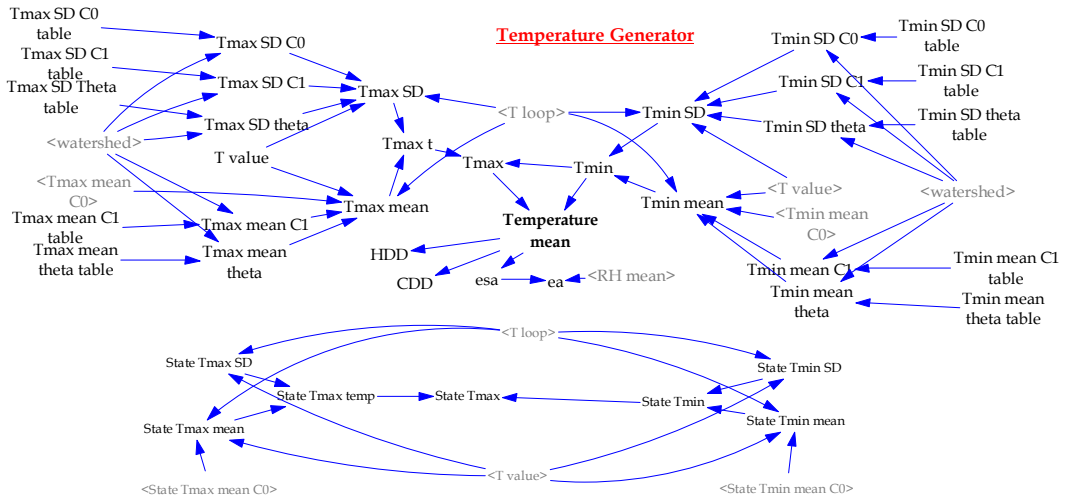
73. Alcamo, J.; Döll, P.; Henrichs, T.; Kaspar, F.; Lehner, B.; Rösch, T.; Siebert, S., Global estimates of water withdrawals and availability under current and future "Business-as-usual" Conditions. *Hydrological Sciences Journal* **2003,** *48*, (3), 339-348.

Appendix I – System dynamic model

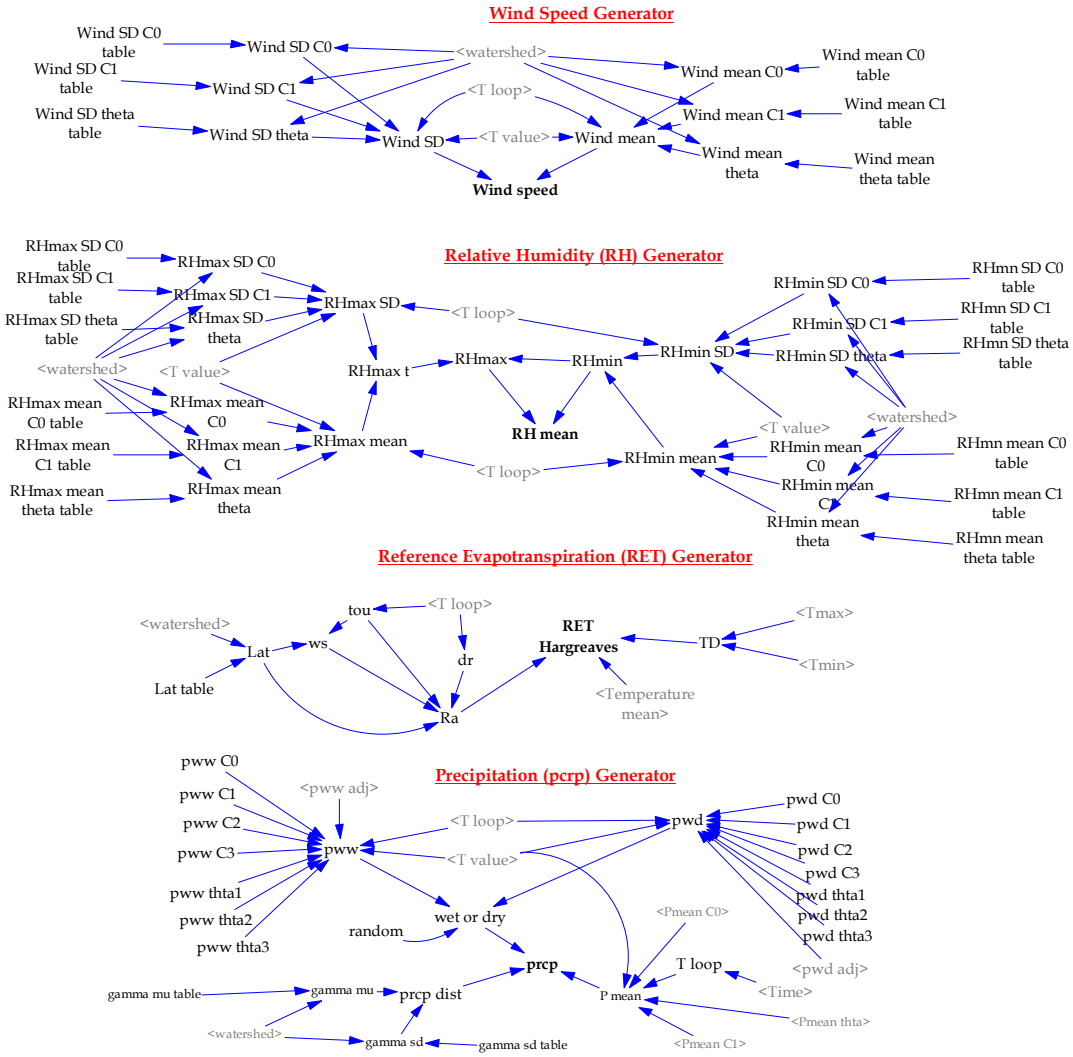
Water balance module



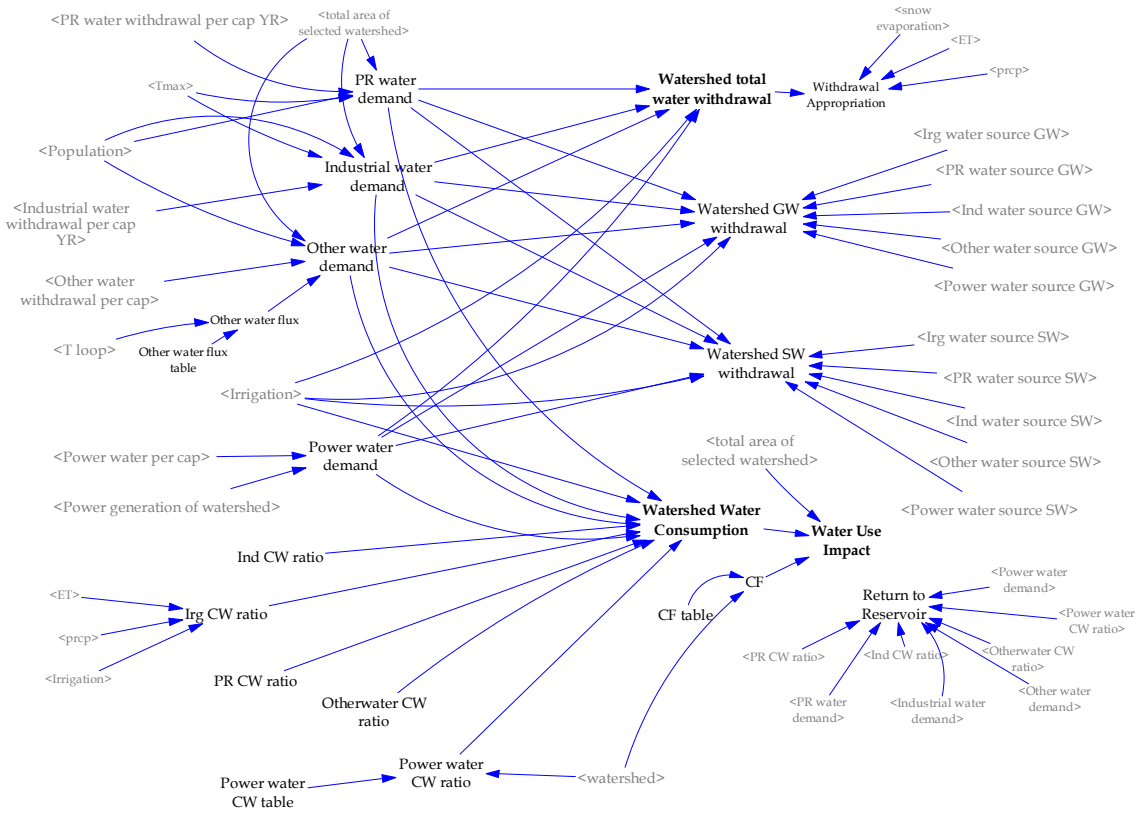
Climate module: temperature generator



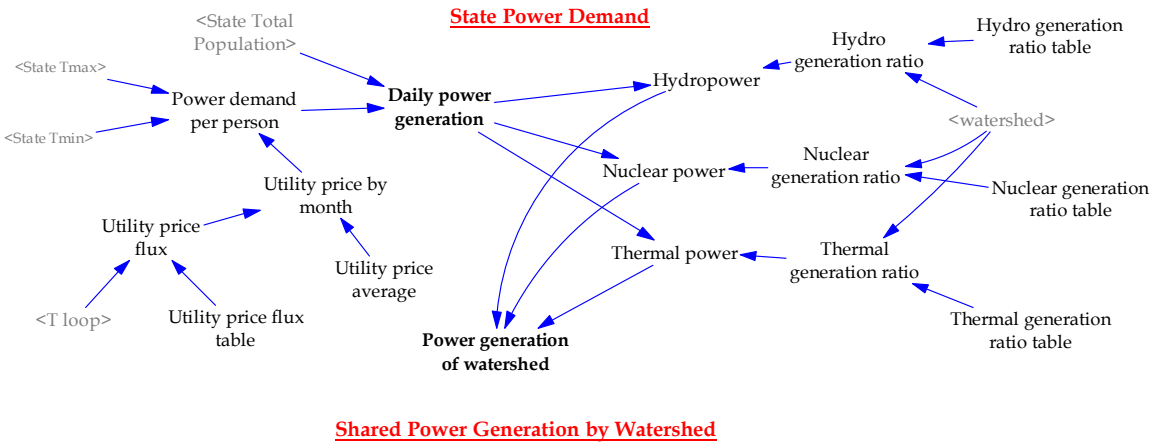
Climate module: wind speed, relative humidity, reference evapotranspiration, and precipitation generators



Water demand module

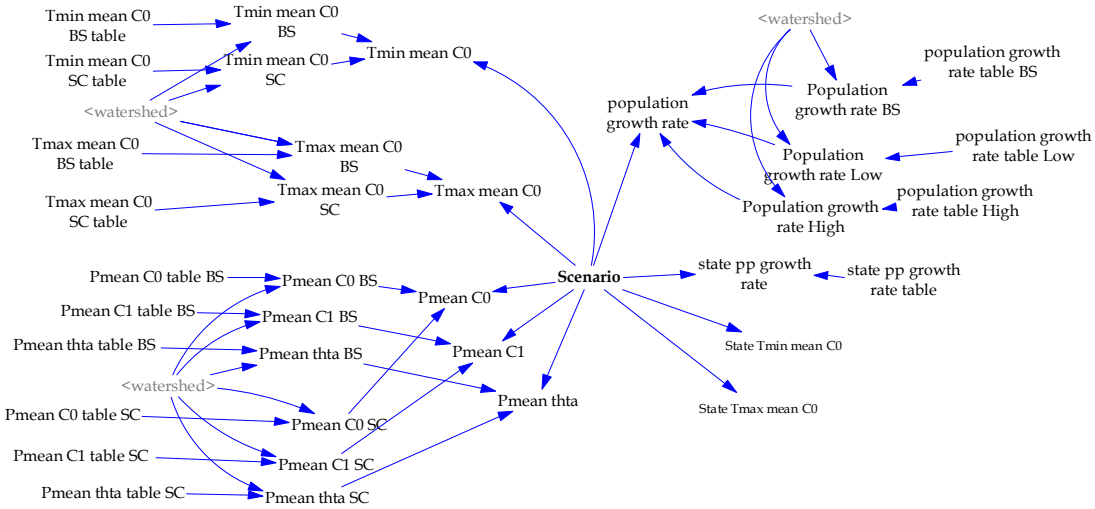


Energy module

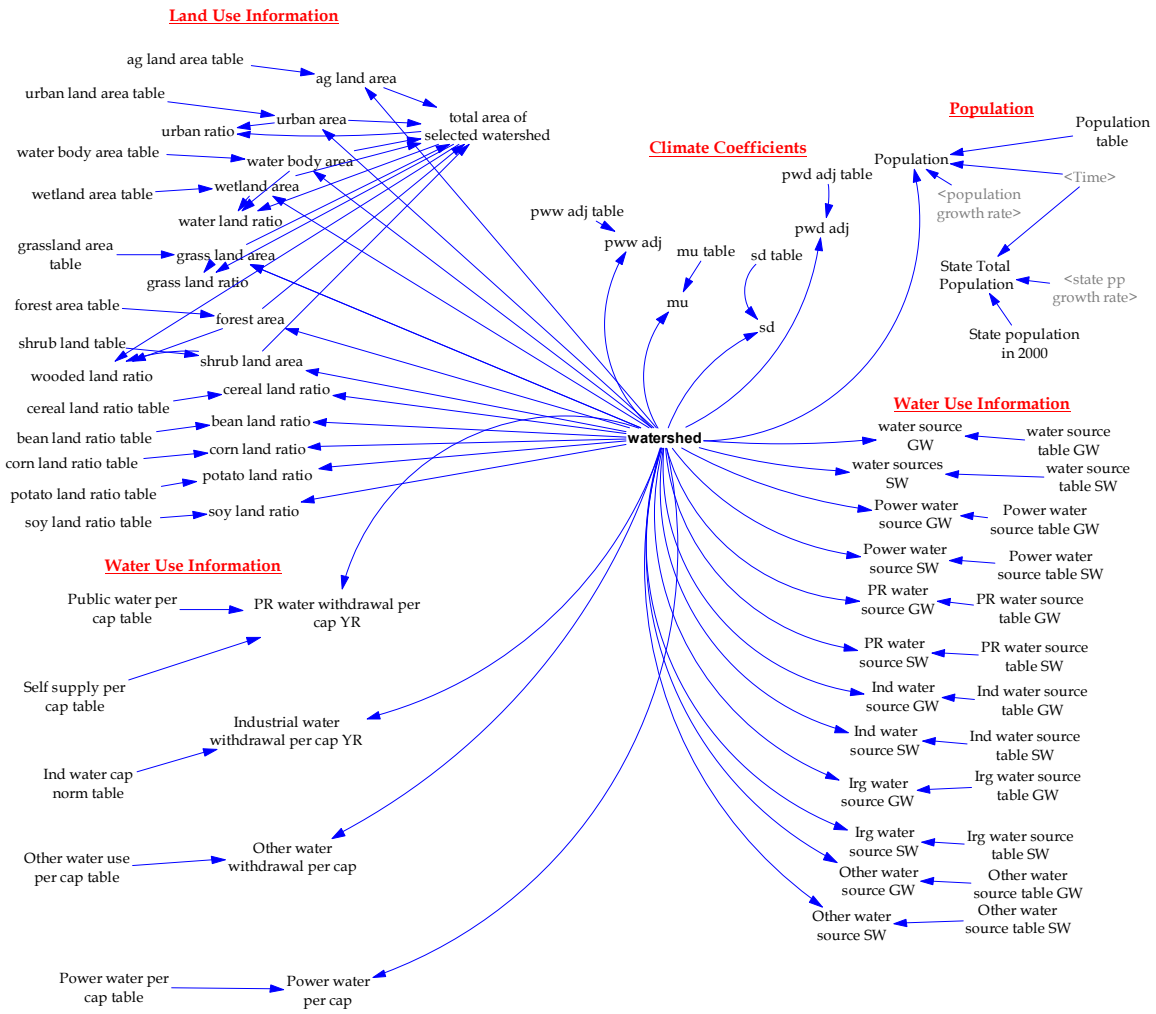


Supportive modules

Scenario selection module: when a particular scenario is chosen, related coefficients are selected accordingly.



Watershed selection: many coefficients are spatial-specific, therefore, are designed to be selected accordingly based on the selection of target watershed.



Appendix II – Result summary

Table A1. Background information by watershed: (a) water withdrawal per person per year by category, (b) population in 2000s and projection to 2030, and (c) power generation capacity by fuel type.

Watershed	Div.	Water withdrawal (m3/person/yr)				Population (1000 people)			Power generation (MWhr/yr)			
		Industrial	Public	Others	Self Supply	2000BL	2030BAU	Extreme	Hydro	Nuclear	Thermal	Wind
1	3	19723	49	16	46	7756	9830	11796	0	0	1411642	0
2	3	1513	483	13	18	95394	103878	124654	0	0	778297	0
3	3	173	45	250	16	217558	236287	283544	20433	0	1263758	0
4	3	0	0	0	16	196236	212083	254500	0	0	0	0
5	6	0	0	0	47	37798	57548	69058	0	0	0	0
7	2	6	39	5	51	41399	55692	66831	9608	0	7398188	0
8	2	1	12	0	67	31330	44016	52820	22450	0	0	0
9	6	286	69	94	43	45884	55690	66828	1840	0	0	0
10	6	100	153	7	49	41045	59515	71418	18719	0	1383	0
11	6	0	5	19	55	49348	74400	89280	0	0	0	0
12	2	47	50	0	57	30876	42414	50897	0	0	59163	0
13	4	0	11	0	43	51323	61671	74005	0	0	0	0
14	5	12	82	11	48	35928	47122	56546	0	0	40	0
15	5	171	55	2	28	78353	116067	139280	169388	0	88016	0
16	5	12	49	16	22	116723	174693	209632	0	0	-330	0
17	5	16	181	74	39	85616	189261	227113	0	4474918	13784682	0
18	5	8	55	20	20	120053	200801	240961	0	0	1193	0
19	5	30	71	6	12	90729	120554	144664	0	0	23700	0
20	6	16	415	39	4	791009	941586	1129903	60536	0	4687438	0
21	6	9	72	9	35	69193	117886	141463	0	0	1137	0
22	4	0	78	6	25	8975	8302	9963	0	0	0	0
23	4	19	72	6	37	25976	30157	36188	0	0	0	0
24	4	135	161	1	29	10647	9637	11564	0	0	0	0
25	7	26	327	18	24	20968	22246	26695	6477	0	41742	453083
26	4	19	134	23	36	21395	25570	30684	0	0	479	0
27	7	3	19	1	21	22104	22192	26630	0	0	0	0
28	8	60	407	136	20	34110	41777	50132	0	0	122950	0
29	7	44	203	20	22	23328	23910	28692	1512	0	2873	0
30	8	196	130	6	21	28027	29939	35927	0	0	407705	44092
31	8	5	134	5	18	22727	24533	29440	0	0	1220	0
32	8	17	100	2	21	40049	48859	58630	23499	0	42647	0
33	8	57	517	127	9	148127	234157	280988	0	0	2383771	0
34	6	1	2	0	59	32627	48014	57616	0	0	380	0
35	6	0	28	14	53	32958	49100	58920	258847	0	154	0
36	6	1	50	1	61	22564	34802	41762	0	0	642	0
37	6	12	104	8	21	128768	220822	264987	0	0	2797339	0
38	9	34	86	3	3	253356	372541	447050	37333	8360301	245403	0
39	9	15	161	30	9	90290	132278	158734	0	0	128322	0
40	9	38	83	54	17	71635	93769	112523	0	0	233	0
41	9	32	308	35	19	65300	98912	118694	12178	0	430487	95059
42	9	0	11	48	20	48736	54128	64953	0	0	0	0
43	9	6	67	306	23	44548	57686	69223	68	0	280502	0
44	9	1	17	0	33	24249	29085	34902	0	0	0	0
46	9	0	19	12	26	33518	39111	46934	0	0	0	0
47	9	0	0	0	19	47476	53994	64793	0	0	0	0
48	9	86	117	1	20	42476	48474	58169	0	0	144652	56952
49	8	9	119	0	21	40072	42178	50614	0	0	0	0

50	8	0	2	0	21	39876	41961	50354	0	0	0	0
51	7	43	217	35	26	15411	15960	19152	0	0	28	338336
52	7	0	0	1	27	16052	16949	20339	0	0	0	0
53	8	0	13	0	19	23917	23451	28141	0	0	0	0
54	4	0	6	0	35	11356	11953	14343	0	0	0	0
55	4	0	55	0	30	9407	9707	11649	0	0	0	0
56	4	20	130	6	44	55731	68736	82483	3570	0	931012	0
57	4	0	178	0	11	31484	41591	49910	0	0	65	0
58	1	4	43	1	17	50061	68992	82790	0	0	35136	8021
59	1	0	24	0	18	14611	17225	20670	0	0	1	0
60	1	24	26	0	30	18955	24613	29536	0	0	0	0
61	1	1	15	0	22	33498	39006	46807	0	0	0	0
62	2	0	3	0	49	43354	64245	77094	0	0	0	0
63	1	16	392	4	30	27013	33958	40749	3277	0	35943	0
65	1	1	2	0	44	26163	36220	43465	0	0	0	0
66	1	7	34	3	31	20783	24970	29964	0	0	0	0
67	1	0	2	0	22	34677	40430	48516	0	0	0	0
68	1	0	49	11	29	13997	15062	18075	0	0	0	0
69	1	35	21	4	23	9337	8860	10633	0	0	0	0
70	1	0	56	0	35	12626	14072	16886	0	0	0	0
71	1	0	29	0	45	20048	25474	30569	0	0	0	0
72	3	0	10	101	18	90713	98854	118625	18770	0	77	0
73	3	0	1	0	16	246610	266137	319364	47344	0	45959	0
74	2	0	0	0	17	163528	175849	211018	0	0	135661	0
75	2	3573	51	0	33	17653	17321	20785	0	0	0	0
76	2	1	2	0	18	132978	143525	172230	0	0	0	0
77	2	0	3	1	42	35483	40079	48095	58880	0	0	0
78	2	0	0	0	47	16323	21106	25328	0	0	0	0
79	2	0	23	0	54	5561	5967	7161	0	0	0	0
80	2	0	40	0	50	8510	9880	11856	0	0	0	0
81	7	0	0	0	10	7902	7838	9405	0	0	0	0
82	7	0	290	2	9	11744	12228	14673	0	0	0	580494
83	7	4	130	0	17	17635	18619	22343	0	0	160	6084
84	7	0	0	0	25	17939	19295	23154	0	0	0	0

Table A2. Land use by watershed in million m^2, estimated based on 2000 satellite image.

Watershed	Water	Urban	Wetland	Agriculture	Forest	Grassland	Shrub Land	Total Area
1	226	95	583	1	3209	0	8	4125
2	15	108	74	34	1401	2	2	1638
3	196	498	1031	443	4994	7	218	7389
4	114	51	240	27	1611	0	13	2055
5	6	20	81	57	543	2	10	719
7	703	157	580	470	3114	14	41	5079
8	646	80	488	202	2031	3	8	3459
9	282	214	867	283	3591	11	126	5373
10	223	249	915	795	2079	36	74	4370
11	220	52	279	123	1346	2	10	2032
12	317	219	525	1403	2487	32	57	5039
13	33	108	235	1441	455	4	51	2328
14	166	162	270	1175	485	30	24	2313
15	59	192	575	1192	503	87	33	2641
16	112	223	282	1656	273	133	20	2700
17	95	346	399	1286	562	194	22	2905
18	235	344	553	2102	388	188	30	3841
19	109	292	292	2321	216	64	19	3312
20	219	1147	315	337	429	149	34	2630
21	585	270	577	1186	1215	151	52	4035
22	121	123	199	1226	50	223	30	1971
23	188	121	63	1610	153	126	5	2266
24	15	133	125	1388	52	235	23	1972
25	57	361	221	4170	236	283	43	5373
26	276	301	228	3742	333	467	24	5371
27	26	120	60	1397	61	127	35	1826
28	60	296	180	2576	247	111	21	3490
29	19	206	81	2773	134	151	36	3400
30	40	256	58	2640	97	34	13	3138
31	25	188	68	1885	53	41	13	2273
32	56	179	86	2417	89	46	9	2881
33	112	715	414	2825	434	178	36	4714
34	5	33	204	96	1055	4	19	1417
35	43	95	615	273	1647	10	37	2720
36	27	142	480	566	1353	17	27	2613
37	128	306	361	766	658	139	29	2389
38	78	210	71	743	322	120	22	1566
39	94	326	297	2432	395	220	44	3809
40	55	150	27	672	699	106	3	1713
41	9	335	62	2462	563	218	35	3684
42	7	22	10	39	133	11	0	222
43	2	313	8	2354	1282	314	23	4296
44	9	29	23	130	251	31	1	475
46	0	44	0	416	69	32	2	563
47	0	2	0	29	0	1	0	32
48	8	137	24	1558	51	46	15	1840
49	20	58	37	462	30	22	8	637
50	6	9	8	154	4	3	1	185
51	72	196	80	2560	98	168	55	3229
52	0	25	1	192	4	2	1	225
53	15	45	7	447	3	3	2	522
54	40	78	12	1260	13	52	5	1461
55	69	112	38	1941	32	75	12	2278
56	715	273	312	2664	1069	93	11	5136
57	1	84	7	1005	20	20	2	1140
58	84	123	75	2258	199	127	4	2871
59	2	47	9	910	29	15	3	1014
60	122	136	202	2735	935	77	13	4220
61	21	67	25	1243	84	16	4	1461
62	1214	75	770	390	2628	7	30	5114
63	13	127	507	2372	308	73	17	3417
65	30	60	544	1294	735	68	57	2789
66	83	133	356	2166	704	117	30	3588
67	5	56	21	1444	11	14	1	1553

Watershed	Water	Urban	Wetland	Agriculture	Forest	Grassland	Shrub Land	Total Area
68	0	75	64	1742	98	39	14	2033
69	4	94	99	1950	151	17	12	2327
70	2	86	234	2176	207	57	25	2788
71	7	107	439	1413	737	26	30	2758
72	801	65	1324	7	4283	0	15	6496
73	332	65	190	49	1941	0	104	2681
74	376	18	99	42	1788	0	31	2354
75	7	49	154	58	1070	0	18	1356
76	94	113	374	200	3855	0	137	4774
77	210	77	732	110	4205	1	34	5370
78	1	22	601	96	1504	0	95	2319
79	5	30	158	155	414	0	27	790
80	1230	60	440	397	827	4	21	2979
81	0	6	2	63	1	32	2	107
82	1	78	5	1034	13	162	29	1322
83	1	141	12	1905	27	245	44	2375
84	26	51	26	661	20	22	6	810

Table A3. Water availability, consumption, and withdrawal under different scenarios in various divisions. Figures are in mm/month and may not add up due to rounding and error. All regional simulated stream flows within 10% of historical records and system water residual within 10% of local precipitation would be accepted.

Figures listed in the tables are for analysis purposes and representing "most-possible" ranges. They should not be treated as absolute or exact quantities occurring in a hydro system.

Division	Indicator	scenario	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	consumption	BL	0.01	0.01	0.03	0.06	0.09	0.19	0.32	0.24	0.08	0.06	0.03	0.01
1	consumption	CnBAU	0.01	0.01	0.04	0.07	0.11	0.21	0.35	0.27	0.10	0.07	0.03	0.01
1	consumption	Cx	0.01	0.01	0.04	0.06	0.09	0.23	0.33	0.27	0.09	0.06	0.03	0.01
1	consumption	CxBAU	0.01	0.02	0.05	0.08	0.12	0.25	0.36	0.30	0.11	0.08	0.04	0.02
1	consumption	EtOHn	0.01	0.01	0.03	0.06	0.09	0.19	0.32	0.24	0.08	0.06	0.03	0.01
1	consumption	Extreme	0.01	0.02	0.06	0.10	0.14	0.28	0.39	0.33	0.14	0.09	0.05	0.02
1	consumption	PPn	0.01	0.01	0.04	0.07	0.11	0.21	0.35	0.26	0.10	0.07	0.03	0.01
1	consumption	PWn	0.01	0.01	0.03	0.06	0.09	0.19	0.32	0.24	0.08	0.06	0.03	0.01
1	availability	BL	0.09	0.30	22.36	21.23	8.69	8.29	7.77	2.94	3.01	6.35	3.35	0.05
1	availability	CnBAU	0.08	0.33	21.58	21.24	9.39	7.91	8.02	3.10	3.25	6.32	2.95	0.05
1	availability	Cx	0.30	1.33	42.82	35.98	2.54	40.18	12.94	0.42	4.07	0.88	2.25	0.07
1	availability	CxBAU	0.32	1.38	43.73	34.97	2.69	36.69	11.68	0.48	4.12	0.83	2.13	0.07
1	availability	EtOHn	0.08	0.32	21.21	20.63	8.27	7.88	7.86	2.98	3.00	6.25	3.00	0.06
1	availability	Extreme	0.31	1.27	43.57	34.14	2.77	34.81	11.41	0.46	4.02	0.84	2.22	0.08
1	availability	PPn	0.07	0.32	21.11	20.91	8.73	8.14	8.42	2.91	2.59	4.96	2.39	0.04
1	availability	PWn	0.08	0.35	21.33	20.41	8.58	6.66	7.75	3.28	3.14	6.17	2.99	0.05
1	withdrawal	BL	0.01	0.01	0.04	0.07	0.11	0.23	0.40	0.30	0.10	0.07	0.03	0.01
1	withdrawal	CnBAU	0.01	0.02	0.05	0.09	0.13	0.26	0.43	0.33	0.12	0.08	0.04	0.01
1	withdrawal	Cx	0.01	0.02	0.04	0.07	0.11	0.28	0.41	0.33	0.11	0.07	0.04	0.02
1	withdrawal	CxBAU	0.01	0.02	0.05	0.09	0.14	0.31	0.45	0.36	0.13	0.09	0.05	0.02
1	withdrawal	EtOHn	0.01	0.01	0.04	0.07	0.11	0.23	0.40	0.30	0.10	0.07	0.03	0.01
1	withdrawal	Extreme	0.02	0.02	0.06	0.11	0.17	0.34	0.48	0.40	0.16	0.11	0.06	0.02
1	withdrawal	PPn	0.01	0.02	0.05	0.09	0.13	0.26	0.44	0.33	0.12	0.08	0.04	0.01
1	withdrawal	PWn	0.01	0.01	0.04	0.07	0.11	0.23	0.40	0.29	0.10	0.07	0.03	0.01
2	consumption	BL	0.18	0.18	0.23	0.28	0.37	0.53	0.76	0.65	0.38	0.30	0.22	0.18
2	consumption	CnBAU	0.36	0.34	0.40	0.45	0.57	0.76	1.01	0.91	0.60	0.50	0.39	0.36
2	consumption	Cx	0.18	0.18	0.24	0.29	0.38	0.60	0.78	0.70	0.40	0.31	0.23	0.19
2	consumption	CxBAU	0.36	0.34	0.41	0.46	0.58	0.83	1.05	0.97	0.63	0.51	0.40	0.37
2	consumption	EtOHn	0.18	0.18	0.23	0.28	0.37	0.53	0.75	0.65	0.37	0.30	0.22	0.18
2	consumption	Extreme	0.50	0.48	0.56	0.62	0.78	1.06	1.30	1.22	0.85	0.70	0.56	0.52
2	consumption	PPn	0.23	0.22	0.28	0.33	0.43	0.60	0.84	0.73	0.45	0.36	0.27	0.23
2	consumption	PWn	0.28	0.27	0.33	0.37	0.47	0.65	0.89	0.79	0.50	0.41	0.32	0.29
2	availability	BL	0.73	0.60	46.47	38.11	20.09	9.35	5.27	1.43	3.51	22.74	11.96	0.24
2	availability	CnBAU	0.68	0.60	46.21	38.51	20.56	9.14	5.27	1.45	3.41	22.83	12.10	0.28
2	availability	Cx	1.54	1.24	73.47	54.23	10.77	66.98	8.47	0.37	3.29	1.76	8.40	0.60

Division	Indicator	scenario	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2	availability	CxBAU	1.55	1.21	73.49	54.22	11.05	65.26	7.97	0.37	3.25	1.78	8.37	0.60
2	availability	EtOHn	0.71	0.56	46.41	38.39	19.74	8.98	5.45	1.41	3.32	23.19	12.25	0.25
2	availability	Extreme	1.57	1.18	73.70	53.72	10.65	64.54	8.11	0.37	3.27	1.76	8.33	0.64
2	availability	PPn	0.70	0.62	45.84	38.70	19.99	9.35	5.54	1.39	3.02	22.66	12.43	0.27
2	availability	PWn	0.71	0.62	45.88	38.60	20.23	9.25	5.30	1.46	3.77	24.00	12.40	0.27
2	withdrawal	BL	0.45	0.42	0.51	0.57	0.72	0.96	1.30	1.16	0.76	0.63	0.49	0.45
2	withdrawal	CnBAU	0.90	0.84	0.95	1.00	1.21	1.51	1.93	1.79	1.32	1.13	0.94	0.91
2	withdrawal	Cx	0.45	0.43	0.52	0.59	0.74	1.06	1.33	1.23	0.80	0.65	0.51	0.46
2	withdrawal	CxBAU	0.90	0.84	0.96	1.02	1.24	1.62	1.99	1.89	1.37	1.16	0.95	0.91
2	withdrawal	EtOHn	0.45	0.42	0.51	0.57	0.72	0.97	1.30	1.16	0.76	0.63	0.49	0.45
2	withdrawal	Extreme	1.27	1.19	1.33	1.40	1.70	2.14	2.57	2.47	1.88	1.60	1.33	1.29
2	withdrawal	PPn	0.57	0.54	0.63	0.69	0.86	1.12	1.48	1.34	0.92	0.77	0.62	0.58
2	withdrawal	PWn	0.71	0.66	0.76	0.81	0.99	1.27	1.64	1.51	1.07	0.91	0.75	0.72
3	consumption	BL	0.42	0.47	0.83	1.26	1.77	2.10	2.32	2.16	1.68	1.22	0.72	0.45
3	consumption	CnBAU	0.70	0.74	1.17	1.65	2.28	2.67	2.98	2.79	2.21	1.64	1.05	0.75
3	consumption	Cx	0.43	0.49	0.87	1.29	1.82	2.15	2.38	2.21	1.73	1.25	0.75	0.48
3	consumption	CxBAU	0.71	0.76	1.20	1.70	2.33	2.74	3.05	2.86	2.26	1.69	1.09	0.77
3	consumption	EtOHn	0.41	0.46	0.83	1.25	1.76	2.08	2.31	2.14	1.67	1.21	0.72	0.45
3	consumption	Extreme	0.97	1.01	1.55	2.13	2.91	3.41	3.79	3.56	2.84	2.14	1.41	1.03
3	consumption	PPn	0.51	0.56	0.98	1.47	2.07	2.44	2.71	2.51	1.97	1.43	0.86	0.55
3	consumption	PWn	0.57	0.61	0.98	1.40	1.93	2.28	2.53	2.37	1.87	1.38	0.87	0.61
3	availability	BL	0.33	0.15	50.59	77.65	21.22	11.45	10.22	5.51	27.82	59.86	14.84	0.74
3	availability	CnBAU	0.33	0.15	50.77	77.71	22.27	10.68	9.82	5.04	26.88	58.56	13.51	0.74
3	availability	Cx	0.76	0.37	70.25	113.69	15.02	68.36	7.95	3.07	15.07	12.05	16.55	1.23
3	availability	CxBAU	0.76	0.38	69.87	115.87	15.74	65.41	6.66	3.05	14.25	11.79	16.59	1.23
3	availability	EtOHn	0.33	0.15	50.56	76.81	21.46	10.43	9.63	5.11	27.34	60.07	14.22	0.68
3	availability	Extreme	0.76	0.38	70.20	114.43	14.75	62.76	6.81	2.91	15.32	12.23	16.70	1.23
3	availability	PPn	0.33	0.14	50.67	76.53	21.15	11.08	10.41	4.59	25.84	57.54	14.30	0.68
3	availability	PWn	0.33	0.15	50.12	77.05	20.79	9.86	9.96	5.08	28.28	59.71	14.46	0.68
3	withdrawal	BL	0.76	0.81	1.34	1.94	2.72	3.19	3.56	3.33	2.62	1.93	1.19	0.81
3	withdrawal	CnBAU	1.47	1.48	2.11	2.78	3.75	4.37	4.89	4.64	3.72	2.86	1.95	1.53
3	withdrawal	Cx	0.78	0.83	1.39	1.99	2.78	3.27	3.63	3.40	2.68	1.98	1.24	0.84
3	withdrawal	CxBAU	1.48	1.50	2.15	2.83	3.83	4.47	5.00	4.74	3.81	2.93	2.00	1.55
3	withdrawal	EtOHn	0.76	0.81	1.34	1.94	2.72	3.19	3.56	3.33	2.62	1.93	1.19	0.81
3	withdrawal	Extreme	2.06	2.06	2.86	3.67	4.91	5.71	6.40	6.09	4.93	3.84	2.68	2.15
3	withdrawal	PPn	0.96	1.00	1.63	2.31	3.22	3.78	4.21	3.94	3.12	2.32	1.46	1.02
3	withdrawal	PWn	1.16	1.18	1.72	2.30	3.13	3.65	4.09	3.86	3.09	2.36	1.58	1.21
4	consumption	BL	0.12	0.11	0.14	0.17	0.21	0.56	0.83	0.65	0.24	0.19	0.14	0.12
4	consumption	CnBAU	0.21	0.20	0.24	0.27	0.33	0.71	0.98	0.81	0.38	0.31	0.24	0.22
4	consumption	Cx	0.12	0.11	0.14	0.17	0.23	0.64	0.84	0.69	0.28	0.19	0.15	0.13
4	consumption	CxBAU	0.22	0.21	0.24	0.27	0.35	0.78	1.01	0.85	0.41	0.32	0.25	0.23
4	consumption	EtOHn	0.12	0.11	0.14	0.17	0.22	0.57	0.82	0.67	0.25	0.19	0.14	0.12

Division	Indicator	scenario	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
4	consumption	Extreme	0.30	0.28	0.33	0.37	0.46	0.92	1.15	0.99	0.54	0.42	0.34	0.31
4	consumption	PPn	0.14	0.14	0.17	0.20	0.26	0.62	0.88	0.72	0.30	0.23	0.18	0.15
4	consumption	PWn	0.17	0.16	0.19	0.21	0.27	0.63	0.89	0.72	0.31	0.24	0.19	0.18
4	availability	BL	0.57	0.53	23.77	24.99	10.00	7.07	7.60	3.92	3.40	4.76	4.35	0.32
4	availability	CnBAU	0.55	0.63	22.38	24.16	10.70	6.40	7.89	4.14	3.72	4.79	4.19	0.32
4	availability	Cx	1.21	1.72	60.12	55.67	1.80	21.36	3.69	1.00	3.49	0.87	2.60	0.30
4	availability	CxBAU	1.22	1.83	60.24	54.07	1.62	20.16	3.41	0.98	3.25	0.71	2.46	0.28
4	availability	EtOHn	0.51	0.53	22.39	24.33	9.63	6.89	7.28	3.64	3.59	4.54	3.93	0.28
4	availability	Extreme	1.27	1.91	60.74	50.98	1.64	18.50	3.44	1.01	3.39	0.61	2.90	0.27
4	availability	PPn	0.53	0.55	21.74	23.35	9.59	6.62	7.93	3.52	2.81	3.69	3.11	0.22
4	availability	PWn	0.53	0.55	22.03	23.16	10.95	5.78	8.05	4.32	3.66	5.15	4.36	0.38
4	withdrawal	BL	0.25	0.24	0.28	0.32	0.40	1.31	1.99	1.54	0.48	0.36	0.29	0.26
4	withdrawal	CnBAU	0.49	0.46	0.52	0.55	0.68	1.64	2.33	1.90	0.80	0.64	0.53	0.51
4	withdrawal	Cx	0.25	0.24	0.29	0.32	0.43	1.51	2.01	1.62	0.57	0.37	0.29	0.27
4	withdrawal	CxBAU	0.49	0.46	0.53	0.57	0.72	1.84	2.41	2.00	0.89	0.66	0.54	0.51
4	withdrawal	EtOHn	0.25	0.24	0.28	0.32	0.40	1.33	1.97	1.56	0.49	0.37	0.29	0.26
4	withdrawal	Extreme	0.69	0.65	0.73	0.77	0.97	2.13	2.72	2.31	1.16	0.90	0.75	0.71
4	withdrawal	PPn	0.32	0.30	0.35	0.39	0.50	1.43	2.10	1.69	0.59	0.45	0.36	0.33
4	withdrawal	PWn	0.39	0.36	0.41	0.44	0.54	1.49	2.16	1.70	0.65	0.51	0.42	0.40
5	consumption	BL	1.04	0.97	1.10	1.18	1.44	2.58	3.59	2.88	1.68	1.36	1.13	1.07
5	consumption	CnBAU	2.11	1.97	2.20	2.31	2.80	4.15	5.38	4.66	3.20	2.69	2.25	2.17
5	consumption	Cx	1.04	0.97	1.11	1.20	1.52	2.82	3.69	2.99	1.84	1.40	1.15	1.08
5	consumption	CxBAU	2.11	1.97	2.22	2.36	2.93	4.42	5.56	4.82	3.41	2.76	2.28	2.18
5	consumption	EtOHn	1.04	0.97	1.10	1.18	1.44	2.60	3.58	2.89	1.68	1.36	1.13	1.07
5	consumption	Extreme	2.95	2.75	3.06	3.22	3.95	5.60	6.90	6.17	4.57	3.77	3.15	3.04
5	consumption	PPn	1.36	1.28	1.48	1.63	2.03	3.27	4.36	3.65	2.32	1.89	1.53	1.42
5	consumption	PWn	1.62	1.51	1.65	1.71	2.05	3.28	4.38	3.66	2.37	1.99	1.69	1.65
5	availability	BL	0.58	1.08	30.08	23.48	14.62	11.57	9.86	5.77	6.54	12.60	14.05	1.47
5	availability	CnBAU	0.55	1.01	29.37	23.40	15.47	11.34	9.96	5.94	6.58	11.98	13.26	1.35
5	availability	Cx	1.36	3.05	68.93	50.44	2.40	24.91	6.15	4.37	3.83	0.95	7.44	1.34
5	availability	CxBAU	1.25	3.10	70.63	50.22	2.45	22.42	5.74	4.41	3.86	0.93	7.07	1.41
5	availability	EtOHn	0.55	1.02	29.13	22.47	14.08	11.19	10.12	5.80	6.45	12.68	13.62	1.37
5	availability	Extreme	1.31	3.08	70.54	49.06	2.66	21.27	5.74	4.30	3.67	0.65	6.68	1.41
5	availability	PPn	0.62	1.03	29.32	23.04	15.40	11.34	10.47	5.73	5.76	10.67	12.21	1.26
5	availability	PWn	0.58	1.07	28.49	22.19	14.68	9.75	9.94	6.30	6.53	11.67	13.87	1.43
5	withdrawal	BL	2.38	2.21	2.40	2.45	2.92	4.51	6.01	5.10	3.39	2.86	2.45	2.42
5	withdrawal	CnBAU	4.88	4.51	4.87	4.91	5.81	7.77	9.76	8.86	6.64	5.75	4.96	4.94
5	withdrawal	Cx	2.37	2.20	2.41	2.49	3.04	4.85	6.17	5.28	3.62	2.93	2.48	2.42
5	withdrawal	CxBAU	4.84	4.48	4.88	4.99	6.02	8.20	10.08	9.15	6.97	5.88	5.02	4.94
5	withdrawal	EtOHn	2.38	2.21	2.40	2.45	2.92	4.52	5.99	5.11	3.39	2.86	2.45	2.42
5	withdrawal	Extreme	6.82	6.31	6.83	6.93	8.29	10.79	13.05	12.14	9.57	8.18	7.02	6.95
5	withdrawal	PPn	3.07	2.85	3.15	3.27	3.93	5.68	7.33	6.43	4.51	3.82	3.22	3.14

Division	Indicator	scenario	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5	withdrawal	PWn	3.79	3.50	3.74	3.73	4.38	6.16	7.89	6.98	5.06	4.37	3.81	3.83
6	consumption	BL	1.42	1.29	1.42	1.39	1.50	1.55	1.67	1.67	1.53	1.50	1.39	1.42
6	consumption	CnBAU	2.40	2.19	2.40	2.35	2.55	2.64	2.87	2.86	2.63	2.54	2.36	2.41
6	consumption	Cx	1.46	1.33	1.46	1.44	1.56	1.61	1.74	1.73	1.59	1.55	1.44	1.46
6	consumption	CxBAU	2.43	2.21	2.43	2.40	2.61	2.71	2.95	2.94	2.70	2.60	2.40	2.44
6	consumption	EtOHn	1.42	1.29	1.42	1.40	1.51	1.55	1.68	1.67	1.54	1.50	1.40	1.43
6	consumption	Extreme	3.26	2.97	3.26	3.21	3.50	3.63	3.95	3.95	3.62	3.49	3.22	3.28
6	consumption	PPn	1.78	1.62	1.79	1.77	1.92	1.98	2.15	2.14	1.96	1.90	1.76	1.79
6	consumption	PWn	1.90	1.73	1.89	1.85	2.00	2.06	2.24	2.24	2.05	2.00	1.86	1.91
6	availability	BL	1.51	0.96	48.73	38.66	22.89	16.34	12.16	4.64	11.57	33.73	25.74	1.55
6	availability	CnBAU	1.52	0.87	48.52	39.01	24.19	15.42	11.64	4.49	11.69	32.12	24.22	1.48
6	availability	Cx	2.85	2.73	82.11	66.67	11.42	53.70	11.69	1.99	3.63	2.02	15.84	2.37
6	availability	CxBAU	2.77	2.67	83.15	67.19	12.02	51.90	10.47	1.96	3.57	1.95	14.78	2.41
6	availability	EtOHn	1.51	0.96	48.45	38.41	23.28	15.07	11.37	4.52	11.60	32.73	24.94	1.55
6	availability	Extreme	2.78	2.58	83.18	66.30	11.36	48.38	10.65	1.91	3.62	1.88	15.62	2.46
6	availability	PPn	1.51	0.86	48.06	38.96	23.05	16.05	12.57	4.23	10.74	31.00	24.53	1.58
6	availability	PWn	1.49	0.94	48.22	37.93	22.53	14.76	11.84	4.81	12.03	33.76	25.72	1.63
6	withdrawal	BL	2.50	2.37	2.84	3.23	4.10	4.89	5.71	5.53	4.49	3.74	2.94	2.63
6	withdrawal	CnBAU	4.94	4.62	5.26	5.67	6.97	8.14	9.46	9.27	7.74	6.60	5.41	5.10
6	withdrawal	Cx	2.53	2.39	2.87	3.30	4.21	5.06	5.87	5.70	4.64	3.84	3.00	2.66
6	withdrawal	CxBAU	4.94	4.62	5.31	5.79	7.17	8.42	9.74	9.56	7.98	6.76	5.49	5.12
6	withdrawal	EtOHn	2.50	2.37	2.84	3.23	4.09	4.89	5.71	5.53	4.49	3.74	2.94	2.63
6	withdrawal	Extreme	6.91	6.44	7.32	7.86	9.66	11.25	13.00	12.80	10.77	9.20	7.55	7.14
6	withdrawal	PPn	3.20	3.01	3.60	4.09	5.17	6.12	7.12	6.92	5.67	4.74	3.72	3.35
6	withdrawal	PWn	3.87	3.62	4.13	4.47	5.51	6.46	7.53	7.37	6.10	5.20	4.25	3.99
7	consumption	BL	0.06	0.05	0.07	0.09	0.11	0.15	0.17	0.15	0.11	0.10	0.07	0.06
7	consumption	CnBAU	0.07	0.06	0.08	0.10	0.12	0.16	0.18	0.17	0.13	0.11	0.09	0.07
7	consumption	Cx	0.06	0.06	0.07	0.09	0.11	0.15	0.17	0.16	0.12	0.10	0.08	0.06
7	consumption	CxBAU	0.07	0.07	0.09	0.10	0.13	0.17	0.19	0.17	0.13	0.11	0.09	0.08
7	consumption	EtOHn	0.06	0.06	0.08	0.09	0.11	0.15	0.17	0.16	0.12	0.10	0.08	0.07
7	consumption	Extreme	0.09	0.08	0.11	0.13	0.16	0.20	0.22	0.20	0.16	0.14	0.11	0.09
7	consumption	PPn	0.06	0.06	0.08	0.09	0.12	0.16	0.18	0.16	0.12	0.10	0.08	0.06
7	consumption	PWn	0.06	0.06	0.07	0.09	0.11	0.15	0.17	0.16	0.12	0.10	0.08	0.06
7	availability	BL	1.50	2.33	27.50	24.43	10.19	5.36	6.28	3.11	2.63	2.75	4.50	1.85
7	availability	CnBAU	1.41	2.31	27.37	23.98	10.42	5.08	6.25	3.07	2.61	2.54	4.07	1.80
7	availability	Cx	2.44	5.14	66.43	34.03	0.88	6.66	3.19	1.72	2.15	0.08	0.75	0.30
7	availability	CxBAU	2.45	5.40	67.04	34.85	0.79	6.47	3.06	1.73	2.14	0.08	0.69	0.29
7	availability	EtOHn	1.50	2.45	27.09	24.09	10.33	5.26	6.22	3.12	2.73	2.58	4.12	1.70
7	availability	Extreme	2.51	5.24	68.23	33.87	0.91	6.40	3.11	1.70	2.23	0.08	0.62	0.22
7	availability	PPn	1.46	2.48	26.71	24.94	10.20	5.30	6.38	3.05	2.63	2.27	3.58	1.70
7	availability	PWn	1.42	2.44	26.58	23.96	10.38	4.97	6.33	3.24	2.58	2.65	4.19	1.80
7	withdrawal	BL	0.21	0.20	0.25	0.28	0.36	0.48	0.56	0.52	0.40	0.33	0.26	0.23

Division	Indicator	scenario	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
7	withdrawal	CnBAU	0.41	0.38	0.44	0.47	0.57	0.72	0.83	0.79	0.64	0.55	0.45	0.43
7	withdrawal	Cx	0.22	0.20	0.25	0.29	0.38	0.50	0.57	0.53	0.42	0.34	0.26	0.23
7	withdrawal	CxBAU	0.41	0.38	0.44	0.48	0.59	0.74	0.85	0.81	0.66	0.56	0.46	0.43
7	withdrawal	EtOHn	0.22	0.21	0.25	0.29	0.37	0.49	0.57	0.53	0.41	0.34	0.26	0.23
7	withdrawal	Extreme	0.57	0.53	0.60	0.64	0.79	0.97	1.11	1.07	0.89	0.76	0.62	0.59
7	withdrawal	PPn	0.27	0.25	0.30	0.33	0.42	0.55	0.64	0.60	0.47	0.39	0.31	0.28
7	withdrawal	PWn	0.32	0.30	0.35	0.38	0.48	0.61	0.70	0.67	0.53	0.45	0.36	0.34
8	consumption	BL	0.67	0.64	0.81	0.96	1.23	1.46	1.66	1.59	1.32	1.09	0.84	0.72
8	consumption	CnBAU	1.26	1.19	1.45	1.67	2.10	2.45	2.78	2.69	2.27	1.91	1.50	1.33
8	consumption	Cx	0.69	0.65	0.83	0.99	1.27	1.50	1.70	1.64	1.36	1.12	0.86	0.74
8	consumption	CxBAU	1.27	1.20	1.47	1.70	2.15	2.51	2.85	2.76	2.33	1.95	1.53	1.35
8	consumption	EtOHn	0.69	0.65	0.82	0.98	1.25	1.48	1.68	1.61	1.34	1.11	0.85	0.74
8	consumption	Extreme	1.73	1.63	1.97	2.23	2.80	3.25	3.68	3.59	3.04	2.57	2.03	1.83
8	consumption	PPn	0.88	0.84	1.09	1.32	1.71	2.02	2.28	2.20	1.83	1.50	1.14	0.96
8	consumption	PWn	0.96	0.90	1.08	1.22	1.53	1.79	2.03	1.97	1.65	1.40	1.11	1.00
8	availability	BL	1.71	2.54	33.26	36.19	23.96	10.17	8.43	5.63	5.62	7.47	7.99	2.07
8	availability	CnBAU	1.68	2.66	31.65	35.31	25.76	10.67	9.20	5.80	6.82	8.82	9.94	2.28
8	availability	Cx	2.64	4.83	64.24	51.78	6.64	12.19	6.11	4.96	1.93	1.59	4.97	1.28
8	availability	CxBAU	2.75	5.23	64.42	49.21	7.56	10.34	5.42	4.75	1.69	0.67	3.35	1.06
8	availability	EtOHn	1.72	2.82	31.90	36.12	23.88	11.39	8.18	5.33	6.14	8.40	8.47	2.35
8	availability	Extreme	2.72	5.25	64.44	48.51	7.64	10.31	5.56	4.79	1.63	0.57	4.08	1.03
8	availability	PPn	1.63	2.61	30.60	35.76	22.41	10.56	9.71	4.94	5.11	6.85	7.69	2.19
8	availability	PWn	1.75	2.63	31.00	35.42	26.07	10.06	8.78	6.56	6.48	9.25	9.45	2.36
8	withdrawal	BL	1.37	1.28	1.52	1.71	2.15	2.54	2.92	2.84	2.37	1.99	1.58	1.44
8	withdrawal	CnBAU	2.72	2.54	2.91	3.15	3.88	4.50	5.17	5.08	4.30	3.68	3.01	2.82
8	withdrawal	Cx	1.38	1.29	1.54	1.75	2.21	2.62	3.00	2.92	2.44	2.04	1.61	1.45
8	withdrawal	CxBAU	2.72	2.54	2.94	3.21	3.99	4.63	5.32	5.22	4.42	3.76	3.05	2.83
8	withdrawal	EtOHn	1.39	1.30	1.54	1.73	2.17	2.56	2.94	2.86	2.39	2.01	1.60	1.45
8	withdrawal	Extreme	3.79	3.54	4.03	4.34	5.35	6.18	7.10	7.00	5.95	5.10	4.18	3.93
8	withdrawal	PPn	1.77	1.67	2.00	2.28	2.90	3.40	3.90	3.80	3.17	2.66	2.09	1.87
8	withdrawal	PWn	2.10	1.96	2.22	2.38	2.92	3.39	3.90	3.83	3.24	2.78	2.29	2.17
9	consumption	BL	1.79	1.66	1.84	1.92	2.32	2.91	3.42	3.30	2.64	2.23	1.89	1.83
9	consumption	CnBAU	3.58	3.31	3.60	3.67	4.36	5.21	6.06	5.94	4.94	4.28	3.67	3.64
9	consumption	Cx	1.78	1.66	1.85	1.95	2.39	3.01	3.52	3.40	2.73	2.28	1.91	1.83
9	consumption	CxBAU	3.55	3.29	3.61	3.72	4.48	5.37	6.24	6.12	5.09	4.36	3.70	3.63
9	consumption	EtOHn	1.79	1.67	1.85	1.93	2.32	2.92	3.43	3.31	2.64	2.24	1.89	1.84
9	consumption	Extreme	4.97	4.60	5.01	5.13	6.14	7.24	8.41	8.29	6.97	6.03	5.15	5.07
9	consumption	PPn	2.31	2.15	2.39	2.51	3.04	3.73	4.35	4.22	3.43	2.91	2.44	2.36
9	consumption	PWn	2.79	2.58	2.79	2.83	3.35	4.06	4.75	4.64	3.81	3.30	2.84	2.83
9	availability	BL	3.78	2.10	43.68	35.75	23.90	11.24	9.48	5.29	6.07	19.06	25.34	5.61
9	availability	CnBAU	3.62	2.26	43.83	34.76	25.08	11.14	9.58	5.39	6.38	18.53	24.73	5.65
9	availability	Cx	4.45	3.52	70.68	52.85	9.17	13.11	8.80	6.63	0.77	1.01	11.73	4.12

Division	Indicator	scenario	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
9	availability	CxBAU	4.53	3.74	70.42	53.63	9.58	12.67	8.45	6.53	0.77	0.85	11.11	3.85
9	availability	EtOHn	3.74	2.08	44.23	34.66	23.94	10.74	9.43	5.27	6.05	17.91	24.48	5.58
9	availability	Extreme	4.45	3.71	72.32	52.88	8.69	11.64	8.39	6.44	0.71	0.83	10.82	3.93
9	availability	PPn	3.59	2.04	43.89	34.42	24.41	10.81	9.91	5.12	5.75	17.21	23.83	5.40
9	availability	PWn	3.75	2.13	43.46	34.38	24.05	9.96	9.66	5.43	6.23	19.19	25.97	5.72
9	withdrawal	BL	3.55	3.28	3.54	3.57	4.23	5.12	6.01	5.87	4.82	4.18	3.61	3.60
9	withdrawal	CnBAU	7.22	6.66	7.10	7.05	8.24	9.62	11.20	11.09	9.38	8.26	7.22	7.29
9	withdrawal	Cx	3.52	3.25	3.54	3.62	4.35	5.29	6.18	6.04	4.98	4.26	3.64	3.59
9	withdrawal	CxBAU	7.14	6.59	7.09	7.13	8.46	9.93	11.55	11.43	9.67	8.42	7.27	7.25
9	withdrawal	EtOHn	3.56	3.28	3.55	3.57	4.23	5.13	6.01	5.87	4.82	4.18	3.61	3.60
9	withdrawal	Extreme	10.06	9.28	9.94	9.96	11.76	13.64	15.85	15.74	13.41	11.76	10.20	10.20
9	withdrawal	PPn	4.56	4.21	4.57	4.62	5.49	6.55	7.64	7.50	6.23	5.41	4.66	4.63
9	withdrawal	PWn	5.63	5.19	5.52	5.46	6.38	7.52	8.78	8.67	7.28	6.40	5.61	5.68

Table A4. Water withdrawal (in million m^3/year) by user group by division under different scenarios. For ethanol (EtOH) and oil refineries (Ptro), water withdrawal (WU) and consumption (Wc) are also summarized. Oil refineries are assumed to acquire only make-up water for balancing water loss through vapor or waste water treatment. Therefore, only water consumption is listed under the oil refinery category (Ptro Wc).

Figures listed in the tables are for analysis purposes and representing "most-possible" values. They should not be treated as absolute or exact quantities occurring in a hydro system.

Statistics	Division	2000BL	Cx	PPn	EtOHn	PWn	CxBAU	CnBAU	Extreme
Public	1	23.9	25.6	29.8	23.9	23.9	31.9	29.8	38.3
Public	2	21.4	22.6	26.8	21.4	21.4	28.4	26.8	34.1
Public	3	68.2	70.9	74.2	68.2	68.2	77.2	74.3	92.7
Public	4	30.0	31.4	35.4	30.0	29.7	37.7	35.7	45.2
Public	5	57.8	60.5	99.4	57.8	57.5	104.7	99.6	125.6
Public	6	413.9	429.9	511.5	413.7	413.5	531.5	510.9	637.8
Public	7	26.7	26.9	27.2	26.8	26.1	28.7	27.9	34.5
Public	8	123.7	128.2	178.4	127.0	123.9	187.7	181.5	225.4
Public	9	89.6	91.9	126.1	89.8	89.3	130.2	126.6	156.3
Power	1	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1
Power	2	213.5	216.5	273.3	213.5	343.7	446.2	440.0	631.9
Power	3	204.5	207.4	261.8	204.5	329.3	427.5	421.5	605.3
Power	4	69.3	70.3	88.7	69.3	111.6	144.9	142.8	205.1
Power	5	527.0	534.4	674.6	527.0	848.4	1101.5	1086.1	1559.7
Power	6	814.9	826.4	1043.2	814.9	1312.0	1703.3	1679.6	2411.9
Power	7	42.9	43.5	54.9	42.9	69.0	89.6	88.4	126.9
Power	8	276.0	279.9	353.3	276.0	444.4	576.9	568.9	816.9
Power	9	798.0	809.3	1021.6	798.1	1284.8	1668.1	1644.8	2362.0
Industry	1	1.5	1.6	1.9	1.5	1.5	2.0	1.9	2.4
Industry	2	61.7	65.5	61.2	61.8	61.7	65.0	61.3	78.0
Industry	3	315.2	323.9	368.4	315.2	315.2	378.2	368.4	454.5
Industry	4	3.7	4.2	4.3	4.5	4.0	4.9	4.8	5.9
Industry	5	21.1	22.2	31.8	21.1	21.0	33.6	31.9	40.4
Industry	6	20.2	21.4	26.7	20.1	20.1	28.4	26.7	34.0
Industry	7	2.6	3.4	3.5	4.0	3.4	4.2	4.1	5.0
Industry	8	18.5	19.4	25.2	19.1	18.8	26.4	25.6	31.7
Industry	9	20.7	21.6	27.9	21.4	21.3	28.4	28.0	34.1
Irrigation	1	16.6	19.2	16.6	16.5	16.4	19.4	16.6	19.4
Irrigation	2	29.2	34.3	29.2	29.2	29.1	34.5	29.1	34.6
Irrigation	3	2.2	2.4	2.2	2.2	2.2	2.4	2.2	2.4

Statistics	Division	2000BL	Cx	PPn	EtOHn	PWn	CxBAU	CnBAU	Extreme
Irrigation	4	81.6	89.6	82.3	81.9	81.0	90.4	81.5	90.5
Irrigation	5	86.8	95.8	87.2	86.8	86.8	96.4	87.3	96.6
Irrigation	6	23.3	26.1	23.4	23.3	23.2	26.3	23.4	26.3
Irrigation	7	4.1	4.3	4.1	4.1	4.1	4.3	4.1	4.3
Irrigation	8	5.0	5.2	5.0	4.9	4.9	5.3	4.9	5.3
Irrigation	9	26.7	28.3	26.8	26.6	26.6	28.4	26.6	28.4
Ptro Wc	1	--	--	--	--	--	--	--	--
Ptro Wc	2	--	--	--	--	--	--	--	--
Ptro Wc	3	--	--	--	--	--	--	--	--
Ptro Wc	4	--	--	--	--	--	--	--	--
Ptro Wc	5	--	--	--	--	--	--	--	--
Ptro Wc	6	0.3	0.3	0.4	0.3	0.3	0.3	0.4	0.4
Ptro Wc	7	--	--	--	--	--	--	--	--
Ptro Wc	8	--	--	--	--	--	--	--	--
Ptro Wc	9	0.6	0.7	0.9	0.7	0.7	0.9	0.9	1.1
EtOH Wc	1	--	--	--	0.0	--	0.0	0.0	0.0
EtOH Wc	2	--	--	--	0.0	--	0.0	0.0	0.0
EtOH Wc	3	--	--	--	--	--	--	--	--
EtOH Wc	4	0.5	0.5	0.5	0.7	0.5	0.8	0.7	0.9
EtOH Wc	5	0.5	0.5	0.4	0.5	0.4	0.6	0.5	0.7
EtOH Wc	6	0.1	0.0	0.0	0.1	0.0	0.1	0.1	0.1
EtOH Wc	7	0.3	0.2	0.2	0.4	0.2	0.4	0.4	0.5
EtOH Wc	8	0.7	0.8	0.8	1.4	0.8	1.4	1.4	1.7
EtOH Wc	9	0.2	0.2	0.2	0.3	0.2	0.3	0.3	0.4
EtOH WU	1	--	--	--	0.0	--	0.0	0.0	0.0
EtOH WU	2	--	--	--	0.0	--	0.0	0.0	0.0
EtOH WU	3	--	--	--	--	--	--	--	--
EtOH WU	4	0.6	0.6	0.6	0.9	0.6	1.0	0.9	1.0
EtOH WU	5	0.6	0.6	0.5	0.6	0.5	0.7	0.6	0.9
EtOH WU	6	0.1	0.0	0.0	0.1	0.0	0.1	0.1	0.1
EtOH WU	7	0.3	0.2	0.2	0.4	0.2	0.4	0.4	0.5
EtOH WU	8	0.7	0.8	0.8	1.4	0.8	1.4	1.4	1.7
EtOH WU	9	0.3	0.2	0.2	0.3	0.2	0.3	0.3	0.5

PROJECT TITLE: Accelerating plans for the integrated control of the common carp

Project Manager: Peter W. Sorensen
Co-manager: Przemyslaw G. Bajer
Affiliation: University of Minnesota
Mailing Address: 1980 Folwell Ave.
City / State / Zip: St. Paul, MN 55108
Telephone Number: 612-624-4997
E-mail Address: soren003@umn.edu
Web Page address: http://fwcb.cfans.umn.edu/personnel/faculty/sorensen/
Funding Source: Environment and Natural Resources Trust Fund
Legal Citation: ML 2008, [Chap. 367], Sec.[2], Subd.4
Appropriation amount: $550,000

Overall Project Outcome and Results

The common carp (*Cyprinus carpio*) was introduced to Minnesota in the late 1800s and quickly came to dominate the fish communities in the south-central portion of the state where it is now responsible for poor water quality and greatly reduced duck habitat. Our previous Environment and Natural Resources Trust Fund (ENRTF) funded projects from appropriations in 2003 and 2005 had suggested that recruitment (survival of fertilized eggs to adulthood) might be a key weakness in the life history of the carp and that predatory fish, odors, or sounds might be used to control recruitment. This project investigated these possibilities in six studies '(results'):

1. For the first, we monitored the fate of carp eggs and larvae in both the field and lab to determine if predators might be eating them. We discovered that bluegill sunfish, a native game-fish, consume large numbers of carp eggs and larvae.
2. For result 2 we examined correlations between the abundance of young-of-the-year (YOY) carp and predatory game-fish across two dozen lakes using trap-net surveys. We discovered the YOY carp are rarely found in lakes that have bluegills, suggesting that bluegills control carp in lakes.
3. A third study examined the age structure of several populations of adult carp. It found that YOY carp only recruit in years and places where winter oxygen levels are low enough to kill bluegills.
4. A fourth study examined whether food odors might be used to enhance capture rates of YOY carp. While, we found evidence that certain baits are attractive in the lab, field results were variable and application appeared impractical.
5. A fifth study examined pheromones for use in YOY removal and came to a similar conclusion.
6. Lastly, we examined whether air-bubble curtains have potential to reduce the movement of YOY carps from nursery areas by producing sound. These results were promising.

In summary, this project provided compelling evidence that populations of invasive carp can be controlled by promoting the abundance of native predators and controlling movement using bubble barriers.

Project Results and Dissemination

The results of this project are presently being implemented by the Riley Purgatory Bluff Creek Watershed District and the Ramsey Washington Metro Watershed District. Both watersheds report that carp densities are reduced and under control while water quality has improved. The barrier bubble developed here is now being developed further by another ENRTF project. This work has been described in 6 peer-reviewed publications (with more in review), over a dozen scientific meetings, a dozen agency meetings and in at least 6 press and TV reports.

Environmental and Natural Resources Trust Fund 2008 Work Program Final Report

Date of Report: August 31, 2011
Final Report
Date of Work Program Approval: June 10, 2008
Project Completion Date: June 30, 2011

I. PROJECT TITLE: Accelerating plans for the integrated control of the common carp

Project Manager: Peter W. Sorensen
Co-manager: Przemyslaw G. Bajer
Affiliation: University of Minnesota
Mailing Address: 1980 Folwell Ave.
City / State / Zip: St. Paul, MN 55108
Telephone Number: 612-624-4997
E-mail Address: soren003@umn.edu
FAX Number: 612-625-5299
Web Page address: http://fwcb.cfans.umn.edu/personnel/faculty/sorensen/

Total Trust Fund Project Budget:	**Trust Fund Appropriation:**	**$550,000**
	Minus Amount Spent:	**$495,773**
	Equal Balance:	**$54,227**

Legal Citation: ML 2008, [Chap. 367], Sec.[2], Subd.4

Appropriation Language:
$550,000 is from the trust fund to the board of regents of the University of Minnesota to accelerate research on new approaches to control the invasive common carp. This appropriation is available until June 30,2011, at which time the project must be completed and final products delivered, unless an earlier date is specified in the work program.

II. and III. FINAL PROJECT SUMMARY

Overall Project Outcome and Results

The common carp (*Cyprinus carpio*) was introduced to Minnesota in the late 1800s and quickly came to dominate the fish communities in the south-central portion of the state where it is now responsible for poor water quality and greatly reduced duck habitat. Our previous Environment and Natural Resources Trust Fund (ENRTF) funded projects from appropriations in 2003 and 2005 had suggested that recruitment (survival of fertilized eggs to adulthood) might be a key weakness in the life history of the carp and that predatory fish, odors, or sounds might be used to

control recruitment. This project investigated these possibilities in six studies '(results'):

1. For the first, we monitored the fate of carp eggs and larvae in both the field and lab to determine if predators might be eating them. We discovered that bluegill sunfish, a native game-fish, consume large numbers of carp eggs and larvae.
2. For result 2 we examined correlations between the abundance of young-of-the-year (YOY) carp and predatory game-fish across two dozen lakes using trap-net surveys. We discovered the YOY carp are rarely found in lakes that have bluegills, suggesting that bluegills control carp in lakes.
3. A third study examined the age structure of several populations of adult carp. It found that YOY carp only recruit in years and places where winter oxygen levels are low enough to kill bluegills.
4. A fourth study examined whether food odors might be used to enhance capture rates of YOY carp. While, we found evidence that certain baits are attractive in the lab, field results were variable and application appeared impractical.
5. A fifth study examined pheromones for use in YOY removal and came to a similar conclusion.
6. Lastly, we examined whether air-bubble curtains have potential to reduce the movement of YOY carps from nursery areas by producing sound. These results were promising.

In summary, this project provided compelling evidence that populations of invasive carp can be controlled by promoting the abundance of native predators and controlling movement using bubble barriers.

Project Results and Dissemination

The results of this project are presently being implemented by the Riley Purgatory Bluff Creek Watershed District and the Ramsey Washington Metro Watershed District. Both watersheds report that carp densities are reduced and under control while water quality has improved. The barrier bubble developed here is now being developed further by another ENRTF project. This work has been described in 6 peer-reviewed publications (with more in review), over a dozen scientific meetings, a dozen agency meetings and in at least 6 press and TV reports.

IV. OUTLINE OF PROJECT RESULTS*:*

Result 1: To determine if predation by native gamefish on carp eggs, larvae and fry can potentially be used to control carp recruitment in lake enclosures.

Introduction: The goal of this experiment was to evaluate the possibility that predatory game-fish can be managed to control the survival of carp eggs and larvae. Several experiments were conducted in both field and lab with very positive results.

Methods & Results- field: Three field experiments were conducted to test the possibility carp recruitment is controlled by native fishes. In our initial experiment (2009), we located carp spawning areas in a lake that did not winterkill and had a healthy game-fish population (Lake Keller), and another lake which winterkilled and did not (Lake Casey), and then monitored the fate of carp eggs while monitoring the

stomach contents of game-fish in this region. We discovered that carp eggs disappeared within just two days of being spawned in Lake Keller (i.e. they did not survive to hatching) but survived for at least 5 days (until hatching) in Lake Casey (Fig. 1.1). Further, many bluegill sunfish were captured and they had an average of 17.2 eggs in the stomachs. In a second field experiment (2010), eggs were collected from spawning carp and placed into the same two lakes either directly, or after being placed into coarse mesh bags (which kept fish away from the eggs), or a fine mesh bags which kept both invertebrates and fish away from the eggs. We discovered that unprotected eggs disappeared rapidly from the lake with bluegill sunfish (and other game-fish) but did not disappear from the lake that lacked predatory fish. Further, eggs survived to hatching if they were protected by mesh from fish predation (Fig. 1.2). A third field study (2011) constructed 8 enclosures in two lakes (4 per lake) and added carp eggs to all of them along with bluegills or no other fish In this still ongoing experiment, young carp are found in the enclosures that lack bluegills but not the enclosure with bluegills (data not shown).

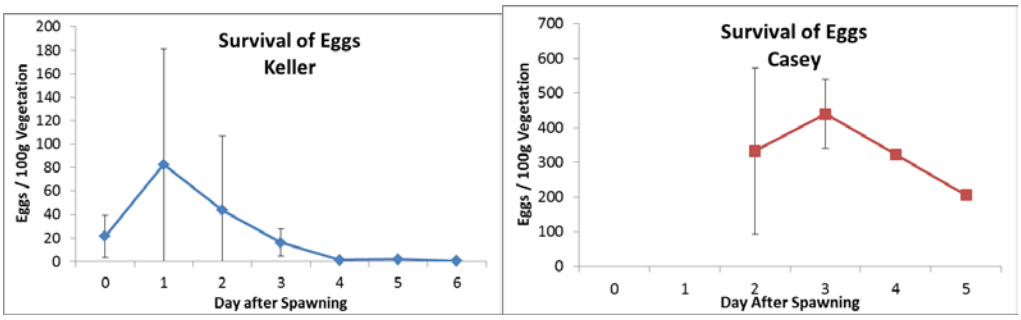


Fig. 1.1. Survival of carp eggs spawned in a 'normoxic' lake (ie. a lake that did not winterkill) and a 'hypoxic' lake (i.e. a lake that winterkilled).

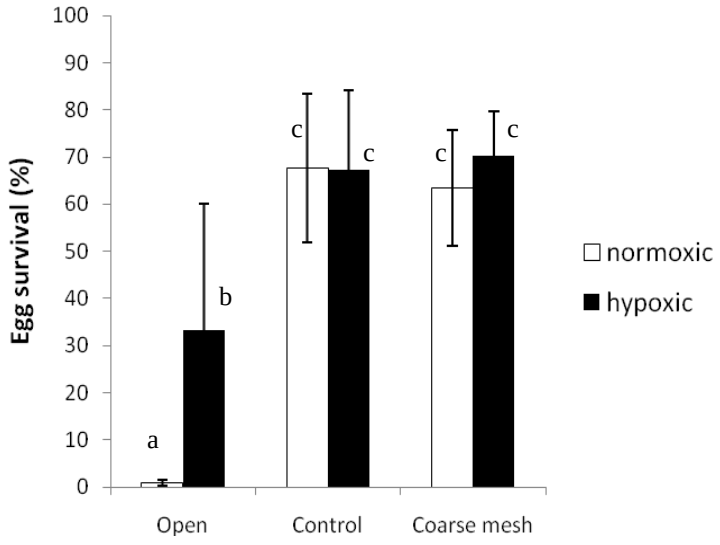


Fig. 1.2. Survival of carp eggs placed into normoxic and hypoxic lakes. Eggs were either unprotected, held in coarse mesh bags (to exclude fish), or held in fine mesh bags (to exclude invertebrates). Different letters indicate statistical differences

Methods & Results- lab: Two laboratory experiments were conducted to further test the rates at which bluegill sunfish consume carp eggs. In the first experiment, carp eggs were placed into tanks with bluegill sunfish and predation on eggs closely monitored. Eggs disappeared within a day (data not shown). In the second experiment, carp eggs were hatched and the larvae added to large tanks which either had bluegill sunfish, bullhead catfish, or no fish. Larvae did not survive more than 12 hours when present with sunfish while survival was noted in the other treatments (Fig. 1.3).

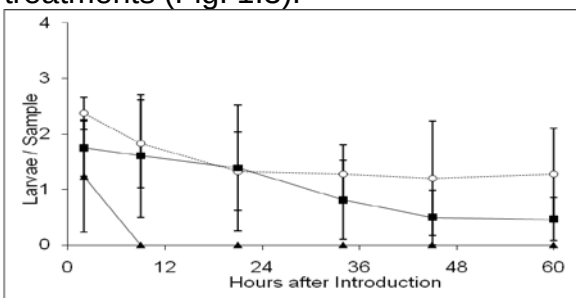


Fig. 1.3. Survivorship of carp larvae in tanks containing bluegill sunfish (triangles), catfish (squares) or no fish (circles; controls).

Summary: These experiments conclusively demonstrated that bluegill sunfish consume very large numbers of carp eggs and larvae in both the lab and field, suggesting they function as a natural control mechanism. These results are now found in a thesis manuscript and have also been submitted as a manuscript to the journal *Ecology*.

Result 2: To determine if the abundance of young-of-the-year (YOY) carp is inversely correlated with predator abundance in nursery areas following winterkills.

Introduction: This study assessed the possibility that game-fish might control carp recruitment in the field by determining whether the abundance of carp YOY recruits is naturally correlated with natural fluctuations in game-fish abundance. The alternative hypothesis that planktonic food for larval carp might explain the abundance of YOY carp in the field was examined at the same time.

Methods & Results: In the first component of this study, two dozen lakes were selected for monitoring based on whether or not they experienced winterkill, had adult carp, and could be trap-netted for sampling young fishes. A yearly sampling program then sampled each lake for oxygen to determine if it winterkilled and then the following summer sampled it for young fish by setting trap-nets. Plankton samples were taken at the same time in a subset of these lakes. This experiment showed a strong negative correlation between the presence of YOY carp and bluegill sunfish (Fig. 2.1). YOY carp were never found in the presence of bluegill

sunfish (Fig. 2.2). Analysis of plankton data showed that food supply did not always limit YOY carp survival (ex. Lake Keller had more planktonic food for YOY fishes than Lake Casey but far fewer carp). An AIC model confirmed that the presence of sunfish could be best predicted by winter oxygen levels.

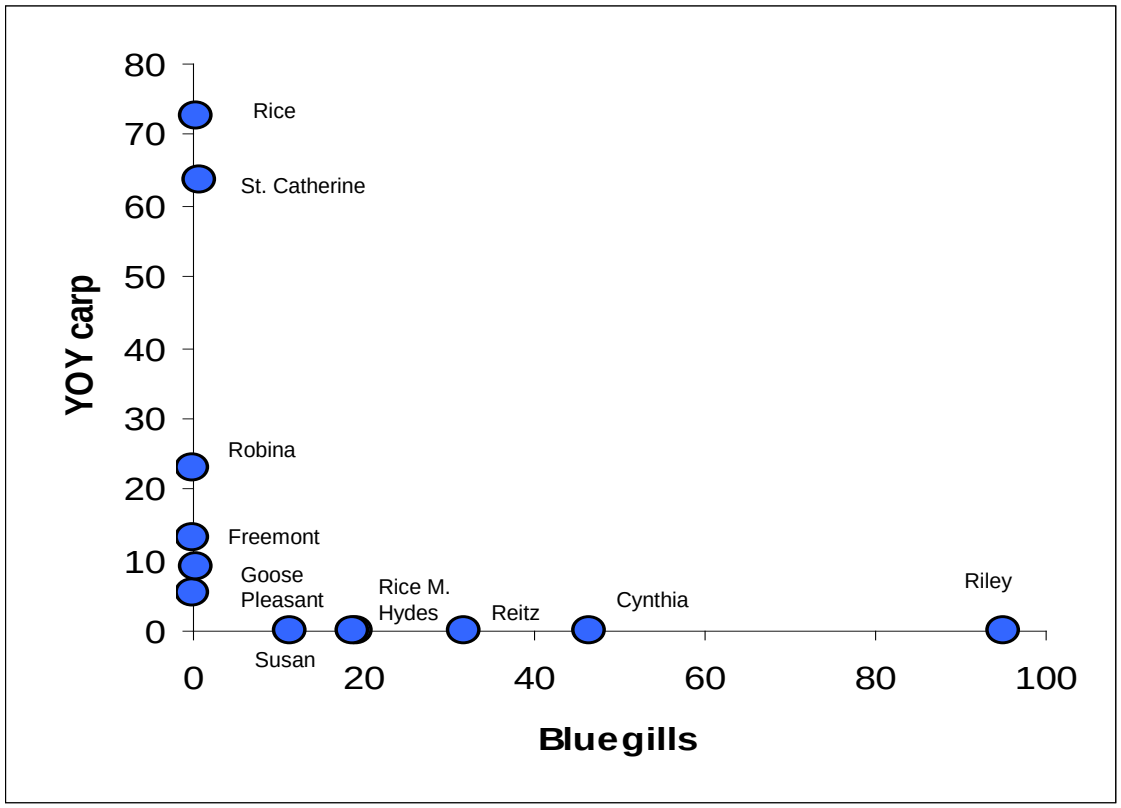


Fig. 2.1 The abundance of young-of-year (YOY) common carp versus the abundance of bluegill sunfish in our study lakes. Six lakes (Lakes Rice, St. Catherine, Robin, Freemont, Goose, and Pleasant) experienced at least a partial winterkill.

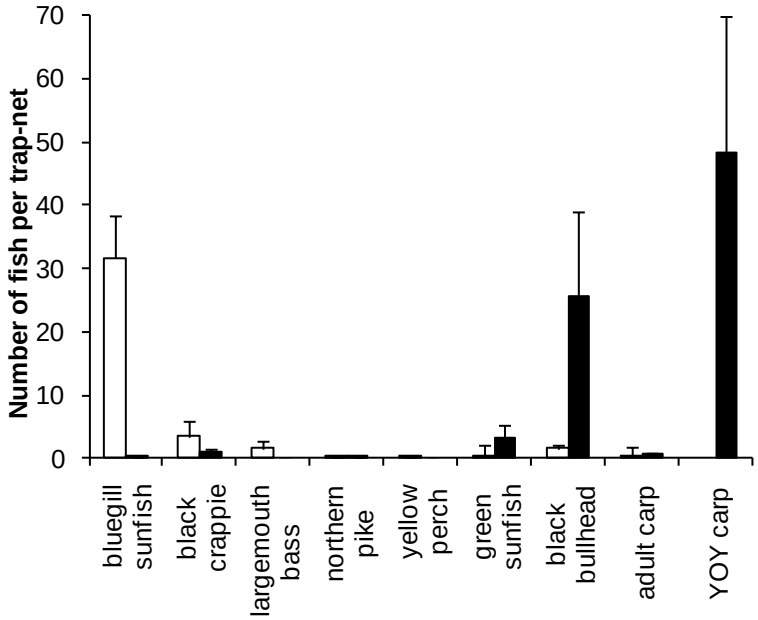


Fig. 2.2. Relative abundance of young-of-year common carp (YOY carp) and native fishes in normoxic (open bars) and hypoxic (filled bars) lakes. Error bars represent one standard error. Figures 2-1 and 2-2 share the same data.

Summary: The distribution of YOY carp across several dozen Minnesota lakes strongly supports the possibility that it is driven by the abundance of bluegill sunfish, which in turn is driven by winter oxygen. These results are described in manuscript sent to the journal *Ecology*.

Result 3: Determine whether carp age structure correlates with winterkill events.

Introduction: The goal of this experiment was to conduct a third independent test of our hypothesis that winterkill-driven declines in predatory fish trigger carp recruitment by examining the age structure of common carp populations in three lakes and correlating them with documented winterkills in those systems.

Methods and results: Three study lakes were selected in consultation with the DNR based on whether they either did (or did not) experience winterkill in the past 20 years (Lake Fremont, Lake Lucy, Upper Basin in Lake Kohlman Chain). Populations of 100 carp were sampled from each chain and their otoliths removed for aging. Lake Fremont, which has frequent and dramatic winterkills had two classes of carp that precisely coincided with winterkill events (Fig. 3.1) while the other two lakes, which do not experience winterkill, had smaller and more age classes (Fig. 3.2).

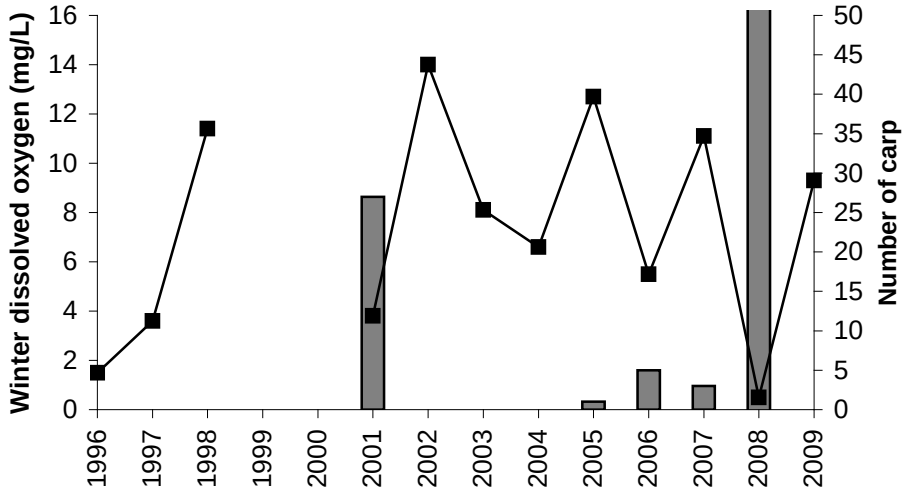


Fig. 3.1. The age structure of the population of carp in Lake Freemont and winter dissolved oxygen levels. Winter dissolved oxygen was not measured in 1999 and 2000 as these winters were relatively mild.

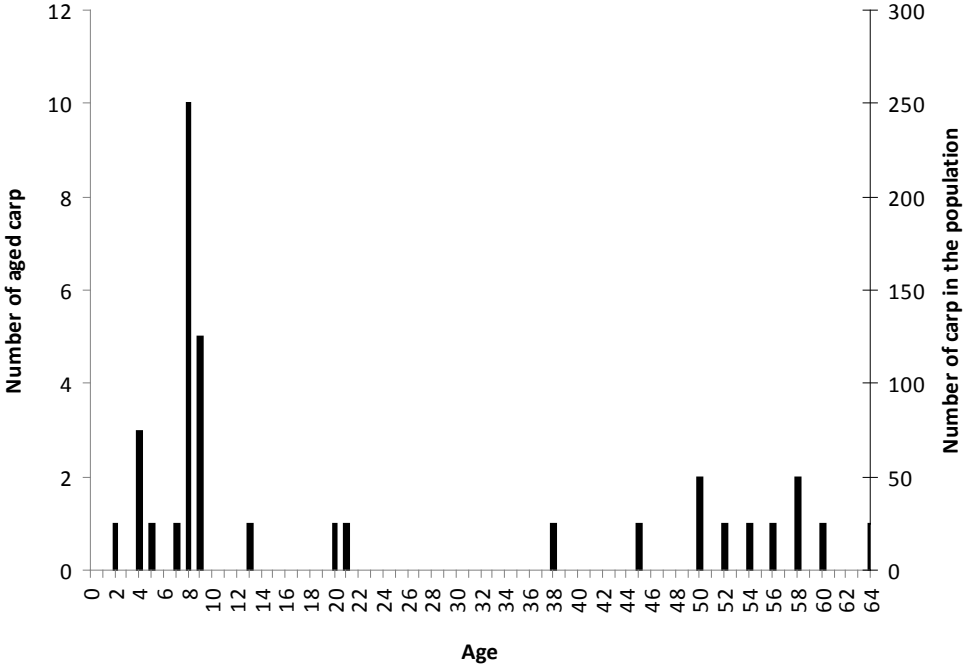


Fig. 3.2. Age structure of carp in Lake Lucy. No winterkill was noted during this period.

Summary: Winterkill, which is well known to reduce the abundance of bluegill sunfish (result 2 and Bajer and Sorensen (2010)), is highly correlated with recruitment of YOY carp. Likely winterkill acts by reducing the density of bluegill sunfish in inter-connected lakes.

Result 4: To determine if young-of-the-year (YOY) carp can be effectively trapped for census and/or removal using bait attractants.

Introduction: Integrated pest management (IPM) of carp will require excellent tools to both monitor the abundance and distribution of YOY carp and remove them when/as necessary. Odors (food and pheromones [Result 5]) and sound [Result 6] have potential given the sensitivity of young carp to these stimuli and the ease with which they can be applied. This objective sought to test whether and how food baits might be used as attractants for YOY carp. Both lab and field experiments were conducted.

Methods & Results-lab: Several sets of experiments were conducted. First, we determined what time of day carp might be most sensitive to food cues as knowing this could facilitate field trapping. YOY carp were held in 70 l aquaria into which food pellets were dropped at random while the aquaria were being observed and food-search behaviors noted. These experiments found that YOY carp are nocturnal (Fig. 4.1). Another set of laboratory experiments showed that flow appeared to enhance attraction to food (both corn and pellets, data not shown). Finally, we analyzed the amino acid composition of these food items and found them to be complex (Fig. 4.2).

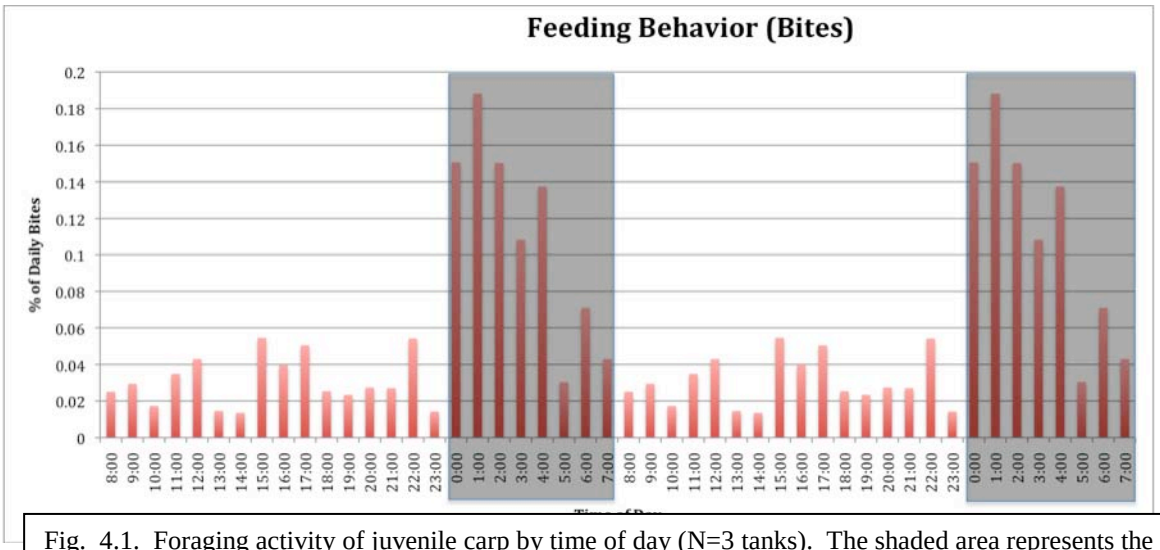


Fig. 4.1. Foraging activity of juvenile carp by time of day (N=3 tanks). The shaded area represents the scotophase (periods of darkness - lights-off; 23:30h-07:30h).

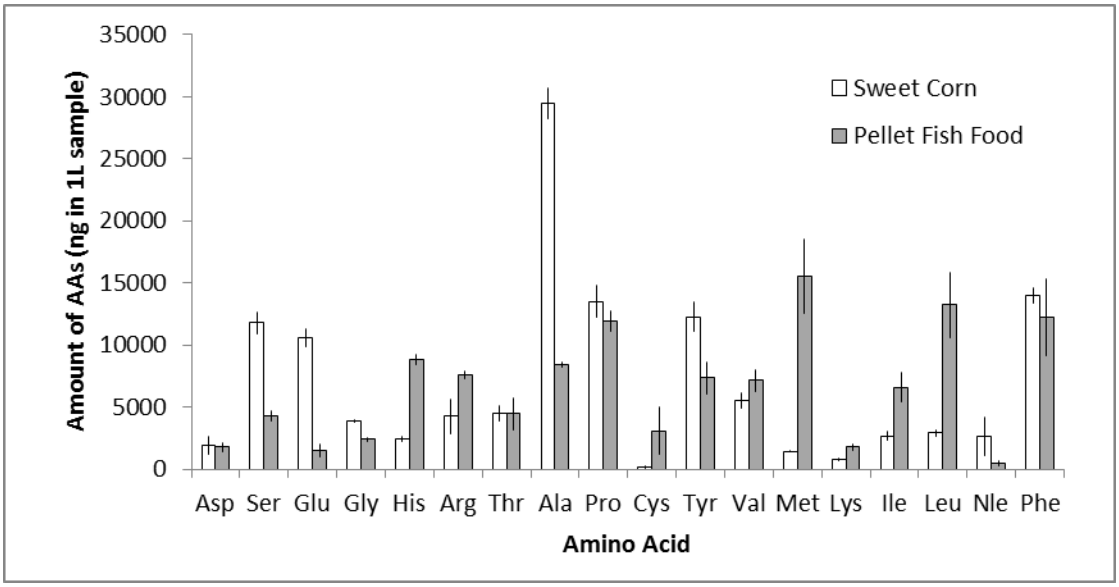


Fig. 4.2. Amino acid composition of two different carp foods.

Methods & Results- field: Having established when best to attract carp, we next conducted a field experiment in a carp nursery lake to test odor and flow. Specially designed traps were set into Lake Markham and Lake St. Catherine and battery

operated pumps used to add various food odors. While these experiments suggested that baited traps tended to catch more YOY carp than non-baited traps and that flow enhanced capture rates, the results were not significant and high by-catch of other species (bullhead catfish in particular), confounded the results (Fig. 4.2).

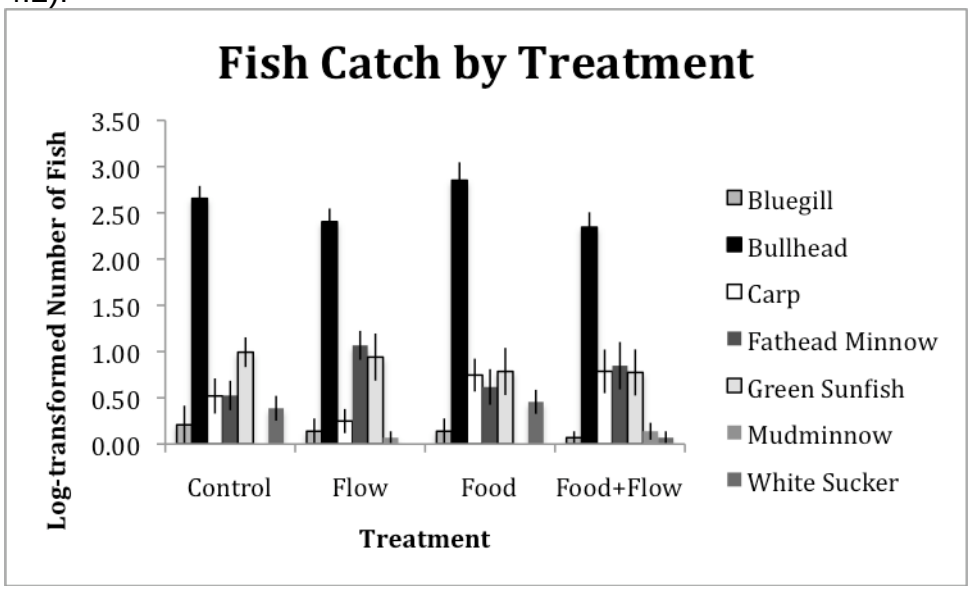


Fig. 4-2. Nightly catch rates (mean +/- standard error) of fishes in our 4 trap types in Lake St. Catherine.

Two more field experiments were conducted in two more lakes with similarly variable results. In one experiment we found that we could attract YOY carp to pelleted bait in Lake Markham without using flow (Fig 4.3) while a third experiment in Lake Casey found that YOY carp were not captured in any traps in spite of the presence of bait. Electro-fishing confirmed YOY carp were present and we surmised that adult fish were probably interfering with capture rates.

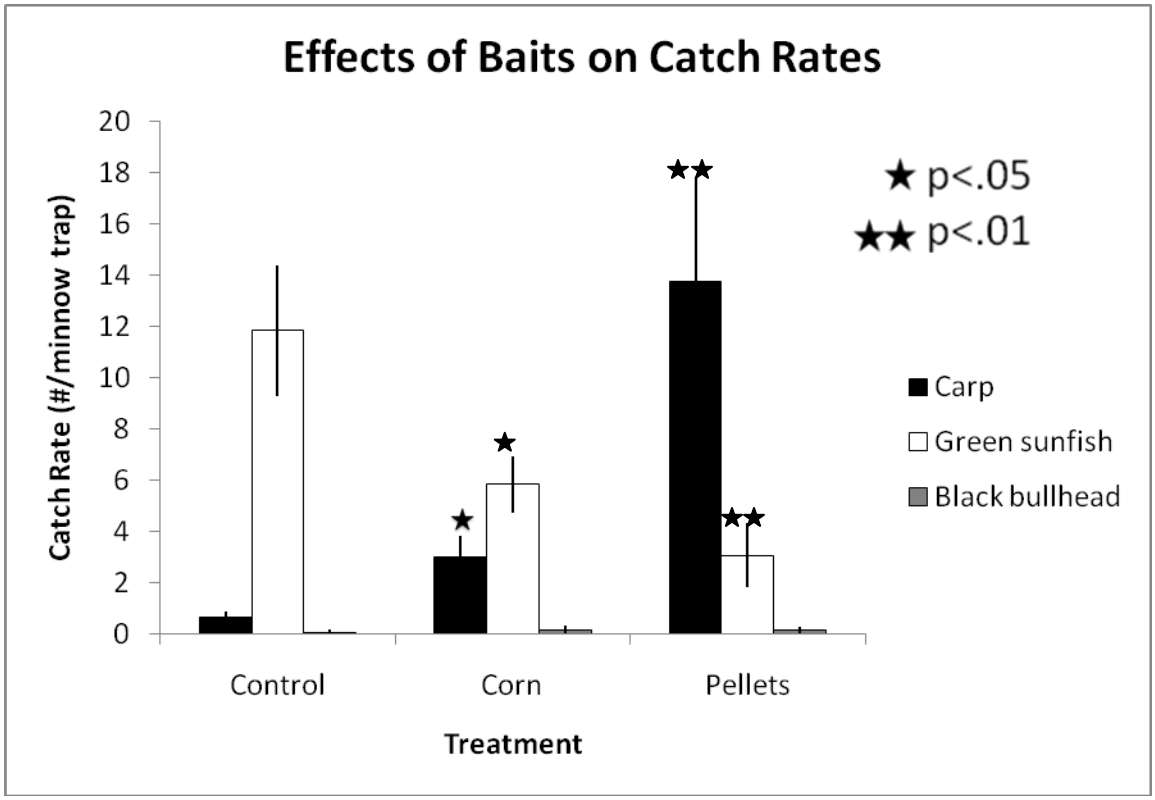


Fig. 4-3. Catch rates (mean +/- standard error) of carp and other fishes in minnow traps baited with canned sweet corn, commercial pellet fish food, and a blank control in Lake Markham.

Summary. Food odors can attract YOY carp but their utility in the field is limited and greatly complicated by local factors including the presence of other fish and hunger. Unbaited trap-nets are much easier to use and nearly as effective.

Result 5*:* To determine if young-of-the-year (YOY) carp can be effectively trapped for census and/or removal using pheromonal attractants.

Introduction: This study asked whether pheromones (chemical signals that pass between members of the same species) might have potential for use as attractants for censusing and removing carp. This class of stimuli has the potential advantage of being highly specific and thus might not be plagued by the by-catch issues seen with food. Previous studies (Levesque et al., 2011) had already shown that carp use species-specific pheromones. Here, we sought to determine their relative potency in lab tests and then if/as appropriate in field trials.

Methods & Results: An initial set of experiments used round maze tanks (Levesque et al., 2011) to confirm that the odor of juvenile carp was indeed attractive to other YOY carp and then what chemical fraction contained the activity so that chemical

analysis could be performed, if necessary. We found YOY odor was weakly (but significantly) attractive and that activity was found in both the polar and non-polar fractions (i.e. the chemistry was complex; Fig. 5.1.). Tests of flow found that it did not enhance the attractive properties of conspecific odor (data not shown) whose amino acid composition was evaluated (data not shown). Next, to determine the potency of the pheromone (and the possible need to conduct field tests), we tested the potency of food odor (pellets) versus pheromone in starved and fed YOY carp in our maze tanks. We found that food was much more potent than pheromone in hungry fish and no more attractive than pheromone in satiated carp (Figs. 5.2, 5.3).

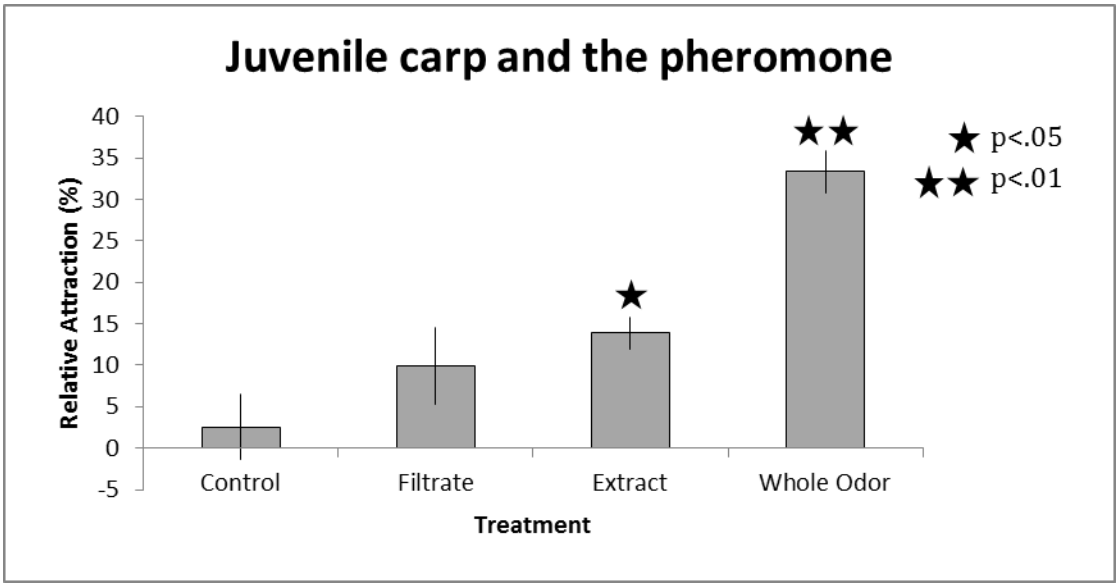


Fig. 5.1. Attractive properties of the carp pheromone and fractions thereof in lab maze tanks.

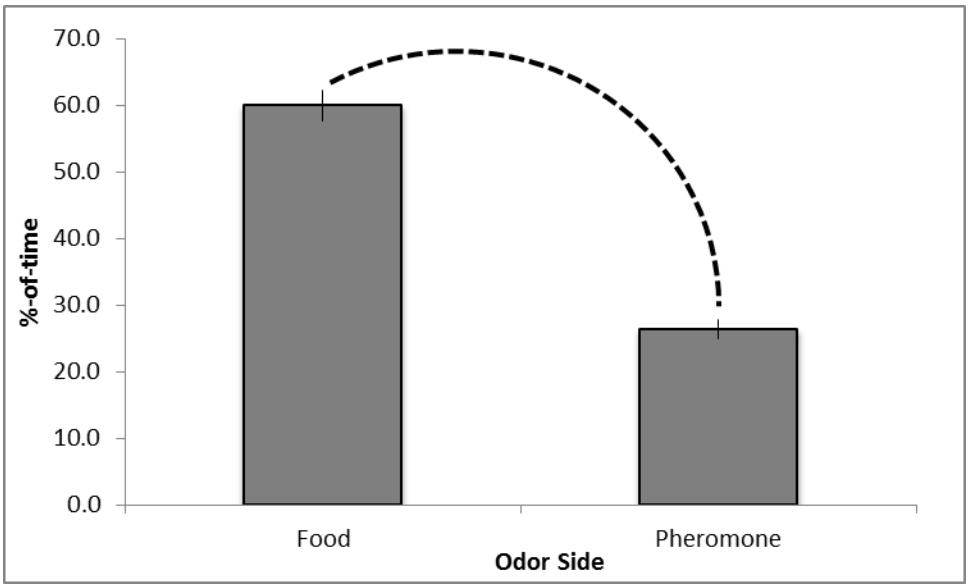


Fig. 5.2. Attractiveness of food versus pheromone odors to starved YOY carp in lab mazes

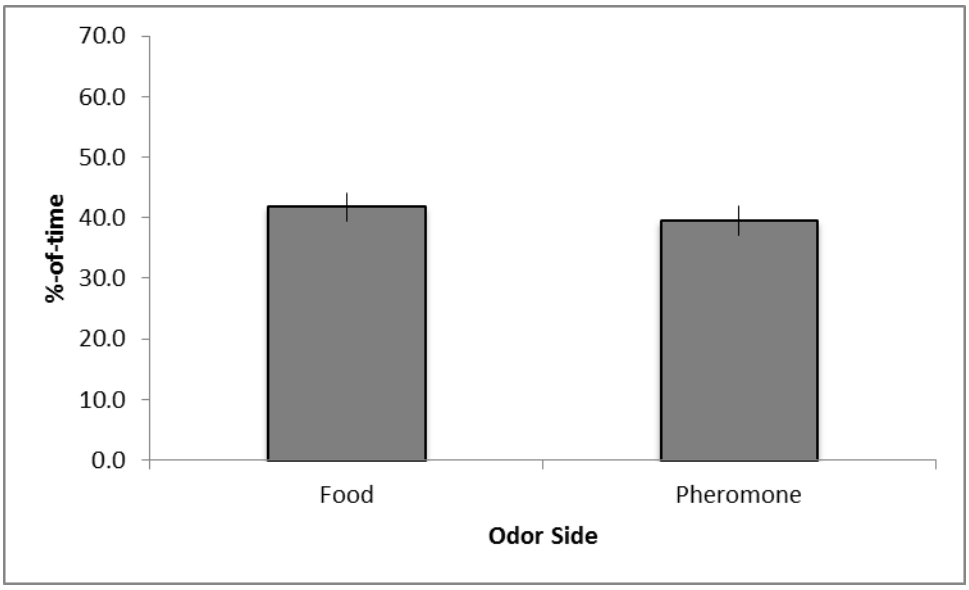


Fig. 5.3. Attractiveness of food versus pheromone odors to satiated YOY carp in lab mazes

Summary: The carp pheromone is only weakly attractive and on its own and thus appears to have little promise for field trapping. Nevertheless, because it is also used by sexually mature carp which are also highly attracted to it (Lim and Sorensen, 2011), its identity is worth pursuing for future studies.

Result 6: Developing barrier technologies to prevent spread of juvenile carp from their nurseries

Introduction: For a carp management program to be successful, tools are needed to suppress the movement of YOY carp between lakes. Trapping is of limited value (see above) and electrical barriers cannot stop upstream movement and both expensive and dangerous. This study investigated that possibility that air-bubble barriers might, through their safe and inexpensive production of sound, serve this function as carp have an unusually acute sense of hearing.

Methods & Results: Three bubble barriers were constructed and tested in rectangular troughs in the laboratory. Relatively simple bubble curtains were shown to arrest carp movement in the laboratory while causing them to jump and suppressing their feeding with 50-75% success rates (Table 6.1). Further, acoustic measurements at their dominant frequency (around 200Hz) showed that a strong acoustical pressure field is produced in front of them which both acts as a dipole source, and behaves in way that can bopth be manipulated and sensed by carp. In

particular, a field of 20 dB above background was generated up to a distance of 25 cm (10 inches) from the curtain (Fig. 6.1).

Table 6.1 Initial experimental results using acoustic fields to stop carp.

Bimodal Analysis			
Treatment	**% Pass Barrier**	**% Jump Out of Tank**	**% of Food Consumed**
Barrier Off	95%	0%	43%
Barrier On	3%	68%	3%

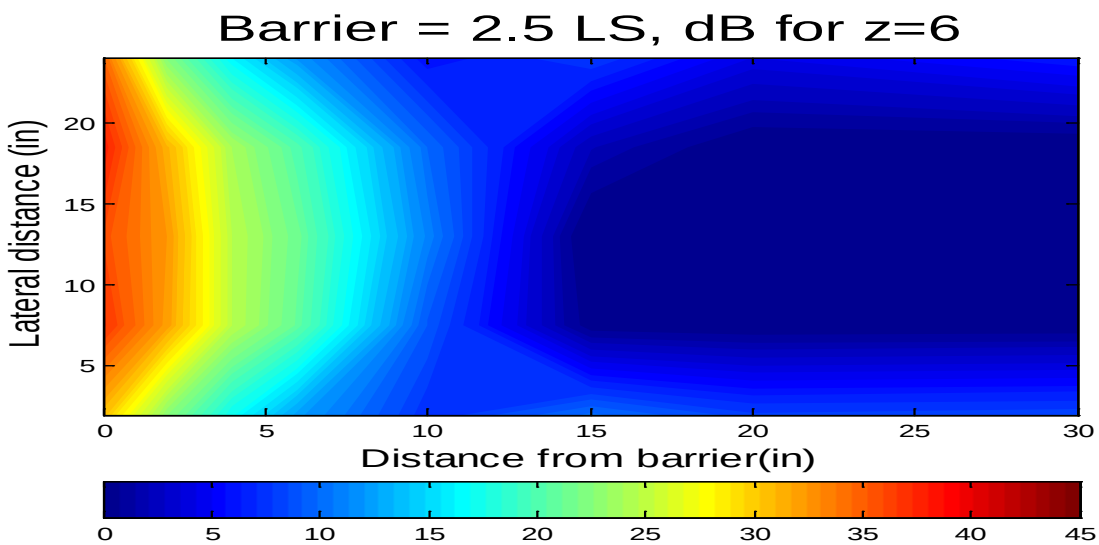


Fig. 6.1 . The spatial dB levels above background recorded six inches below the water surface for a barrier with orifices spaced 2.5 cm apart.

Summary: Bubble barriers appear to have considerable potential to deter the movement of YOY carp. Although not 100% effective, this technology is safe and inexpensive and could be applied to other species of carp. Research continues with a new LCCMR-project.

V. TOTAL TRUST FUND PROJECT BUDGET:

- *SEE ATTACHMENT A*

All results: Personnel: $417,246
All results; Equipment: $4,800
All results: Printing: $4,000
All results: Supplies: $65,954
All results: Travel:
Inside Minnesota: $25,000
Outside Minnesota: $6,000
All results: Other
Equipment repairs: $12,000
Services: $15,000
TOTAL TRUST FUND PROJECT BUDGET: $550,000

Explanation of Capital Expenditures Greater Than $3,500:
Ageing analysis (Result #3) required a low-speed diamond blade saw such as the Buehler Isomet low speed saw (http://www.buehler.com),to precisely section fish inner ear bones (otoliths) for aging. The cost estimate for the saw was furnished by a local Buehler dealer is $4,800.

VI. OTHER FUNDS & PARTNERS:

A. Project Partners:

1. Ramsey-Washington Metro Watershed District: The RWMWD paid $331,000 to cover the costs of the experimental exclosures and other materials, and one year's salary for a postdoctoral research associate to conduct Result #1. This project still continues.

2. Minnesota Department of Natural Resources, Section of Fisheries provided in-kind support for sampling lakes for Results #2 and 3.

3. Riley Purgatory Bluff Creek Watershed District (RPBCWD) provided in-kind salary support for Result #6.

4. University of Minnesota St. Anthony Falls Laboratory provided flumes for testing carp free of charge.

B. Other Funds Proposed to be spent during the Project Period:

Dr. Sorensen contributed part of his academic year salary time from the University of Minnesota to this project.

C. Past Spending:

2004-2004: Developing pheromones for use in carp control $100,000

2005-2009 Integrated and pheromonal control of carp $550,000

D. Time: July 1,2008 until June 30, 2011

We needed three years of support for this project because of its complexity and difficulty. In particular, two full field seasons (2009, 2010) were needed to investigate processes that control carp recruitment (Results 2, 3) and to allow for surveying sifficient number of lakes and account for potential year-to-year variability in recruitment. Also, because Results 4 and 5 were complex and involved both laboratory and field components that required 3 years..

VII. DISSEMINATION:

1.Publications in the peer-reviewed literature:

1. Sisler, S.P., and P.W. Sorensen. 2008. Common carp and goldfish discern conspecific identity using chemical cues. *Behaviour*. 145: 1409-1429.
2. Bajer, P.G, G.S. Sullivan, and P.W. Sorensen. 2009. Effects of a rapidly increasing population of common carp on vegetative cover and waterfowl in a recently restored Midwestern shallow lake. *Hydrobiologia* 632: 235-245.
3. Bajer, P.G, and P.W. Sorensen. 2010. The superabundance of common carp in interconnected lakes in Midwestern North America can be attributed to the propensity of adults to reproduce in outlying habitats that experience winter hypoxia. *Biological Invasions* 12: 1101-1112.
4. Bajer, P.G, H.K. .Lim, M. J. Travaline, B.D. Miller, and P.W. Sorensen. 2010 Cognitive aspects of food searching behavior in free-ranging wild common carp. *Environmental Biology of Fishes*. 88: 295-300..
5. Levesque, H., D. Scaffidi, C.A. Polkinghorne, and P.W. Sorensen 2011. A multi-component species identifying pheromone in the goldfish. *Journal of Chemical Ecology* 37(2): 219-227 (DOI 10.1007/s10886-011-9907-6)
6. Bajer, P.B., C.J. Chizinski, and P.W. Sorensen. 2011. Using the Judas technique to locate and remove wintertime aggregations of invasive common carp. *Fisheries Management and Ecology* (in press).

2. Presentations at scientific meetings (by year):

Bajer P. G., and P. W. Sorensen. 2008. Invasiveness in the common carp as a function of environmental instability and life history. Shallow Lakes Meeting, Fergus Falls, MN, USA.

Sorensen, P.W., Bajer, PB., Levesque, H., and Lim, H.K. 2008. An integrated pest management program for the common carp. Annual Midwest Fish and Wildlife Meeting, Columbus, OH.

Bajer, P. G., and P. W. Sorensen. 2009. Life history and reproductive success of common carp in Minnesota Lakes. 139th Annual Meeting of the American Fisheries Society, Nashville, TN, USA.

Sorensen .P.W. and Bajer, P.B. 2009 Integrated control of the common carp. American Fisheries society meetings, Nashville, TN

Sorensen. PW and Lim, HK 2009 lake Ecosystem and restoration, Waikato, New Zealand

Sorensen, P.W. 2009. The invasive species problem. National Caucus of Environmental Legislators, Minneapolis, MN

Sorensen, P.W. and Bajer, P.B. 2010. Integrated pest control strategies for fish. International symposium on genetic biocontrol of fish, Minneapolis, MN, June 21-24, 2010.

Sorensen, P.W. and Bajer, P.B. 2010. Sustainable removal of common carp in a model lake and its effects on water quality. Midwest Fish &Wildlife Society Meetings, Minneapolis, MN

Bajer, P. G., C. J. Chizinski, J. Silbernagel, and P. W. Sorensen. 2011. Alien versus predators: can native predators control a globally invasive fish. .Minnesota Chapter of the American Fisheries Society, Bemidji, MN, USA

Bajer, P. G., C. J. Chizinski, J. Silbernagel, J. Osborne, H. Lim, and P. W. Sorensen. 2011. Integrated Pest Management for the invasive common carp. Minnesota-Wisconsin Invasive Species Meeting, St. Paul, MN, USA

2. *Meetings with the DNR and other groups*

We have met with the DNR each year in December to discuss our project.
We meet with RWMWD and RPBCWD at least twice each year
We have been giving at least 5 talks each year to various environmental organizations (ex. Minnesota waters, Audubon, various lake associations)

3. *Media*

Minnesota Public Radio (barrier story)
Kare 11 TV (winter seining story)
Australian Broadcasting Corporation (story on carp control)
Minnesota Bound (story on carp control)

Channel 5 TV (winterkill story)
Minneapolis Star Tribune (two stories on carp control)
Milwaukee Sentinel (story on carp control)
Outdoor News (two stories on carp)
Chanhassen Villager (three stories on carp and water quality)

4. Website

http://fwcb.cfans.umn.edu/sorensen/

VIII. REPORTING REQUIREMENTS:

Periodic work program progress reports will be submitted on a biannual basis. A final work program report and associated products will be submitted between June 30 and August 1, 2011 as requested by the LCCMR

IX. RESEARCH PROJECTS:

IX RESEARCH PROJECTS

Research Addendum as Attachment B

Attachment A: Budget Detail for 2008 Projects - Summary and budget page for the University of Minnesota

Project Title: ***Accelerating plans for the integrated control of the common carp***

Project Manager Name: ***Peter W. Sorensen***

Trust Fund Appropriation: $ *550,000*

2008 Trust Fund Budget	**Result 1 Budget:**	**Amount Spent**	**Balance** 8/24/11	**Result 2 Budget:**	**Amount Spent**	**Balance** 8/24/11	**Result 3 Budget:**	**Amount Spent**	**Balance** 8/24/11	**Result 4 Budget:**	**Amount Spent**	**Balance** 8/24/11	**Result 5 Budget:**	**Amount Spent**	**Balance** 8/24/11	**Result 6 Rebudget**	**Amount Spent**	**Balance** 8/24/11	**TOTAL BUDGET**	**TOTAL BALANCE**	
	To determine if predation by native gamefish on carp eggs, larvae and fry can potentially be used to control carp recruitment in lake enclosures.			*To determine if the abundance of young-of-the-year (YOY) carp is inversely correlated with predator abundance in nursery areas following winterkills.*			*To determine whether carp age structure correlates with winterkill events*			*To determine if young-of-the-year (YOY) carp can be effectively trapped for census and/or removal using bait attractants.*			*To determine if young-of-the-year (YOY) carp can be effectively trapped for census and/or removal using pheromonal attractants.*			*Developing barrier technologies to prevent spread of juvenile carp from their nurseries12/31/2009*					
BUDGET ITEM																					
PERSONNEL: wages and benefits (TOTAL)	100,000	100,000	0	115,200	115,200	0	89,400	89,399	1	43,100	43,100	0	43,100	43,100	0	26,446	26,446	0	417,246	1	**1**
Academic salaries and fringe : Pincipal Investigator and Project Manager (10%) Co-project manager (50% time; Objectives 2,3) Postdoctoral Associate (100% time, Objective 1)	35,000	33,648	1,352	64,100	64,156	-56	46,700	36,752	9,948	14,100	10,482	3,618	14,100	7,630	6,470	2,885	2,885	0	176,885	21,332	
Graduate students salary and fringe : PhD student (Objective 4,5, 1 year) MS student (Objective 6, 25% time, 1 year)	65,000	60,909	4,091	0	0	0	0	0	0	17,700	22,787	-5,087	17,700	32,257	-14,557	23,561	23,561	0	123,961	-15,553	
Undergraduate student salary and fringe	0	3,092	-3,092	5,300	101	5,199	6,900	808	6,092	1,300	244	1,056	1,300	877	423		0	0	14,800	9,678	
Civil service salary and fringe : Field technician (50% time)	0	2,351	-2,351	45,800	50,943	-5,143	35,800	51,839	-16,039	10,000	9,587	413	10,000	2,336	7,664		0	0	101,600	-15,456	
Equipment *(saw for Csectioning carpiotoliths; i.e.aging)*	0	0	0	0	0	0	4,800	4,951	-151		0	0		0	0		0	0	4,800	-151	
Printing (*copies, publication costs)*	0	0	0	1,000	91	909	1,000	0	1,000	1,000	432	568	1,000	354	646		0	0	4,000	3,123	
Supplies (TOTAL);	0	0	0	10,600	14,566	-3,966	10,700	7,068	3,632	22,100	10,235	11,865	22,000	16,434	5,566	554	554	0	65,954	17,097	17,097
General operating supplies	0	0	0	600	305	600	2,700	0	2,700	3,100	42	3,058	3,000	21	2,979	0	0	0	9,400	9,032	
Laboratory and field supplies	0	0	0	10,000	14,261	-4,261	8,000	7,068	932	19,000	10,193	8,807	19,000	16,413	2,587	554	554	0	56,554	8,065	
Travel expenses in Minnesota (TOTAL)	0	0	0	15,000	7,283	7,717	3,000	1,056	1,944	3,500	929	2,571	3,500	394	3,106		0	0	25,000	15,339	
Fuel for dedicated field vehicle (~15,000 miles/yr)	0	0	0	14,000	7,283	6,717	2,000	1,056	944	2,000	929	1,071	2,000	394	1,606		0	0	20,000	10,339	
Vehicle rental for peak field season	0	0	0	0	0	0	0	0	0	500	0	500	500	0	500	0	0	0	1,000	1,000	
travel to local meetings	0	0	0	1,000	0	1,000	1,000	0	1,000	1,000	0	1,000	1,000	0	1,000	100	0	0	4,100	4,100	
Travel outside Minnesota *(professional acientific meetings)*	0		0	0	0	0	0	0	0	3,000	0	3,000	3,000	0	3,000		0	0	6,000	6,000	
Other: Equipment and field vehicle maintenance and repairs	0	0	0	6,400	1,933	4,467	2,600	871	1,729	1,800	0	1,800	1,200	331	869		0	0	12,000	8,865	
Other: Lab/ medical Services *St. Anthony Fall Laboratory, Chemcial anlyses of attractants*	0	0	0	0	0	0	0	0	0	4,500	518	3,982	10,500	10,529	-29	0	0	0	15,000	3,953	
COLUMN TOTAL	**$100,000**	**$100,000**	**$0**	**$148,200**	**$139,073**	**$9,127**	**$111,500**	**$103,345**	**$8,155**	**$79,000**	**$55,214**	**$23,786**	**$84,300**	**$71,142**	**$13,158**	**$27,000**	**$27,000**	**$0**	550,000	**$54,227**	$54,227
																			550,000	**54,227**	

** The principle investigator is a professor with 9 months of regular pay from the University of MN ; the 10% time is over and above that pay level and is for summer research*

*** Supplies to include:*

General operating supplies to include: Result 1: and 2: small boat gasoline and oil for boats raingear, small sampling nets, baits; Res 4 and 5: Fish traps and baits; Res 6: nets, carp , sound projection systems

Labaoratory and field supplies to include: Result 2: plankton and other fish nets, oxygen meter, small boat; Result 3: saw blades, resins, molds, microscope slides; Results 4 and 5: carp for lab work, aquarium supplies, fish food lab solvernts, glass ware, baits and related chemicals, electrodes, pheromones; Result 6: air bubblers, video cameras, carp for tests, fish food, etc

*** Professional meeting(s): Data on carp will be presented and exchanged with national and international experts at scientific meetings which will include: Annual meetng of the American Fisheries Society, International Chemical Ecology Sooiety; Midewest Fish and Wildlife Conference*

12/31/2009 rebudegte requested for Result 6. Graduate student wrok and salary had been underestmated because of well problems while supplies were overestimated

6/29/2010. Allocation for personnel reallocated within result 1 to provide funding for student after M. McDonough granted permission

8/30/2011 Notes at closeout: results 2 and 3 often used the same field supplies which results in a slight inbalance in result 2. The intial equipment budget for result 3 was not adequate to to cover a small unanticipated price increase

2008 Project Abstract
For the Period Ending June 30, 2010

PROJECT TITLE: Testing Pesticides and Degradates in Public Drinking Water
PROJECT MANAGER: John W. Hines
AFFILIATION: Minnesota Department of Agriculture
MAILING ADDRESS: 625 Robert Street North
CITY/STATE/ZIP: Saint Paul, Minnesota, 55155
PHONE: 651-201-6694
E-MAIL: john.w.hines@state.mn.us
WEBSITE: http://www.mda.state.mn.us/chemicals/pesticides/maace.aspx
FUNDING SOURCE: Environment and Natural Resources Trust Fund
LEGAL CITATION: M.L. 2008, Chp. 367, Sec. 2, Subd. 4(c)

APPROPRIATION AMOUNT: $368,000

Overall Project Outcome and Results

Pesticides are known to impact Minnesota's groundwater and there are new pesticides being developed and registered for use every year. To ensure the safe use of new pesticides it is essential to measure the concentration and frequency of their detection in the state's water resources. In addition it is critically important, for proper pesticide management, to be able to analyze water samples for the compounds parent pesticides break down into. It is only through the precise measurement of extremely small quantities of pesticides in the state's water resources that impacts to human and ecological health may be determined.

Through this project the Minnesota Department of Agriculture (MDA) laboratory acquired the necessary analytical equipment and developed appropriate analytical methods for analyzing water samples for additional new generation pesticides and their degradates in groundwater and drinking water in Minnesota. The new equipment and related methods expanded the spectrum of compounds the MDA is able to detect in water samples, increased precision of water sample analysis, and improved the overall efficiency of water sample analysis at the MDA. Furthermore, the MDA laboratory is now capable of measuring many pesticides to levels of sub parts-per-trillion in a water sample. Measures of such precision will allow the MDA to manage pesticide use to keep concentrations below levels injurious to humans or the environment.

Prior to completion of this project the MDA was able to analyze water samples for 36 pesticide parent compounds and 11 breakdown products. The new methods are able to analyze samples for 88 parent pesticides and 22 breakdown products. Before the new methods were developed the lowest measurable value for a specific pesticide was between 50 and 1000 parts-per-trillion while the laboratory is now able to measure pesticide quantities between 0.8 and 50 parts-per-trillion, depending on the specific pesticide being measured.

Sample results for monitoring conducted by the MDA during winter and spring periods in 2010 are showing interesting results. A small number of pesticides never before discovered have been detected, albeit at very low concentrations. A clearer image of the occurrence of various pesticide breakdown products is also beginning to emerge and ongoing work should provide insight to the balance between pesticide parent and degradate detections in the state's water resources. These results will also allow the MDA to more precisely determine pesticide impacts to the water resources and aid in understanding the effectiveness of recommended BMPs and other pesticide management practices.

To the degree that time and lab resources allow, the equipment purchased and methods developed through this project will also be available for use by any future publicly funded projects at no cost except standard operating expenses.

Project Results Use and Dissemination

Immediately following successful development of the new methods the MDA laboratory analyzed 100 samples from public drinking water wells across the state. These wells were selected and sampled by the Minnesota Department of Health from the available community wells that are not typically included in the US-EPA Safe Drinking Water Act pesticide monitoring requirements. As of this report results are just becoming available. Results of the testing will be made available by the Department of Health following proper notification of the participating communities.

In addition to the one time sampling of the community wells, every sample collected by the MDA monitoring program for both surface water and groundwater will be analyzed with the new methods. The first results from the MDA monitoring program samples will be published in mid 2011 as part of the program's annual water quality monitoring data report. Development of the methods and analysis of samples utilizing the methods will also be reported to the US-EPA as part of the federal reporting requirements enabling the registration of pesticides for use in the state of Minnesota.

Trust Fund 2008 Work Program Final Report

Date of Report: July 2, 2010
Date of Next Status Report: Final Report
Date of Work program Approval: June 10, 2008
Project Completion Date: June 30, 2009

I. PROJECT TITLE: **Testing Pesticides and Degradates in Public Drinking Water**

Project Manager: John W. Hines
Affiliation: Minnesota Department of Agriculture
Mailing Address: 625 Robert St. North
City / State / Zip : St. Paul, MN, 55155
Telephone Number: 651-201-6694
E-mail Address: John.W.Hines@state.mn.us
Fax Number: 651-201-6117
Web Page address: www.mda.state.mn.us

Location: Statewide

Total Trust Fund Project Budget:	**Trust Fund Appropriation:**	**$**	**368,000**
	Minus Amount Spent:	**$**	**367,511**
	Equal Balance:	**$**	**489**

Legal Citation: M.L. 2008, Chap. 367, Sec. 2, Subd. 4(c)

Appropriation Language:

$368,000 is from the trust fund to the commissioner of agriculture, in cooperation with the commissioner of health, to purchase equipment and supplies to accelerate the sampling of public water supplies for the presence and concentration of pesticides and their degradates for health risk assessments.

II and III. FINAL PROJECT SUMMARY:

Pesticides are known to impact Minnesota's groundwater and there are new pesticides being developed and registered for use every year. To ensure the safe use of new pesticides it is essential to measure the concentration and frequency of their detection in the state's water resources. In addition it is critically important, for proper pesticide management, to be able to analyze water samples for the compounds parent pesticides break down into. It is only through the precise measurement of extremely small quantities of pesticides in the state's water resources that impacts to human and ecological health may be determined.

Through this project the Minnesota Department of Agriculture (MDA) laboratory acquired the necessary analytical equipment and developed appropriate

analytical methods for analyzing water samples for additional new generation pesticides and their degradates in groundwater and drinking water in Minnesota. The new equipment and related methods expanded the spectrum of compounds the MDA is able to detect in water samples, increased precision of water sample analysis, and improved the overall efficiency of water sample analysis at the MDA. Furthermore, the MDA laboratory is now capable of measuring many pesticides to levels of sub parts-per-trillion in a water sample. Measures of such precision will allow the MDA to manage pesticide use to keep concentrations below levels injurious to humans or the environment.

Prior to completion of this project the MDA was able to analyze water samples for 36 pesticide parent compounds and 11 breakdown products. The new methods are able to analyze samples for 88 parent pesticides and 22 breakdown products. Before the new methods were developed the lowest measurable value for a specific pesticide was between 50 and 1000 parts-per-trillion while the laboratory is now able to measure pesticide quantities between 0.8 and 50 parts-per-trillion, depending on the specific pesticide being measured.

Immediately following successful development of the new methods the MDA laboratory analyzed 100 samples from public drinking water wells across the state. These wells were selected and sampled by the Minnesota Department of Health from the available community wells that are not typically included in the US-EPA Safe Drinking Water Act pesticide monitoring requirements. As of this report results are just becoming available. Results of the testing will be made available by the Department of Health following proper notification of the participating communities.

In addition to the one time sampling of the community wells, every sample collected by the MDA monitoring program for both surface water and groundwater will be analyzed with the new methods. The first results from the MDA monitoring program samples will be published in mid 2011 as part of the program's annual water quality monitoring data report. Development of the methods and analysis of samples utilizing the methods will also be reported to the US-EPA as part of the federal reporting requirements enabling the registration of pesticides for use in the state of Minnesota.

Sample results just in for monitoring conducted by the MDA during winter and spring periods in 2010 are showing interesting results. A small number of pesticides never before discovered have been detected, albeit at very low concentrations. A clearer image of the occurrence of various pesticide breakdown products is also beginning to emerge and ongoing work should provide insight to the balance between pesticide parent and degradate detections in the state's water resources. These results will also allow the MDA to more precisely determine pesticide impacts to the water resources and aid in understanding the effectiveness of recommended BMPs and other pesticide management practices.

To the degree that time and lab resources allow, the equipment purchased and methods developed through this project will also be available for use by any future publicly funded projects at no cost except standard operating expenses.

IV. OUTLINE OF PROJECT RESULTS*:*

Result 1:
Develop bid specs, post bid and procure new equipment.

Description: The new analytical equipment provides molecular weight information, chemical structure information, and quantitative information for a wide range of compounds. The equipment consists of a tandem quadrapole mass spectrometer, atmospheric pressure ionization high pressure liquid chromatography interface, a photomultiplier detector, and other associated high level equipment and software needed to complete the analytical package. Exact specifications of the system are available from the MDA.

Summary Budget Information for Result 1: **Trust Fund Budget: $364,000**
Amount Spent: $364,000
Balance: $ 0

Deliverable	***Completion Date***	***Budget***	***Status***
1. Specifications	July 15, 2008	$0	Complete
2. Posting of bid	July 22, 2008	$0	Complete
3. Receive bids	August 10, 2008	$0	Complete
4. Review and select bid proposal	August 17, 2008	$0	Complete
5. Purchase equipment	September 1, 2008	$364,000	Complete

Completion Date: *October 1, 2008*

Final Report Summary: Following review of newly available equipment the originally proposed instrument was purchased and delivered. We purchased the originally proposed unit because it was the best we could get with the available funds. The purchased instrument came in at a final cost of $375,841.62, slightly higher than the project proposal. MDA laboratory operating funds covered the remaining cost of $11,842.

Result 2:
Set up equipment and develop Montana method in MDA lab.

Description: The Montana method is now available to the MDA. Analyses of pesticide parent materials and breakdown products now require two samples rather than three and many more pesticides are now available for analysis. We were anticipating being able to reduce the number of samples to one and discovered that would be insufficient for the desired number of analytes. Many high priority pesticide

parent compounds and degradation products that were not available in the old methods are in the new method.

Summary Budget Information for Result 1:	**Trust Fund Budget:**	**$4,000**
	Amount Spent:	**$3,511**
	Balance:	**$489**

Deliverable	***Completion Date***	***Budget***	***Status***
1. Uncrate and setup new analytical equipment	October 14, 2008	$0	Complete
2. Test and training on new analytical equipment	October 21, 2008	$0	Complete
3. Method development	January 21, 2009	$4000	Complete
4. Validate method	April 21, 2009	$0	Complete
5. Train analysts	May 21, 2009	$0	Complete
6. Method available	May 22, 2009	$0	Complete

Completion Date: June 30, 2009

Final Report Summary: The equipment has been set up and is operational. The development of analytical methods is complete. The new methods have been built into the machine's operational software. Validation of all chemical analytes currently available for the method is complete although additional capabilities continue to be discovered. As of August 2010 the method had 83 validated analytes as compared to the previous roughly 30 that were available for analyses of water samples. Chemical analytes are likely to be added to the method for several years as the full power of the instrumentation is realized and staff operational experience and knowledge grows. Ongoing efforts to continuously improve the performance of both the machine and analysts will last as long as the machine is operational.

V. TOTAL TRUST FUND PROJECT BUDGET:

Staff or Contract Services:
Equipment: $364,000
Development: $
Restoration: $
Acquisition, including easements: $
Other: $4,000 (analytical supplies)

TOTAL TRUST FUND PROJECT BUDGET: $368,000.00

Explanation of Capital Expenditures Greater Than $3,500:
Expenditure of $364,000 for laboratory analytical equipment, specifically an HPLC-API-MS-MS (mass spectrometer for analyzing water samples).

VI. OTHER FUNDS & PARTNERS:

A. Project Partners: Minnesota Department of Health

B. Other Funds Proposed to be Spent during the Project Period:

Approximately $50,000 of staff time and supplies for equipment set up and method development.

C. Past Spending:$ 0

D. Time: 1000 hours of in-kind services by an MDA Environemtntal Analyst 3 for the set-up of the equipment and development of the Montana method in the MDA lab.

VII. DISSEMINATION: Project outcomes will be disseminated via the MDA Monitoring Program Annual Report and reports to the LCCMR.

VIII. REPORTING REQUIREMENTS:
Periodic work program progress reports have been submitted on the schedule below beginning October 1, 2008. A final work program report and associated products was submitted prior to August 16, 2010.

Progress Reports:
October 1, 2008
March 1, 2009
August 16, 2010 (final)

IX. RESEARCH PROJECTS:

Attachment A: Budget Detail for 2008 Projects - Summary and a Budget page for each partner (if applicable)

Project Title: *Testing Pesticides and Degradates in Public Drinking Water*

Project Manager Name: *John W. Hines*

Trust Fund Appropriation: $ *368,000*

1) See list of non-eligible expenses, do not include any of these items in your budget sheet

2) Remove any budget item lines not applicable

2008 Trust Fund Budget	**Result 1 Budget:**	**Amount Spent** *(03/01/2009)*	**Balance** *(03/01/2009)*	**Result 2 Budget:**	**Amount Spent** *(03/01/2009)*	**Balance** *(03/01/2009)*	**Result 3 Budget:**	**Amount Spent** *(03/01/2009)*	**Balance** *(03/01/2009)*	**TOTAL BUDGET**	**TOTAL BALANCE**
	Develop bid specs, post bid and procure new equipment			*Set up equipment and develop method in MDA lab*			*Fill in your result title here.*				
BUDGET ITEM			0			0			0	0	0
PERSONNEL: wages and benefits			0			0			0	0	0
Contracts			0			0			0	0	0
Professional/technical *(with whom?, for what?)*			0			0			0	0	0
Other contracts *(with whom?, for what?) list out: personnel, equipment, etc.*			0			0			0	0	0
Other direct operating costs *(for what? – be specific)*			0			0			0	0	0
Equipment / Tools *(what equipment? Give a general description and cost)*	UPLC-MS/MS $364,000	$364,000	$0			0			0	364,000	0
Office equipment & computers - NOT ALLOWED unless unique to the project			0			0			0	0	0
Other Capital equipment *(list specific items)*			0			0			0	0	0
Land acquisition			0			0			0	0	0
Land rights acquisition *(less than fee)*			0			0			0	0	0
Professional Services for Acq.			0			0			0	0	0
Printing			0			0			0	0	0
Other Supplies *(list specific categories)*			0	Lab supplies $4000	$3,511	$489			0	4,000	489
Travel expenses in Minnesota			0			0			0	0	0
Travel outside Minnesota *(where?)*			0			0			0	0	0
Construction *(for what?)*			0			0			0	0	0
Other land improvement *(for what?)*			0			0			0	0	0
Other *(Describe the activity and cost) be specific*			0			0			0	0	0
COLUMN TOTAL	**$364,000**	**$364,000**	**$0**	**$4,000**	**$3,511**	**$489**	**$0**	**$0**	**$0**	**$368,000**	**$489**

2008 Project Abstract

For the Period Ending June 30, 2010

PROJECT TITLE: Install Riparian Buffers in the Whitewater River Watershed

Project Manager: Megan Kranz-McGuire
Affiliation: Whitewater Joint Powers Board
Mailing Address: 400 Wilson St, PO Box 39
City / State / Zip : Lewiston, MN 55952
Telephone Number: 507-523-2171 ext. 110
E-mail Address: whitewaterwatershed@gmail.com
Web Page address: whitewaterwatershed.org

Legal Citation: M.L. 2008, Chap. 367, Sec. 2, Subd. 4(d)

Appropriation Language:
$52,000 is from the trust fund to the Board of Water and Soil Resources for an agreement with the Whitewater Joint Powers Board to inventory streams and adjacent land use and survey riparian landowners to assist in the prioritization of restoration efforts to improve water quality, habitat, and future enforcement of riparian buffers in the southeast ten-county region of the Southeast Minnesota Water Resources Board.

Appropriation Amount: $52,000

Overall Project Outcome and Results

Riparian buffers can provide significant water quality benefits by filtering contaminants such as nitrate, phosphorus, sediment, and pesticides from surface runoff. In addition, buffers stabilize streambanks, enhance riparian and in-stream habitat, and provide landscape connectivity. The DNR's Shoreland Rule requires that landowners maintain a 50 foot buffer of perennial vegetation on public waters. According to previous BWSR estimates, 50% or more of the buffer area in some counties was cropped. Local officials have often struggled to increase compliance with the buffer rule because they did not know the extent and locations of un-buffered streams. This project eliminated that barrier by mapping land use along all public waters in the ten county region of Southeast Minnesota.

a. Mapping

The Whitewater River Watershed Project contracted with Cannon River Watershed Partnership to produce the maps. The mapping process utilized aerial photography and a Geographic Information System (GIS) to conduct an assessment and analysis of existing stream courses, channels and land use within shoreland areas. The assessment included all perennial streams within the 10-county region and utilized post flood aerial photos where available. Land cover adjacent to protected waters in all participating counties was also identified based on aerial photo interpretation.

From this assessment and analysis, two GIS shapefiles were created for each county: a retraced stream layer and a shoreland layer, which maps the land use within 300 feet of the center line of streams.

A total of 3,800 linear miles of streams were mapped, equaling 430 square miles of buffer area. Approximately 60,000 individual polygons were traced, representing 40 unique land uses. These detailed maps show that a much smaller area is being cropped than previously estimated. All counties had 50 foot buffers on at least 90% of their streams.

All GIS files are available to the public on the CRWP website. However, some experience with GIS is necessary to successfully utilize this data. For non-GIS users, contacting your County for maps they have produced using this data will be more efficient.

b. Surveys and Focus Groups

In addition to mapping shoreland land use, the project also conducted landowner surveys and focus groups to 1) explore the barriers to buffer adoption, 2) identify opportunities for establishing and maintaining buffers, and 3) explore what actions would increase adoption of these buffers. Reports summarizing the survey and focus group results are available.

Many counties are moving forward to address areas that lack shoreland buffers. Goodhue is implementing a “Hayable Buffer” program, Olmsted has sent out letters to landowners that are out of compliance, Winona is developing a buffer plan, and additional counties are making progress to ensure all streams are protected by perennial buffers.

Project Results Use and Dissemination

The results of the mapping, surveys, and focus groups were presented and discussed at regional meetings including the Basin Alliance of the Lower Mississippi in Minnesota, the Southeast Water Resources Board, and the Southeast Minnesota Association of County Planning and Zoning Administrators. The maps and land use summary statistics are available on the CRWP website (http://www.crwp.net/Programs/Conservation/ShorelandMapping/ShorelandMapping.html). The project was discussed in a July 8th, 2010 article in AgriNews, a newspaper that reaches many farmers in Southeast Minnesota.

In addition to county staff and commissioners, others are using the data for a variety of purposes related to water quality. Minnesota Pollution Control Agency staff is using the maps to help identify stressors to the ecology of streams in the Root River Watershed, and the Fillmore SWCD is using the data to help identify gullies in pastures adjacent to streams. The data can also be used to assess habitat connectivity.

Trust Fund 2008 Work Program Final Report

Date of Report: August 16, 2010
Date of Next Status Report: Final Report
Date of Work program Approval: June 30, 2008
Project Completion Date: June 30, 2010

I. PROJECT TITLE: Install Riparian Buffers in the Whitewater River Watershed

Project Manager: Megan Kranz-McGuire
Affiliation: Whitewater Joint Powers Board
Mailing Address: 400 Wilson St, PO Box 39
City / State / Zip : Lewiston, MN 55952
Telephone Number: 507-523-2171 ext. 110
E-mail Address: whitewaterwatershed@gmail.com
Fax Number: 507-523-3717
Web Page address: whitewaterwatershed.org

Location: Winona, Wabasha, Olmsted, Steele, Rice, Dodge, Fillmore, Goodhue, Houston, and Mower Counties. See attached map.

Total Trust Fund Project Budget:	**Trust Fund Appropriation:**	**$**	**52,000**
	Minus Amount Spent:	**$**	**51,750**
	Equal Balance:	**$**	**250**

Legal Citation: M.L. 2008, Chap. 367, Sec. 2, Subd. 4(d)

Appropriation Language:
$52,000 is from the trust fund to the Board of Water and Soil Resources for an agreement with the Whitewater Joint Powers Board to inventory streams and adjacent land use and survey riparian landowners to assist in the prioritization of restoration efforts to improve water quality, habitat, and future enforcement of riparian buffers in the southeast ten-county region of the Southeast Minnesota Water Resources Board.

II. and III. FINAL PROJECT SUMMARY:

Overall Project Outcome and Results

Riparian buffers can provide significant water quality benefits by filtering contaminants such as nitrate, phosphorus, sediment, and pesticides from surface runoff. In addition, buffers stabilize streambanks, enhance riparian and in-stream habitat, and provide landscape connectivity. The DNR's Shoreland Rule requires that landowners maintain a 50 foot buffer of perennial vegetation on public waters. According to previous BWSR estimates, 50% or more of the buffer area in some counties was cropped. Local officials have often struggled to increase compliance with the buffer rule because they did not know the extent and locations of un-buffered streams. This project eliminated that

barrier by mapping land use along all public waters in the ten county region of Southeast Minnesota.

The Whitewater River Watershed Project contracted with Cannon River Watershed Partnership to produce the maps. Two GIS shapefiles were created for each county: a retraced stream layer and a shoreland layer, which maps the land use within 300 feet of the center line of streams. A total of 3,800 linear miles of streams were mapped, equally 430 square miles of buffer area. Approximately 60,000 individual polygons were traced, representing 40 unique land uses. All GIS files are available to the public on the CRWP website. These detailed maps show that a much smaller area is being cropped than previously estimated. All counties had 50 foot buffers on at least 90% of their streams.

In addition to mapping shoreland land use, the project also conducted landowner surveys and focus groups to 1) explore the barriers to buffer adoption, 2) identify opportunities for establishing and maintaining buffers, and 3) explore what actions would increase adoption of these buffers. Reports summarizing the survey and focus group results are available.

Many counties are moving forward to address areas that lack shoreland buffers. Goodhue is implementing a “Hayable Buffer” program, Olmsted has sent out letters to landowners that are out of compliance, Winona is developing a buffer plan, and additional counties are making progress to ensure all streams are protected by perennial buffers.

Project Results Use and Dissemination

The results of the mapping, surveys, and focus groups were presented and discussed at regional meetings including the Basin Alliance of the Lower Mississippi in Minnesota, the Southeast Water Resources Board, and the Southeast Minnesota Association of County Planning and Zoning Administrators. The maps and land use summary statistics are available on the CRWP website (http://www.crwp.net/Programs/Conservation/ShorelandMapping/ShorelandMapping.html). The project was discussed in a July 8th, 2010 article in AgriNews, a newspaper that reaches many farmers in Southeast Minnesota.

In addition to county staff and commissioners, others are using the data for a variety of purposes related to water quality. Minnesota Pollution Control Agency staff is using the maps to help identify stressors to the ecology of streams in the Root River Watershed, and the Fillmore SWCD is using the data to help identify gullies in pastures adjacent to streams. The data can also be used to assess habitat connectivity.

IV. OUTLINE OF PROJECT RESULTS*:*

Result 1: Assess Stream Channels and Adjacent Land Use

Description: The project team will assess perennial streams within the 10-county region utilizing post flood aerial photos where available. Land cover adjacent to protected waters in all participating counties will be identified based on aerial photo

interpretation. A temporary staff person will be hired to utilize aerial photography and GIS to conduct an assessment and analysis of existing stream courses, channels and land use within shoreland areas.

Summary Budget Information for Result 1: **Trust Fund Budget: $ 40,100**
Amount Spent: $ 39,999
Balance: $ 101

Deliverable	Completion Date	Budget	Status
1. Assess riparian landuse and stream channels on perennial streams in 3 participating counties in the 10-county SE MN region.	January 31, 2009	20,000	16,540
2. Complete assessment of riparian landuse and stream channels on perennial streams in all participating counties in the 10-county SE MN region.	January 31, 2010	15,900	20,459
3. Compile maps and reports for each watershed organization and county.	June 30, 2010	4,000	3,000

Completion Date: June 30, 2010

Final Report Summary: August 16, 2010

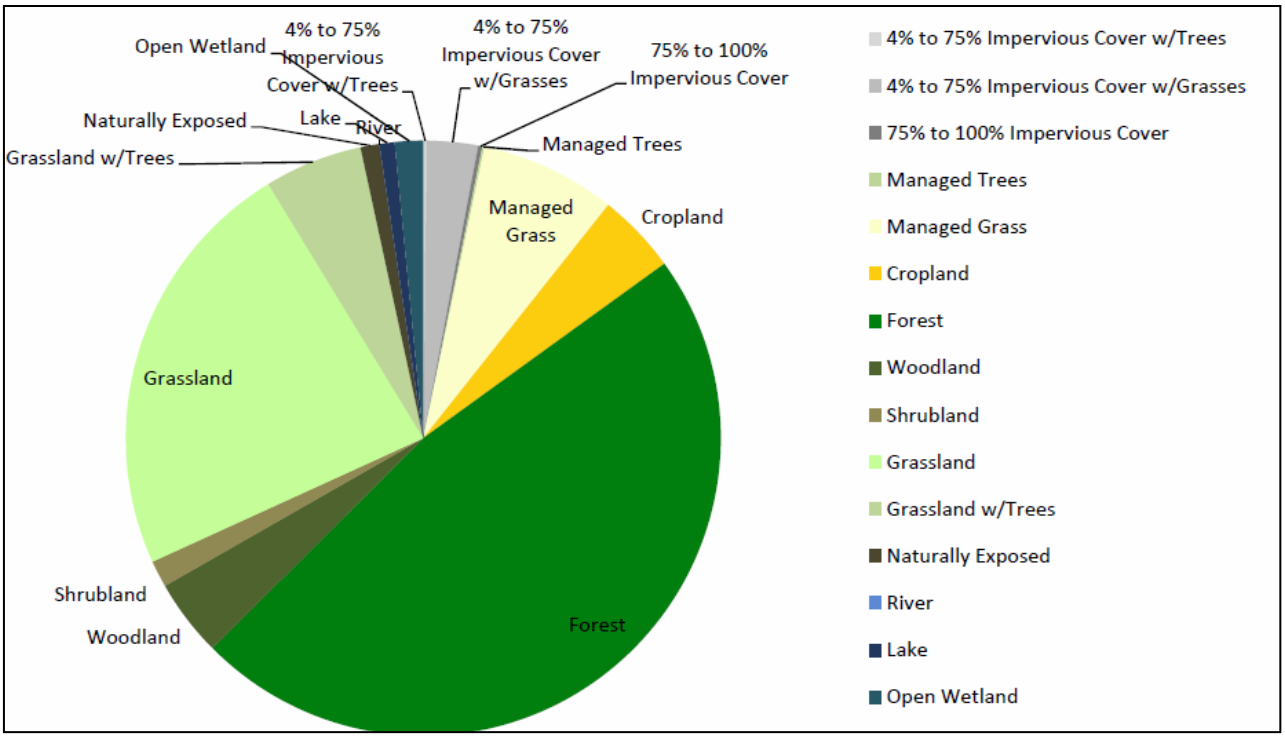
All ten counties were completed as planned. Two GIS shapefiles were created for each county: 1) a retraced stream layer, which corrects inaccuracies in the DNR's public waters stream layer, and 2) a shoreland land use layer, which maps the land use within 300 feet of the center line of the streams. All GIS files are available to the public on the Cannon River Watershed Partnership website (http://www.crwp.net/download.html). County Zoning and Planning staff, SWCD staff, and others are able to download and utilize the maps.

New stream layers were necessary because existing layers were traced from USGS Quads. Sometimes the stream lines were many meters off the actual stream locations due to poor resolution of source data, inaccuracies in digitizing the quads, and changes in stream channels due to flooding or siltation. Very precise stream layers were needed to accurately map the 300 foot buffer area. The new stream layers were created using 2008 FSA NAIP one-meter aerial photography, Lidar topographic layers, and additional information where available.

To create the land use maps, a 300 foot buffer was created around the corrected stream layer. Data was digitized from 2008 FSA aerial photography and coded using a subset of the Minnesota Land Cover Classification System. Data is meant to reflect very basic land use information (eg. forest, grassland, cropland, etc.) within 300 feet of DNR-protected river and stream centerlines for a given county. The data has not been

verified in the field. A total of 3800 linear miles of streams were mapped, equally 430 square miles of buffer area. Approximately 60,000 individual polygons were traced, representing 40 unique land uses.

Two summary reports were compiled and are also available on CRWP's website. One provides summary statistics for land use in the 300 foot shoreland area, and the other provides summary statistics for land use in the 50 foot shoreland area. Region-wide, less than 5% of the area within the 50 foot shoreland buffer is cropped with annuals. In the ten county area, the 50 foot buffer area is composed of: 48% forest, 23% grassland, 7% managed grassland, 4% woodland, and several other land uses with less than 4% coverage. These coverage statistics are estimates, but provide data at a much finer scale than earlier reports, which listed cropped riparian buffer area in Mower County, for example, as high as 56% (BWSR, "Cultivated Riparian Zone Estimates").



Result 2: Landowner Survey and Focus Groups

Description: Develop and administer a survey of riparian landowners with the purpose of identifying the barriers and benefits associated with converting riparian areas from cropland to perennial vegetation. Convene a focus group of riparian landowners to determine the means of eliminating barriers to buffer development.

Summary Budget Information for Result 2:	**Trust Fund Budget:**	**$ 11,900**
	Amount Spent:	**$ 11,751**
	Balance:	**$ 149**

Deliverable	**Completion Date**	**Budget**	**Status**
1. Develop and administer a	March 31, 2009	8,100	4,500

	survey to riparian landowners to I.D. barriers and benefits to riparian buffer adoption.			
2.	Convene a focus group of riparian landowners to determine the means of eliminating barriers.	February 28, 2010	3,000	6,400
3.	Assemble a report summarizing the survey and focus group findings	June 30, 2010	1,000	1,000

Completion Date: June 30, 2010

Final Report Summary: August 16, 2010

The landowner surveys were intended to identify barriers to vegetative buffer adoption and to determine landowner education and assistance needs. The survey was completed in November 2009. Survey questions were developed with an advisory committee and piloted with a small group of landowners to test the workability of the survey. Out of a total of 600 mailed surveys, 282 were returned. The Southeast Minnesota Water Resources Board staff compiled the survey responses and produced a report describing the results. Survey responses are tabulated in an Excel format, as well as analyzed in the written report.

Survey results show that 70% of respondents are aware that the stream on their property is classified as public waters, but only 43% know that their county requires that agricultural lands have a 50 ft. buffer of perennial vegetation next to rivers and streams. In Goodhue County only 28% of respondents were aware that their county requires a 16 1/2 foot buffer of perennial vegetation next to ditches, although this question was worded poorly and did not specify public ditches. A majority of respondents (56%) are aware that under state and county shore land law they can hay, pasture, or manage their shore land buffer as they see fit, as long as it is maintained in permanent vegetation. The survey results indicate the three greatest barriers for land owners to voluntarily plant and maintain a 50' buffer along streams are maintenance cost and time (22%), lack of information regarding shoreland buffer requirements (22%), and reduced row crop production (19%).

Two landowner focus group sessions were held in Southeastern Minnesota during March, 2010. The intent of the focus groups was to: 1) explore the barriers to buffer adoption, 2) identify opportunities for establishing and maintaining buffers, and 3) explore what actions would increase adoption of these buffers. Several prevalent themes came up in both focus group sessions: 1) a whole watershed and whole farm approach should be utilized in considering the establishment of buffers, 2) the cost of installing and maintaining buffers needs to be addressed, and 3) there is a definite interest in streamlining the process related to buffers. The detailed landowner responses are compiled in the focus group report.

V. TOTAL TRUST FUND PROJECT BUDGET:

Staff or Contract Services: $47,090
Equipment:
Development: $
Restoration: $
Acquisition, including easements: $
Other: $4,910

TOTAL TRUST FUND PROJECT BUDGET: $52,000

Explanation of Capital Expenditures Greater Than $3,500:

VI. OTHER FUNDS & PARTNERS:

A. Project Partners: Southeast Minnesota Water Resources Board; Winona State University, Cannon, Zumbro and Root Watershed staff; County Water Planners; SWCD staff; MPCA; MDNR; Olmsted County Environmental Commission and Township Officers.

Cannon River Watershed Partnership: $35,949 for GIS mapping.

Southeast Water Resources Board: $9,381 for landowner surveys and focus groups.

B. Other Funds Spent during the Project Period: Cannon River Watershed Partnership received funding from MPCA to educate local officials about the shoreland ordinance, $50,000. This education was conducted by Ross Hoffman, which helped build relationships and inform staff and local officials about the county maps. Olmsted County, in partnership with Olmsted SWCD, is currently undertaking a county-wide buffer enforcement project. This project is consuming considerable staff time and resources to bring all landowners into compliance with the buffer requirement. The Zumbro Watershed Partnership received a grant from Minnesota Water Continuation Partnership Grant for $5,000 to provide direct education to out-of-compliance shoreland landowners in the Zumbro about the shoreland rule, the benefits of buffers, and incentive programs. The ZWP has produced a brochure for landowners and will be hosting educational workshops in the coming months.

C. Past Spending: *none*

D. Time: *no additional time needed*

VII. DISSEMINATION: Maps of riparian buffer land use are available for download through the Cannon River Watershed Partnership website. Counties, SWCDs, and other agencies have been notified of their availability. Summary statistics of land use in the 300 foot buffer and 50 foot buffer are also available on the CRWP website. Information on the maps and the landowner surveys and focus groups were distributed at multiple regional meetings including the Basin Alliance of the Lower Mississippi in Minnesota, the Southeast Water Resources Board, and the

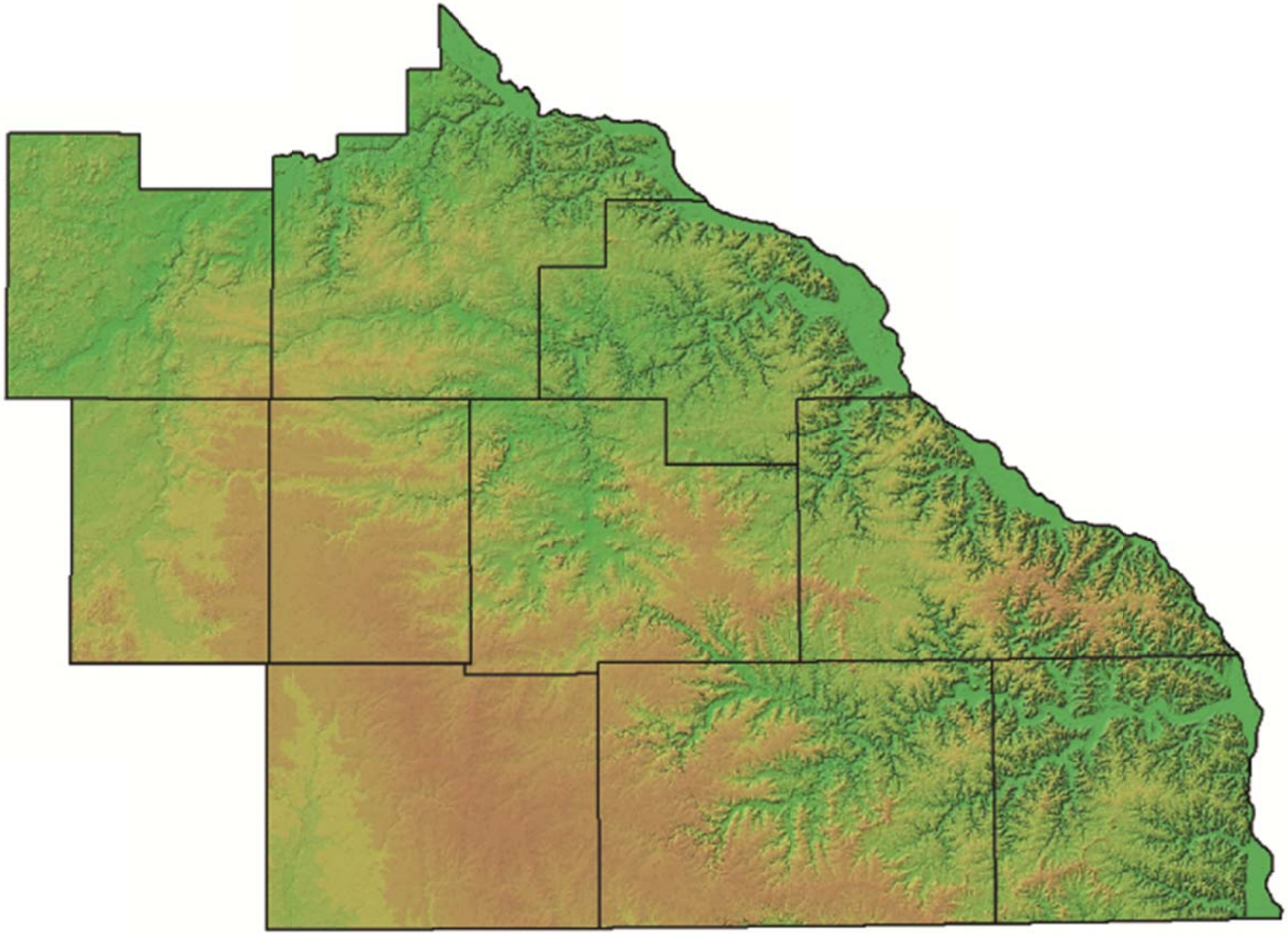
Southeast Minnesota Association of County Planning and Zoning Administrators. Reports will also be made available on the Whitewater Watershed web site soon.

VIII. REPORTING REQUIREMENTS:
Periodic work program progress reports will be submitted not later than February 1 2009, August 1 2009, February 1 2010. A final work program report and associated products will be submitted between June 30 and August 16, 2010 as requested by the LCCMR

IX. RESEARCH PROJECTS: *N/A*

ATTACHMENTS: CRWP Shoreland Mapping Presentation
50 Ft. Shoreland Area Land Use Statistics
300 Ft. Shoreland Area Land Use Statistics

Dodge - Fillmore - Goodhue - Houston - Mower



Olmsted - Steele - Rice - Wabasha - Winona

Whitewater Watershed Project
Megan Kranz-McGuire
whitewaterwatershed@gmail.com
400 Wilson, PO Box 39
Lewiston, MN 55952
(507) 523-2171

Southeast Minnesota Shoreland Buffer Assessment

Funded by an Environmental and Natural Resources Trust Fund Grant to the
Whitewater River Watershed Project

Mapping conducted by Ross Hoffman, Cannon River Watershed Partnership

Survey and Focus Groups conducted by Linda Dahl, Southeast Water Resources Board

Project Summary

The Southeast Shoreland Buffer Assessment Project consisted of three parts: 1) GIS mapping of riparian area land use conducted by Ross Hoffman of the Cannon River Watershed Partnership, 2) landowner surveys, and 3) landowner focus groups conducted by Linda Dahl of the Southeast Water Resources Board.

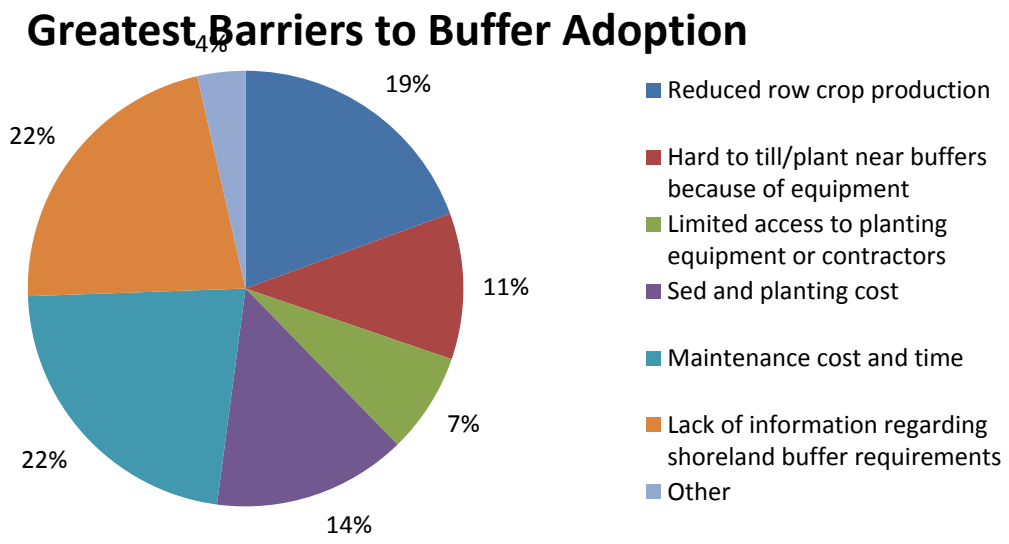
The shoreland mapping component of the project used aerial photos to digitally map the different land uses within SE Minnesota's public water's shoreland. The GIS data and summary reports are available on the CRWP website. Region-wide, 4.34% of land within 50 feet of public waterways is cropped, and 21.39% of land within 300 feet of waterways is cropped. The maps can be used to identify locations needing additional perennial vegetation buffers, and can be utilized for other water quality enhancement projects, such as locating sites of erosion in pasture or enhancing wildlife corridors.

The landowner surveys were intended to identify barriers to vegetative buffer adoption and to determine landowner education and assistance needs. Goodhue, Olmsted, and Winona Counties were selected for the survey. 200 surveys were sent per county to landowners with parcels that contained public waters. Of the 282 surveys returned, 109 were from Olmsted County, 85 from Winona County and 88 from Goodhue County.

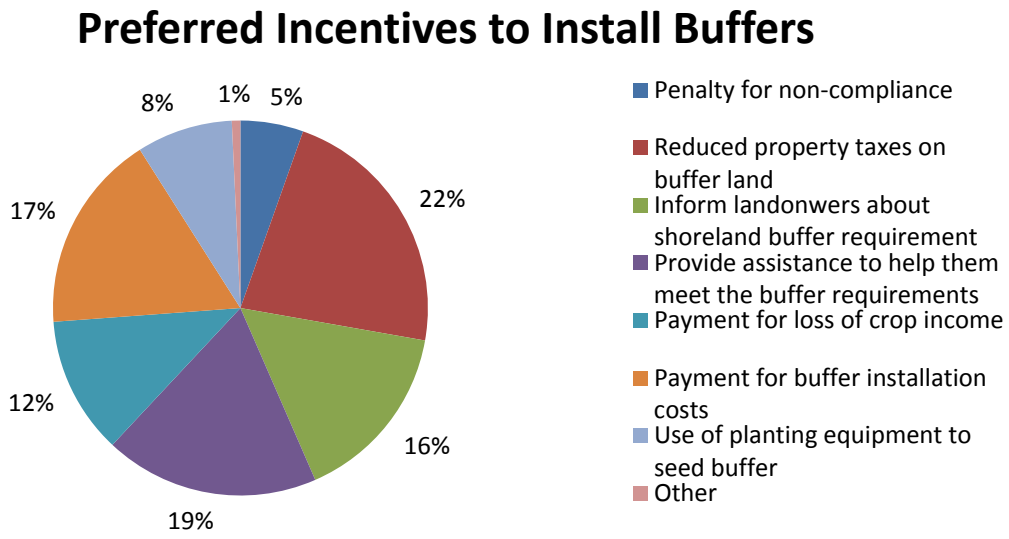
Two landowner focus group sessions were held in Southeastern Minnesota during March, 2010. The intent of the focus groups was to: 1) explore the barriers to buffer adoption, 2) identify opportunities for establishing and maintaining buffers, and 3) explore what actions would increase adoption of these buffers. The summary results are listed below. Detailed reports can be requested by contacting the Whitewater Watershed Project.

Highlights of Survey Data:

- 43% of landowners did not know that their county requires that agricultural lands have a 50 ft. buffer of perennial vegetation next to rivers and streams.
- 44 % of landowners were not aware that under state and county shoreland law they can hay, pasture, or manage their shoreland buffer as they see fit, as long as it is maintained in permanent vegetation.
- Landowners were asked to choose the three greatest barriers to buffer adoption from a list. The chart below shows the percentage of total responses for each category.



- Landowners were asked to select all incentives that would encourage installation of buffers. The chart below shows the percentage of total responses for each category.



Summary of Focus Group Themes:

Several prevalent themes came up in both focus group sessions: 1) a whole watershed and whole farm approach should be utilized in considering the establishment of buffers, 2) the cost of installing and maintaining buffers needs to be addressed, and 3) there is a definite interest in streamlining the process related to buffers.

Additional common themes included the following:

Rule Education/Enforcement

- Farmers want consistency in rule enforcement. ("Why should I maintain a buffer if my neighbor doesn't maintain his?")
- The need for additional education was a reoccurring theme. Participants stated that they did not understand what was permitted and what was not permitted in the buffer area (haying, burning, pesticide applications, mowing, etc.).
- Maintenance is an ongoing need. Landowners need information on maintenance issues such as burning, grazing, and herbicides that can be used near water bodies.

Technical and financial assistance

- Participants suggested that the county, SWCD, and NRCS coordinate services so landowners can get all the information they need at one office.
- Participants suggested trying unconventional approaches such as tours, maintenance demonstrations, or videos
- One size does not fit all situations. Landowners prefer flexibility: buffer width should vary depending on factors such as field operability, slope, and erosion potential.
- Landowners desire financial assistance for seed cost, no-till drill rental, and land rental rates.
- Tax reductions would provide financial relief for loss of crop production.

Survey Results

Of the 282 surveys returned, 109 were from Olmsted County, 85 from Winona County and 88 from Goodhue County, and 80% of the surveys returned were from individuals over the age of 50.

Results show that 70% of respondents are aware that the stream on their property is classified as public waters, but only 43% know that their county requires that agricultural lands have a 50 ft. buffer of perennial vegetation next to rivers and streams. In Goodhue County only 28% of respondents were aware that their county requires a 16 1/2 foot buffer of perennial vegetation next to ditches, although this question was worded poorly and did not specify public ditches. A majority of respondents (56%) are aware that under state and county shore land law they can hay, pasture, or manage their shore land buffer as they see fit, as long as it is maintained in permanent vegetation.

In terms of water quality, 76% of respondents think the water quality in the stream on their property is good or excellent. The most common recreational activities respondents said they engage in include wildlife observation, fishing and swimming/wading. The most common agricultural activities respondents indicated they use their stream for are pasturing and watering livestock.

The benefits of shoreland buffers that are most important to the respondents and their families are wildlife habitat (19%) erosion control by stabilizing stream bank (19%) and erosion control by filtering sediment (19%), followed by pesticide and fertilizer filtering (13%) and pasturing (10%).

The survey results indicate the three greatest barriers for land owners to voluntarily plant and maintain a 50' buffer along streams are maintenance cost and time (22%), lack of information regarding shoreland buffer requirements (22%), and reduced row crop production (19%).

If a landowner does not maintain 50' of permanent vegetation along the stream, 40% of respondents think education should be provided, 32% think financial assistance should be provided, and 17% think the landowner should be required to install a buffer. Respondents indicate that landowners would be encouraged to install buffers by reduced property taxes (22%), technical assistance to meet buffer requirements (19%), payment for buffer installation (17%), and informing landowners about buffer requirements (16%).

The survey indicates there is still work to be done to increase landowner awareness of buffer requirements and to provide education about the benefits of buffers. In addition to public education and awareness, the barriers of maintenance time and cost and reduced row crop production could be alleviated by providing technical and financial assistance for both buffer establishment and maintenance. Seventeen percent of respondents felt that enforcement is a tool to be used where education and assistance are not successful.

Reoccurring Themes from Focus Group Respondents

In general it was felt that buffers are one component of a conservation plan for a farm; a whole watershed and whole farm approach would encourage landowners or renters to install and maintain buffers. Participants felt that buffers should be part of a total conservation plan used to protect their land and soil as well as water quality and wildlife and fish habitat.

The cost of installing and maintaining buffers was a reoccurring theme. Respondents cited the costs of seed, labor, and preparing the area as issues for installation. Participants felt that incentive payments or cost share money should be similar to rental rates in order to fairly compensate for lost production and income on the land allocated to buffers. Financial disincentives should be applied if landowner doesn't maintain buffers.

Issues mentioned as concerns for maintenance were weed control, burning, and other on-going maintenance. Burning can be difficult because many landowners don't have the experience needed to burn their buffers, and the cost to hire it out is too high due to liability. It can also be difficult to find chemicals to control weeds in the buffer area because of proximity to the water.

A repeated technical assistance theme advocated for was to streamline the process for landowners who want to install buffers, so the farmer can get all the information they need from one agency during one contact. A whole farm, whole plan effort working one-on-one with SWCD staff is requested. Technical assistance (planning, burning, no-till drill rental, etc.) coordinated by an agency team was seen as desirable. Flexibility in how buffers are designed should be considered to help farmers improve their farming operation.

Educational needs identified included more information from agencies, assistance in developing a whole farm plan, and information about the laws and available technical support.

A variety of information dissemination methods could be utilized. Agencies should consider new methods of communication such as Facebook, TV, Internet and cell phones. However, traditional methods like letters, brochures, and meetings still need to be utilized. Additionally, hands-on approaches such as individual phone calls and farm visits were suggested, especially if they come from someone who understand farming, such as a retired farmer. Learning from neighbors with established buffers via farms tours or DVD's was seen as a potential method.

Farmers are an independent group and don't like being told what to do, especially by governmental agencies. Enforcement needs to be consistent. They like their neighbors to follow the same practices that they do. Avoid the use of terms such as "Clean Water Act" and a heavy handed, bureaucratic approach.

Enforcement should occur in a soft, step approach beginning with a letter and ending in fines if necessary. Individual situations should be considered.

Southeast Minnesota Riparian Buffer Focus Groups: Final Report

Submitted
June 23, 2010

Authored by:
Sheila Craig, Doug Malchow

Prepared for the Southeast Minnesota Water Resources Board
Linda Dahl, Executive Director

Funded by an Environmental and Natural Resources Trust Fund Grant:
Riparian Buffers in the Whitewater River Watershed

Grant Administered by the Whitewater Watershed Project
Megan Kranz-McGuire Authorized Agent

Table of Contents

Table of Contents ……Page 1

Executive Summary ……Page 2

Introduction …….Page 2

Protocol followed at the focus group sessions……Page 3

Agenda followed at each of the sessions…….Page 3

Focus Group 1 Results – March 25, 2010……..Page 4

Focus Group 2 Results – March 26, 2010…….Page 12

Reoccurring Themes from Focus Group Respondents……..Page 22

Executive Summary

Two focus group sessions were held in Southeastern Minnesota during March, 2010. A total of eleven volunteer riparian landowners attended the two sessions. The intent of the focus groups was to explore the barriers to and opportunities for establishing and maintaining vegetative buffers along Southeast Minnesota waterways and what actions would increase adoption of these buffers. A simple go-around the table format was followed. All responses were noted and recorded in writing. Attendees were assured that their responses would remain anonymous. The most prevalent reoccurring themes that came out of the two sessions were that a whole watershed and whole farm approach needs to be utilized in considering the establishment of buffers, the cost of installing and maintaining buffers needs to be addressed, and there is a definite interest in stream-lining the process related to buffers.

Introduction

Two focus group sessions were held in Southeastern Minnesota during March, 2010. The first was held in Goodhue at the Goodhue County Soil and Water Conservation District Office meeting room from 1 to 3 p.m. on Thursday, March 25, 2010. The first focus group was attended by five volunteer riparian landowners. The second was held at the Winona County Soil and Water Conservation District Office meeting room in Lewiston from 10 a.m. to noon on Tuesday, March, 26. The second focus group was attended by six volunteer riparian landowners.

Originally three focus group sessions were planned: one each in Olmsted, Goodhue, and Winona Counties. However, only one person volunteered for the Olmsted County session; that person agreed to attend the Winona County session.

Attendees were chosen on a first-come first served basis. Each attendee was offered $65 in remuneration.

The intent of the focus groups was to explore the barriers to and opportunities for establishing and maintaining vegetative buffers along Southeast Minnesota waterways and what actions would increase adoption of these buffers.

Refreshments were served at each of the sessions.

In addition to the invited rural residents, both focus groups were attended by Linda Dahl, SE MN Water Resources Board Director, Sheila Craig, response recorder for both sessions, and Doug Malchow, who facilitated both sessions.

Protocol followed at the focus group sessions

Each attendee was provided with a copy of the agenda which included the list of questions that were to be addressed. Each question was read aloud by the facilitator and a short reflection time was provided.

After that reflection period each attendee was given ample individual time to provide their answers to the question. A simple go-around the table format was followed, with a different person being the first to answer subsequent questions. If the first person responsible for answering an individual question was not prepared to be the first to answer, the next person in line was provided that opportunity. Each attendee was offered the opportunity to pass on individual questions followed by the opportunity to answer later, if desired. After each attendee had the opportunity to answer an individual question, all attendees were given the opportunity to add to what had already been said. If a point of clarification was necessary, either the facilitator or response recorder would ask for that clarification during the attendees' responses. After all responses were noted and recorded in writing, Ms. Craig read a short summary of what had been said by the group with the opportunity for attendees to comment on whether the responses had been accurately recorded and portrayed.

Attendees were assured that their responses would remain anonymous. However, they were also made aware that the responses would be broken out by county of residence for reporting purposes. Attendees were also told that they would receive a copy of the final report. Each session was completed within the allotted time period.

Agenda followed at each of the sessions, including questions asked

1. Introductions: After introductions by the focus group facilitator, focus group response recorder, and project coordinator, each attendee was asked to introduce themselves and provide some background on their farming operation. To promote that, the respondents were asked to address the following two points for each distinct farming operation or rural parcel:
a. Tell us briefly about your farming operation(s) if you farm.
b. Share with us where your land is located and its relationship to a body of water (river, stream, lake, public drainage, other).

2. Overview of Shoreland Buffer ordinance and this project: Linda Dahl provided a short introduction, including an overview of the project purpose, definitions of terms we would be using, and current Minnesota shoreland setback rules for agricultural land.

The following questions were asked at each session.

3. Are there benefits to a shoreland buffer? If so, what are they?

4a. What do you see as barriers to landowners installing shoreland buffers?
4b. What do you see as barriers to landowners maintaining shoreland buffers?

5a. If you have installed buffers, what motivated you to establish them?
5b. If you don't have buffers, what would motivate you to install them?

6a. What would motivate landowners to install buffers?
6b. What would motivate landowners to maintain buffers?

The following four questions were introduced with the following: "If you were to design a program that would increased the amount of stream buffers in southeastern Minnesota, what would the program include for ….
7a. Education
7b. Technical Assistance
7c. Financial Assistance
7d. Enforcement

Focus Group 1 Results – March 25, 2010

All the respondents were assigned within the following demographic classifications:
F = currently practicing farmer
RF = retired farmer
RR = rural resident
The classification scheme is used throughout the document. There were two rural residents and three currently active farmers participating in this focus group. Following is a list and brief description of the attendees for Focus Group 1.

RR S, North Fork Zumbro River, rural non-farming resident. This participant is related by marriage to RR B. While the authors are not suggesting that their responses were always similar, there might be the perception that this relationship might weight the overall amount of responses in favor or against a given idea. Those responses were given for the same land, shoreland practices and farming operation.

RR B, North Fork Zumbro River, rural non-farming resident. This participant is related by marriage to RR S. While the authors are not suggesting that their responses were always similar, there might be the perception that this relationship might weight the overall amount of responses in favor or against a given idea. Those responses were given for the same land, shore land practices and farming operation.

F T, Previous dairy, now beef, vegetable crops, on Bitter Creek and also works off farm.

F G, Farms in Dakota and Mower counties, also works off-farm.

F D, Dairy farm on Pine Island creek.

At Focus Group 1 Question 3 was asked of all respondents and each offered all of their responses before the question was asked of the next respondent.

3. Do you feel there are benefits to shoreland buffers? If so, what are they?

RR B Buffers retard leaching of chemicals; they provide aesthetic qualities for family, canoeists, fisherman**;** they grow interesting species that require more water
F G Buffers are good for erosion control
F T Has buffer on both sides Bitter Creek yet banks continue to erode; buffer provides sediment control; absorb nitrogen coming from feedlots

Responses to the remaining questions are organized by like type response category: public versus private rights, ecological, financial, physical, education, and other. Additionally, the classification of respondent is included in the response category breakdown.

4a. "What do you see as the barriers to landowners <u>installing</u> shoreland buffers?"

<u>Public versus private rights barriers</u>
RR B Inconsistent enforcement of buffers
RR B All believe in buffers, but they don't all do it; assistance agencies works with landowners where landowners have buffers, but don't assist tenants who then farm the land
RR B –inconsistent practices by farmers

<u>Ecological barriers</u>
RR S Cattle (beef and dairy) and hogs are in the river so there is no shoreline on which to establish a buffer.
RR B Used to live by Northfield, drainage from dairy (a neighbor) was a problem and the government forced farmer out. Need buffers on fields where manure is spread, need buffer for feedlots too

<u>Financial barriers</u>
F T Tenant farmers want to farm every acre; they take out all grassed waterways, want to make every dime
F T Landowners can't get as many dollars if land has a buffer
F G Cost of seed
F G Labor to install buffer and control weeds needed
FG For leased land, rental contracts don't always require a buffer or no-till zone

<u>Physical barriers</u>
None

<u>Educational barriers</u>
F G There is a lack of information and help from agencies; staff at the Dodge County SWCD is good, easy to contact, had helpful info, and offered help to design

<u>Other</u>
F G The Department of Natural Resources (DNR) is difficult to work with

4b. "What do you see as the barriers to landowners <u>maintaining</u> shoreland buffers?"

<u>Public versus private rights barriers</u>
F T Lack of enforcement

<u>Ecological barriers</u>
F G Noxious weeds at first when getting established

<u>Financial barriers</u>
RR **S** Cost of maintaining, especially with current economy

<u>Physical barriers</u>
None

<u>Educational barriers</u>
F G Need improved communication with farmers; when he installed a buffer, another farmer didn't understand why he was putting in switchgrass
F G Need ongoing information, need assistance with developing a plan
F G Need to put it in the (cost share) contract that the buffer has to be maintained
RR B He thinks if the farmer put it in, it will be maintained, but if land changes hands it will not be maintained
F T People put them in and forget about them, he does custom mowing for people; need education on maintaining

<u>Other</u>
None

5a. “If you installed buffers, what motivated you to install them?”

Public versus private rights motivators
None

Ecological motivators
F T Buffers are part of a conservation plan
F T Grew up with conservation as a way to leave the farm better than he found it, if all good soil leaves farm, then wouldn’t do him any good
F T To protect creek
F G He wanted to preserve his own soil
F G Vermillion River in Dakota Co. started project to restore a streambank, now a beautiful river, he has a small area like that with the idea to pond it
F D Wildlife habitat

Financial motivators
F T If all good soil leaves farm wouldn’t do him any good
F G He wanted to preserve his own soil

Physical motivators
RR B Aesthetics motivated us to install a buffer

Educational motivators
F G SWCD had ideas to help establish buffers

Other
F D Even though this respondent is on Pine Island Creek, he doesn’t have buffers because the land is so flat that water drains slowly to the creek, therefore, he is not sure that buffers are necessary in all situations; but probably might still put a buffer in.

5b. “If you don’t have buffers, what would motivate you to install them?”

Public versus private rights motivators
F D Knowing it’s a law would motivate the respondent, but no one came and told him

Ecological motivators
F G Aesthetics; from his perspective to leave the land better than found it; wildlife
RR S Change grasses to types that looks better

Financial motivators
F D Will get some production from hay; but would still need to maintain
F G Improving the overall farm for economics as buffers will increase value of farm

Physical motivators
None

Educational motivators
F D One size does not always fit all; not a good fit for his land because it’s so flat
F D Going to put them in with Soil and Water Conservation District’s (SWCD) help as SWCD makes buffers sound appealing

Other
None

6a. "What do you think would motivate other landowners to <u>install</u> buffers?"

<u>Public versus private rights motivators</u>
None

<u>Ecological motivators</u>
RR B Need to think for future; it would be helpful to have some kind of incentive

<u>Financial motivators</u>
RR B Need some kind of incentive
F G Cost sharing
F T Cost share

<u>Physical motivators</u>
RR B Every acre is not the same, therefore, flexibility in programs is needed

<u>Educational motivators</u>
RR B Education that it needs to be done
RR S Education, by example from your neighbor, better than a law
F D Education, more information needed, all conservation works together; needs all the rest of the farm taken care of too through a whole farm plan (ie. grass waterways are even more important)
F G Education
F T Should be whole farm plan and watershed approach**, e**ducation about tools available (such as no-till drill, seeding plans)**,** education about what they can use that land for (hay, crop)

<u>Other</u>
None

6b. "What do you think would motivate other landowners to <u>maintain</u> buffers?"

The group agreed that the answers to this question were covered above with the addition of:

<u>Educational motivators</u>
Group believes that that it is important to reinforce the need for maintenance and what the maintenance requirements are for buffers

For the questions comprising question 7, the answers were grouped using the following categories: Marketing Methods, Staff Efforts, Educational Topics, Things to Avoid

7a. "If you were to design a program that would increase the amount of stream buffers in southeastern Minnesota, what would that program include for education"?

Marketing Methods
F T Newsletter from Natural Resource Conservation Service (NRCS) and or Soil and Water Conservation District as they are easier to work with than Department of Natural Resources and Minnesota Pollution Control Agency (MPCA)
F G Sending letter to landowners to shape up

Staff Efforts
F G Dodge County is doing more, they have maps for entire county laid out

Educational Topics
RR S Some way to see whole picture, and to learn about progress on your stretch of the water
F G DVD video of projects that are done in the area (like implement dealers do)
RR B Legal requirements, sources of assistance, provide aerial map of the stream
F D Measure water quality to show benefits, show before and after erosion stopped

Things to Avoid
None

7b. "If you were to design a program that would increase the amount of stream buffers in southeastern Minnesota, what would that program include for technical assistance?"

Marketing Methods None

Staff Efforts
RR B Some method to measure gradient along stream is needed because the steeper the gradient the sooner the buffer issue should be addressed
RR B Prioritize buffer needs by erosion potential within a county
RR S The process needs to be simplified so landowner doesn't have to go to multiple agencies
F G Dodge County is good to work with as they have a whole package; seed, surveyor, etc
F T I had to go to many agencies to get permits, etc
F D Make up mind and get it done with one stop at SWCD; work with just one person with one set of rules, one office

Educational Topics None

Things to Avoid None

7c. "If you were to design a program that would increase the amount of stream buffers in southeastern Minnesota, what would that program include for financial assistance?"

F G No-till drills should be made available through SWCD and one half the seed cost should be cost shared just like in the Conservation Reserve Program (CRP)
F T Assistance to provide waterways on farm, not just buffers; should get money back for drill and seed
F D Don't charge for permits

7d. "If you were to design a program that would increase the amount of stream buffers in southeastern Minnesota, what would that program include for enforcement?"

RR B Don't want enforcement agency staff to act like vigilantes
F T Do enforcement in steps beginning with education and then fines as a last step; start friendly
F D Goodhue County staff comes out to visit and talk; they are innovative to fit situation, as different situations exist for each landowner
Staff shouldn't be pig-headed because that makes the farmer pig-headed;
Fines. Fines levied only if really bad, longtime situation and fines are used as the last resort.

Group In summary the group agreed that a whole farm plan is the best solution and that the plan needs to be followed by a renter as well as the landowner

Focus Group 2 – March 26, 2010

All the respondents were assigned within the following classifications:
F = currently practicing farmer
RF = retired farmer
RR = rural resident

The classification scheme is used throughout the document. Participating in this focus group were three currently active farmers, one rural resident, and three retired farmers. Following is a list of the attendees for Focus Group 2.

F R – Dairy farmer near Altura, dairy and beef, has property on two creeks that are trout habitat.

RR J– Not farmers, gravel pit with 2 lakes, eventually want to convert lakes to recreation. They also have farm property with a stream, that land is rented out.

F B – Farms; beef cows; soybean, corn, hay rotation, Middle Branch of Whitewater River.

F E – Farms cropland in the Fremont area, beef cows; bean, corn, hay rotation, Pine Creek; some land in trees; rotational grazing. Saratoga Township on a trout stream; has beef on rotational grazing.

RF B– Retired, son & grandson farm a dairy, cropland on the South Branch of the Whitewater River.

RF D – Farmed in the St. Charles area, retired, now rent their cropland acres for corn, beans, hay; they have beef cows, keep hay ground; headwaters of Whitewater River. This participant is related by marriage to RF S. While the authors are not suggesting that their responses were always similar, there might be a perception that this relationship might weight the overall amount of responses in favor or against a given idea. Those responses were given for the same land, shore land practices and farming operation.

RF S – This participant has the same characteristics as the RF D respondent as these two participants were related by marriage. While the authors are not suggesting that their responses were always similar, there might be the perception that this relationship might weight the overall amount of responses in favor or against a given idea. Those responses were given for the same land, shore land practices and farming operation.

At Focus Group 2, Question 3 was asked of all respondents and responses were offered in an around the table fashion, with each individual able to offer one response until all responses were exhausted.

3. Do you feel there are benefits to shoreland buffers? If so, what are they?

RF D Wildflowers and the personal view
RF B Eliminate short rows next to stream for the economic advantage
F E Enhance wildlife habitat
F B Reduces soil erosion
RR J Shading for fish when trees are part of the buffer
F R Debris control, filtration by re-establishing wetland
F R Slowing down of flood waters
RF S Filter out chemicals

Responses to the remaining questions are organized by like type response category: public versus private rights, ecological, financial, physical, and other. Additionally, the classification of respondent is included in the response category breakdown.

4a. "What do you see as the barriers to landowners installing shoreland buffers?"

Public versus private rights barriers
RF D Anti-government mentality, nobody wants ASCS or SWCD on their land telling them what to do
F E People don't like to be told what to do
RF S Don't want time limits on practices
FE Big farmers spreading manure on frozen ground need a buffer around the field; why should I do a buffer if the big farmer doesn't have to have a buffer?

Ecological barriers
RR J People have an attitude that they don't care about the environment until it affects them
F R Ecologically some soils are difficult to establish buffer vegetation, some soil needs hand planting to establish and re-establish native grasses

Financial barriers
FE Often payments of whatever program they are in do not keep up with possible rent
F B There is not enough cost share to cover costs; it is just seed cost that get paid. There are other costs to installing a buffer such as moving a fence to get ready to put in buffer, etc.
F R If you have bad practices you get rewarded with CRP or being able to get cost share, but if you are already doing good conservation, then no reward
RF D Set aside payments haven't kept up with rental rates $106 vs. $200; the cost of reimbursement

Physical barriers
RF B Boxelder trees are not a good buffer because they are so thick; the landowner needs to get rid of the trees first in order to see what they have as options for a buffer
RF B Department of Natural Resources regulations require that if you push a tree down the landowner needs to have a place to put the tree to let it dry before burning it

Other
None

4b. "What do you see as the barriers to landowners <u>maintaining</u> shoreland buffers?"

<u>Public versus private rights barriers</u>
None

<u>Ecological barriers</u>
FR Chemical control is a barrier, for example the chemical that will control buckthorn can't be used by water; the chemicals that you can use by water will not kill the weeds that need to be killed

<u>Financial barriers</u>
F E The landowner needs help to maintain them
FB Cost sharing to remove trees, etc.
FR Landowners fear prescribed burning. It costs $4,000-5,000 to get someone to burn because of liability; there needs to be a group doing it who provides the labor and liability insurance
RF S Cost to maintain and the knowledge to do it; the tree issue
RF B If the landowner is in CRP they should get payment every year only if the buffer is maintained, if the buffer is not maintained then no payment

<u>Physical barriers</u>
RF B Buffer strips require ongoing maintenance to keep out boxelders

<u>Education barriers</u>
FB Farmers need more technical support, information on what they can and can't do; farmers need more knowledge and where to get information
RF S Landowners need to know what to do; we didn't even know that we could burn
RF D Landowners need more knowledge of how to maintain; just the awareness of the need to do it is costly

<u>Other</u>
None

5a. "If you installed buffers, what motivated you to install them?"

Public versus private rights motivators
F B Stay ahead of farm regulations, like feedlot improvements – want to do it before being forced

Ecological motivators
RF S It is environmentally the right thing to do even on their good land
RF D Wildlife and flowers can be seen by everyone; the buffers were installed because the landowner could see the need to do something was coming
F E Wanted to do something to preserve the quality of the water, to do our part to keep water clean for everybody
F R Buffers improve the aesthetics such as wildlife and wildflowers

Financial motivators
F B Received cost share initiative
F R Reinvest in Minnesota (RIM) payments were available; the payment was $2600/acre for the one time perpetual easement; it paid enough to do it

Physical motivators
RF B The use of buffers make it easier to farm by eliminating short rows

Other
None

5b. "If you don't have buffers, what would motivate you to install them?"

Public versus private rights motivators
F B The Conservation Reserve Program (CRP) rules need to be changed to allow more acres for inclusion; wanted to put more into CRP to eliminate short rows

Ecological motivators
RR J Buffer to keep lakes clean, so not polluted or developed
RR J Improve fish habitat

Financial motivators
RF B More cost sharing

Physical motivators
None

Other
None

6a. "What do you think would motivate other landowners to <u>install</u> buffers?"

<u>Public versus private rights motivators</u>
None

<u>Ecological motivators</u>
RR J Personal interest in environment and wildlife
F R The flood in 2007 was a tragedy, but it opened up opportunity for landowners to install buffers through additional government assistance programs
F B More flexibility such as 40' to 70' to straighten rows or to follow a contour

<u>Financial motivators</u>
RR J Money
F B Cost share
F B The right rental rate
F R Economic benefit; it needs to be the right amount of money, especially for a program like RIM, where the land will be in it forever
F B Cost sharing

<u>Physical motivators</u>
None

<u>Education motivators</u>
RF S Education; small tract owners knowing about buffer zone requirements
RF D Someone from SWCD going along rivers like they do for the feedlot program
F B Olmsted County sent letters because of a complaint; they have mapped it all and fines are being levied
F B Education

<u>Other</u>
None

6b. "What do you think would motivate other landowners to <u>maintain</u> buffers?"

<u>Public versus private rights motivators</u>
None

<u>Ecological motivators</u>
None

<u>Financial motivators</u>
F R Enforcement could be used via a letter like for CRP; if not maintained the cost share dollars could be pulled

<u>Physical motivators</u>
None

<u>Education motivators</u>
RF S Buffer strip maintenance differs, therefore more information is needed
RF B More awareness that burning can and should be used. Also, how to get help
RF B More technical help
F E Assistance in just trying to understand the DNR rules; need to work closer with them, it causes confusion not knowing if there are other rules
F B Need technical assistance and to know how/where to get information

<u>Other</u>
None

For the questions comprising question 7, the answers were grouped using the following categories: Marketing Methods, Staff Efforts, Educational Topics, Things to Avoid.

7a. "If you were to design a program that would increase the amount of stream buffers in southeastern Minnesota, what would your program include for education?"

Marketing Methods
RF S Need to reach out and not just in the newspaper; then people just say it doesn't apply to them.
RF S Brochure sent by direct mailing, personal invitation to a meeting
RF B Education, door to door on RIM and CRP and other programs; educate on the options and value of doing buffers.
RF S Use new technology such as Facebook
RR J Having someone go door to door, meetings, flyers, phone time for questions, TV, Internet
F R Direct mailing like Olmsted County, which is a proactive county; include going door to door, cell phone; being available for absentee landowners after hours
F E Tours of examples of successes
F E Help neighbors by cutting thistles, noxious weeds, and use flash grazing

Staff Efforts
RF S If you've got property along streams then you need to be contacted
RF S Make effort to connect with small tract farmers
RF B Used the local SWCD person
RR J Need to trust person that comes out
F B Explain during Farm Service Agency appointment about buffers

Educational Topics
RF D Information that beef cattle can be grazed; education on allowable uses
RF B Education, door to door on RIM and CRP and other programs; what are the options for and values of doing buffers?
RR J Include basic information about buffers: what they are, what they do and the pros/cons.
RR J Get local people that aren't government to promote them such as retired or part-time farmers, especially if they have buffers on their own land
F R Information on basics such as the importance of buffers, then provide more technical help
F E Educate the youth in high school regarding the importance of buffers as they are the next generation
F B Understanding of the of current state laws; the basics of the law needs to be explained

Things to Avoid
RF D Don't use term Clean Water Act: that turns farmers off
F R Enforcement

7b. "If you were to design a program that would increase the amount of stream buffers in southeastern Minnesota, what would your program include for <u>technical assistance?</u>"

<u>Marketing Methods</u>
RF D Brochure from SWCD on what you can choose, when grazing can be done, etc
F B Field visits, scheduled every couple years, about what to do for maintenance, such as should they burn, spray, cut trees etc.

<u>Staff Efforts</u>
RF S Staff needs to reach out to absentee landowners who rent to big corporations. It is the renter who comes to FSA, not the owner. Contact the owner directly and help them understand the options without being overly technical
RF D Personal approach by having SWCD come out and 'step-it-off', so farmer could see what it would look like
RF B Use more micro management via assistance from SWCD to explain the pros & cons of different options. Do this when the landowner signs up or go door to door
RR J Have a local crew that could come out to burn, cut, etc.; use volunteers or maybe even a 'for-hire' crew for those who couldn't do it themselves
F R Need clearing house of mapping software that would show where CRP could be used; another layer of mapping with RIM; go through all the options and let the farmer see what it would look like using mapping software and then match this up with dollars and benefits
F B Set up appointment for SWCD personal contact

<u>Education Topics</u>
F E Fishermen say don't take grazing animals off the creeks because that helps to keep the weeds down; DNR regulations concerning animals is confusing; SWCD could be helpful with understanding rules
F E DNR may have information about burning options

<u>Things to Avoid</u>
None

7c. "If you were to design a program that would increase the amount of stream buffers in southeastern Minnesota, what would that program include for financial assistance?"

F B Buffer payments need to equal rental payments
F B Buffer payments are difficult to deal with when a farmer has a rental contract
F B Why should a landowner need to have financial assistance to comply with a law?
F B If buffer put in and maintained incentives should be given on taxes

7d. "If you were to design a program that would increase the amount of stream buffers in southeastern Minnesota, what would that program include for enforcement?"

RF D Start with a call from SWCD to look at existing conditions followed by a soft visit from SWCD to look at their shoreland
RF S Soft, diplomatic, call first
F B Soft approach, because people don't like government
F B If enrolled in a program, remove part of the payment if the landowner doesn't maintain the buffer, prorate the payment on number of years in program
F B If someone is not maintaining a buffer, withhold a portion of the payment(s) they receive from various programs, but this process needs to be explained first
F R Winona County sends a noxious weed letter; this is a good model to follow which uses a step program with the goal of getting the buffer up to par

Reoccurring Themes from Focus Group Respondents

In general it was felt that buffers are one component of a conservation plan for a farm; a whole watershed and whole farm approach would encourage landowners or renters to install and maintain buffers. Participants felt that buffers should be part of a total conservation plan used to protect their land and soil as well as water quality and wildlife and fish habitat.

The cost of installing and maintaining buffers was a reoccurring theme. Respondents cited the costs of seed, labor, and preparing the area as issues for installation. Participants felt that incentive payments or cost share money should be similar to rental rates in order to fairly compensate for lost production and income on the land allocated to buffers. Financial disincentives should be applied if landowner doesn't maintain buffers.

Issues mentioned as concerns for maintenance were weed control, burning, and other on-going maintenance. Burning can be difficult because many landowners don't have the experience needed to burn their buffers, and the cost to hire it out is too high due to liability. It can also be difficult to find chemicals to control weeds in the buffer area because of proximity to the water.

A repeated technical assistance theme advocated for was to streamline the process for landowners who want to install buffers, so the farmer can get all the information they need from one agency during one contact. A whole farm, whole plan effort working one-on-one with SWCD staff is requested. Technical assistance (planning, burning, no-till drill rental, etc.) coordinated by an agency team was seen as desirable. Flexibility in how buffers are designed should be considered to help farmers improve their farming operation.

Educational needs identified included more information from agencies, assistance in developing a whole farm plan, and information about the laws and available technical support.

A variety of information dissemination methods could be utilized. Agencies should consider new methods of communication such as Facebook, TV, Internet and cell phones. However, traditional methods like letters, brochures, and meetings still need to be utilized. Additionally, hands-on approaches such as individual phone calls and farm visits were suggested, especially if they come from someone who understand farming, such as a retired farmer. Learning from neighbors with established buffers via farms tours or DVD's was seen as a potential method.

Farmers are an independent group and don't like being told what to do, especially by governmental agencies. Enforcement needs to be consistent. They like their neighbors to follow the same practices that they do. Avoid the use of terms such as "Clean Water Act" and a heavy handed, bureaucratic approach.

Enforcement should occur in a soft, step approach beginning with a letter and ending in fines if necessary. Individual situations should be considered.

Buffers were thought to be aesthetically pleasing and ecologically beneficial.

Southeast Minnesota Shoreland Buffer Survey

Southeast Minnesota Water Resources Board

November 3, 2009

The shoreland buffer survey is one component of a Legislative and Citizens Commission on Minnesota Resources (LCCMR) grant received by the Whitewater Watershed Project in 2008. Through this grant the SE MN Water Resources Board (SEMWRB) was engaged to develop and administer a survey of a representative sample of riparian landowners in three Southeast Minnesota counties. This survey is part of a larger effort through the LCCMR grant to conduct a shoreland buffer survey, convene focus groups of riparian landowners, and map shoreland buffers in SE Minnesota. The purpose of the survey is to determine the means of eliminating the barriers to, and increasing adoption of, riparian buffers.

A steering committee of county and agency staff was convened to select three Southeast Minnesota counties that represent the diversity of agricultural land in SE Minnesota. The steering committee took into account agricultural practices, land use, topography, and county interest in the selection process, leading to the selection of Olmsted, Goodhue and Winona Counties.

The steering committee guided the development of the survey with the goal of identifying barriers and motivators for converting riparian areas from cropland to perennial vegetation. The survey was then piloted with two landowners to assess the ease of use. The survey finalized for use in all three counties were identical with the exception of one additional question asked in Goodhue County to gather information about landowner understanding of buffer requirements along ditches (question 4 of the Goodhue survey). In the other two counties participating in the survey the drainage ditch question was not applicable.

Each county used GIS to select parcels that intersect shoreland, and provided the SEMWRB with excel spreadsheets of those rural parcels that abut public waters. The process for narrowing the parcels down to 200 per county was different for each county, but involved a combination of removing duplicates and out of state landowners (retaining adjacent WI landowners), and removing small parcels. Of the remaining parcels, the final 200 parcels within each county for inclusion in the survey were randomly selected.

The survey was anonymous, with no landowner name or address tied to it. The surveys and cover letters (attached) were mailed to the selected recipients along with postage-paid return envelopes between June 29th and July 5th, 2009. The counties opted to have the survey cover letters printed on SEMWRB letterhead. Of the 600 surveys mailed out, 275 were received back by the end of August. A few have continued to trickle in, with a total of 282 returned to date.

Survey Results

Of the 282 surveys returned, 109 were from Olmsted County, 85 from Winona County and 88 from Goodhue County, and 80% of the surveys returned were from individuals over the age of 50.

Results show that 70% of respondents are aware that the stream on their property is classified as public waters, but only 43% know that their county requires that agricultural lands have a 50 ft. buffer of perennial vegetation next to rivers and streams. In Goodhue County only 28% of respondents were aware that their county requires a 16 1/2 foot buffer of perennial vegetation next to ditches, although this question was worded poorly and did not specify public ditches. A majority of respondents (56%) are aware that under state and county shore land law they can hay, pasture, or manage their shore land buffer as they see fit, as long as it is maintained in permanent vegetation.

In terms of water quality, 76% of respondents think the water quality in the stream on their property is good or excellent. The most common recreational activities respondents said they engage in include wildlife observation, fishing and swimming/wading. The most common agricultural activities respondents indicated they use their stream for are pasturing and watering livestock.

The benefits of shoreland buffers that are most important to the respondents and their families are wildlife habitat (19%) erosion control by stabilizing stream bank (19%) and erosion control by filtering sediment (19%), followed by pesticide and fertilizer filtering (13%) and pasturing (10%).

The survey results indicate the three greatest barriers for land owners to voluntarily plant and maintain a 50' buffer along streams are maintenance cost and time (22%), lack of information regarding shoreland buffer requirements (22%), and reduced row crop production (19%).

If a landowner does not maintain 50' of permanent vegetation along the stream, 40% of respondents think education should be provided, 32% think financial assistance should be provided, and 17% think the landowner should be required to install a buffer. Respondents indicate that landowners would be encouraged to install buffers by reduced property taxes (22%), technical assistance to meet buffer requirements (19%), payment for buffer installation (17%), and informing landowners about buffer requirements (16%).

The survey indicates there is still work to be done to increase landowner awareness of buffer requirements and to provide education about the benefits of buffers. In addition to public education and awareness, the barriers of maintenance time and cost and reduced row crop production could be alleviated by providing technical and financial assistance for both buffer establishment and maintenance. Seventeen percent of respondents felt that enforcement is a tool to be used where education and assistance are not successful.

Shoreland Mapping in Southeast Minnesota

Whitewater Watershed Project with Cannon River Watershed Partnership

Ross Hoffmann
Cannon River Watershed Partnership

Project Overview

- Applied for by Whitewater River Watershed Project
- Funded by Minnesota Environment and Natural Resources Trust Fund
- Contracted with Cannon River Watershed Partnership for GIS mapping.

Whitewater River Watershed Project

ENVIRONMENT AND NATURAL RESOURCES TRUST FUND

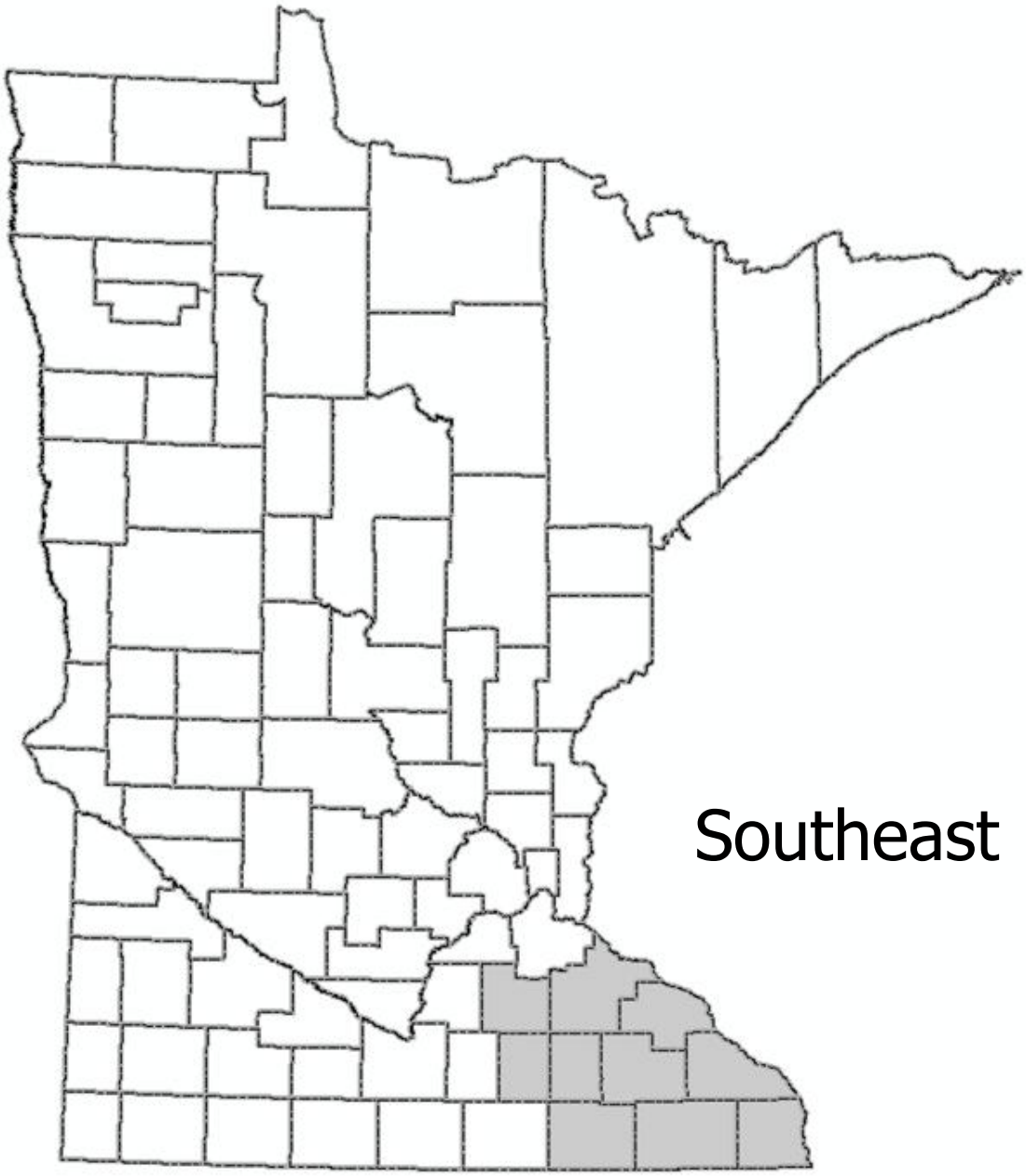
CRWP
Cannon River Watershed Partnership

GIS Mapping

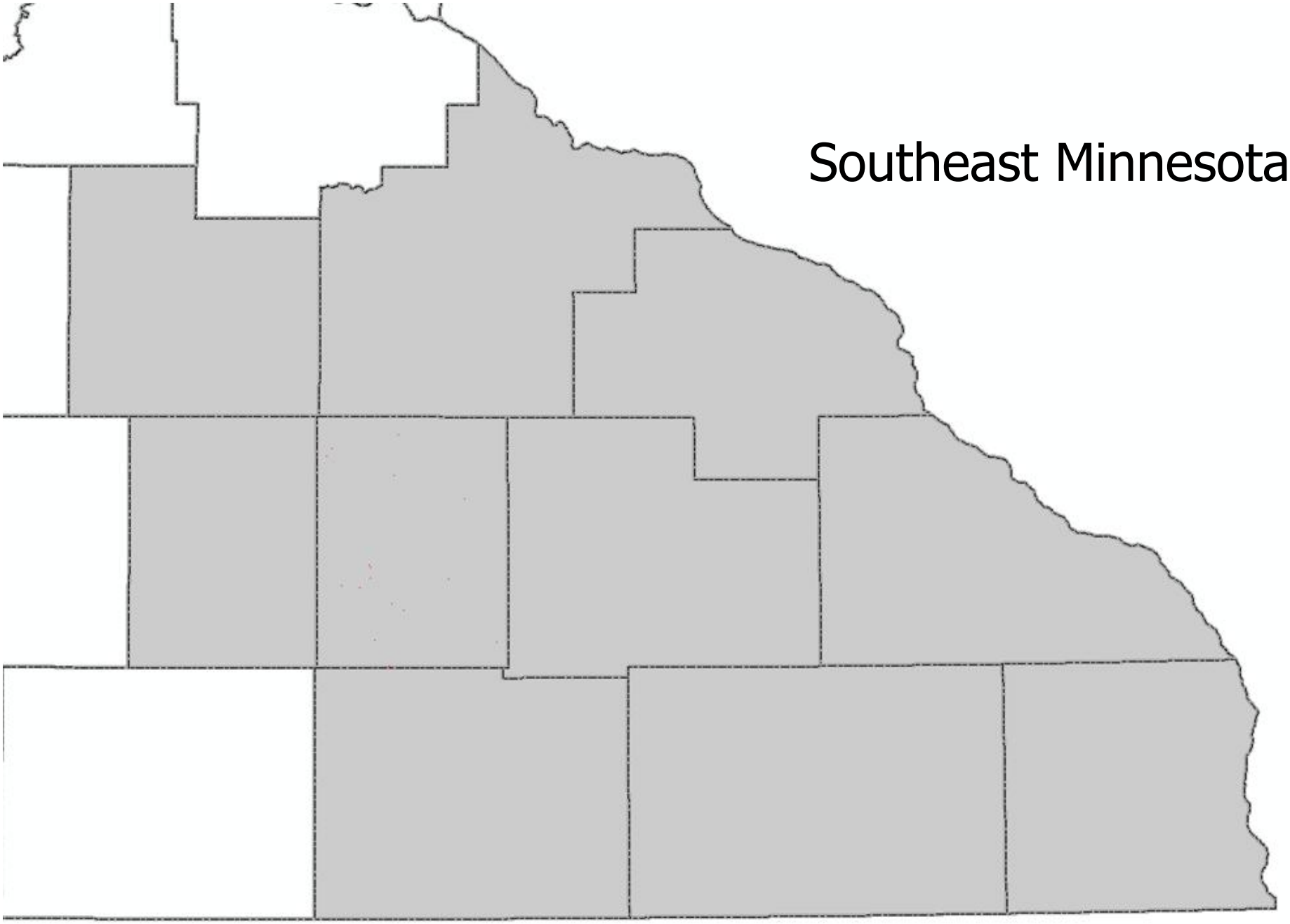
- Obtain a better picture of landuse in SE Minnesota's stream and river shoreland areas.
- Use Geographic Information Systems (GIS).
- Using aerial photography and other spatial data, digitally outline landuses within shoreland areas.

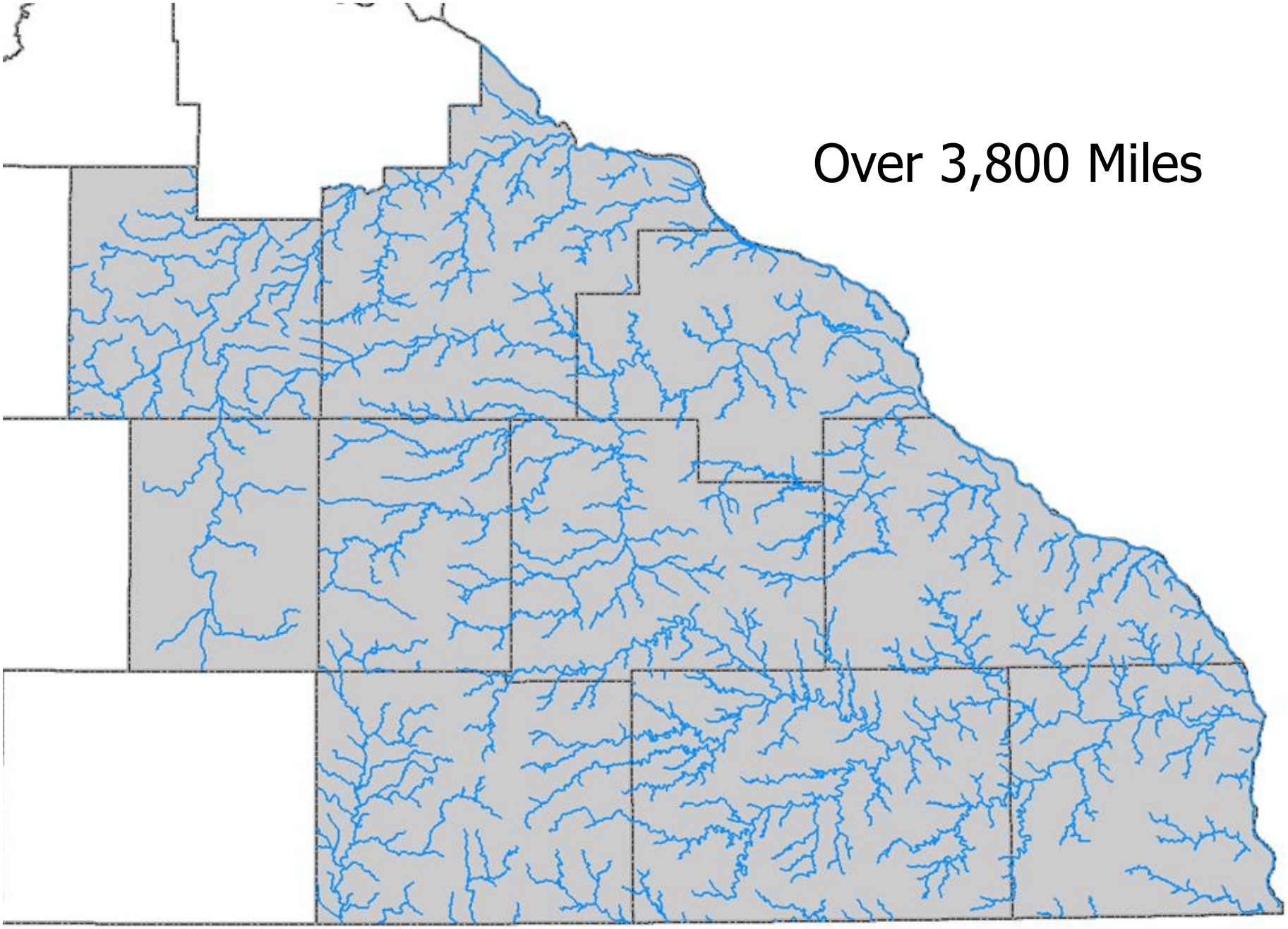
Mapping Example

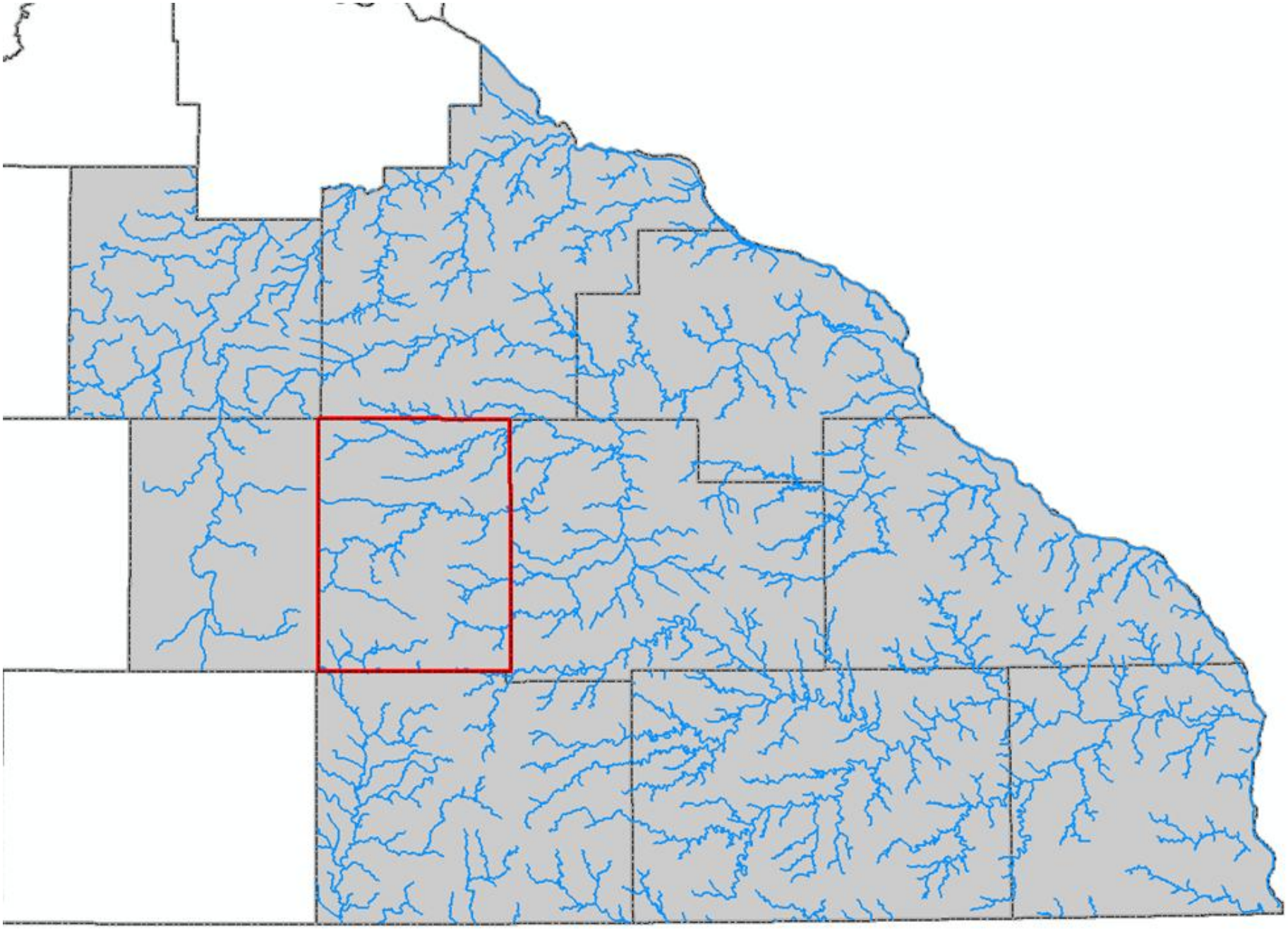
State of Minnesota

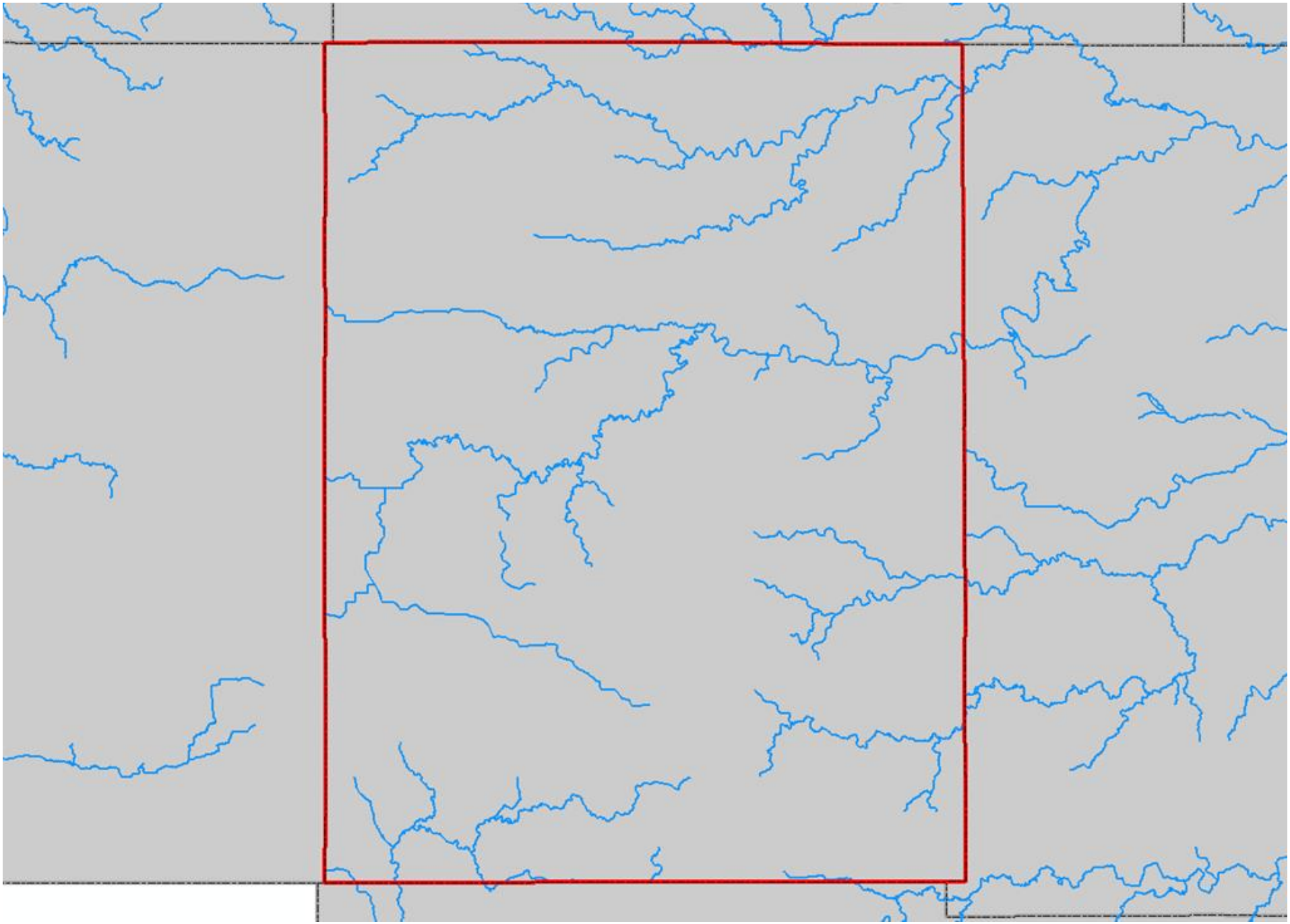


Southeast Minnesota


Southeast Minnesota

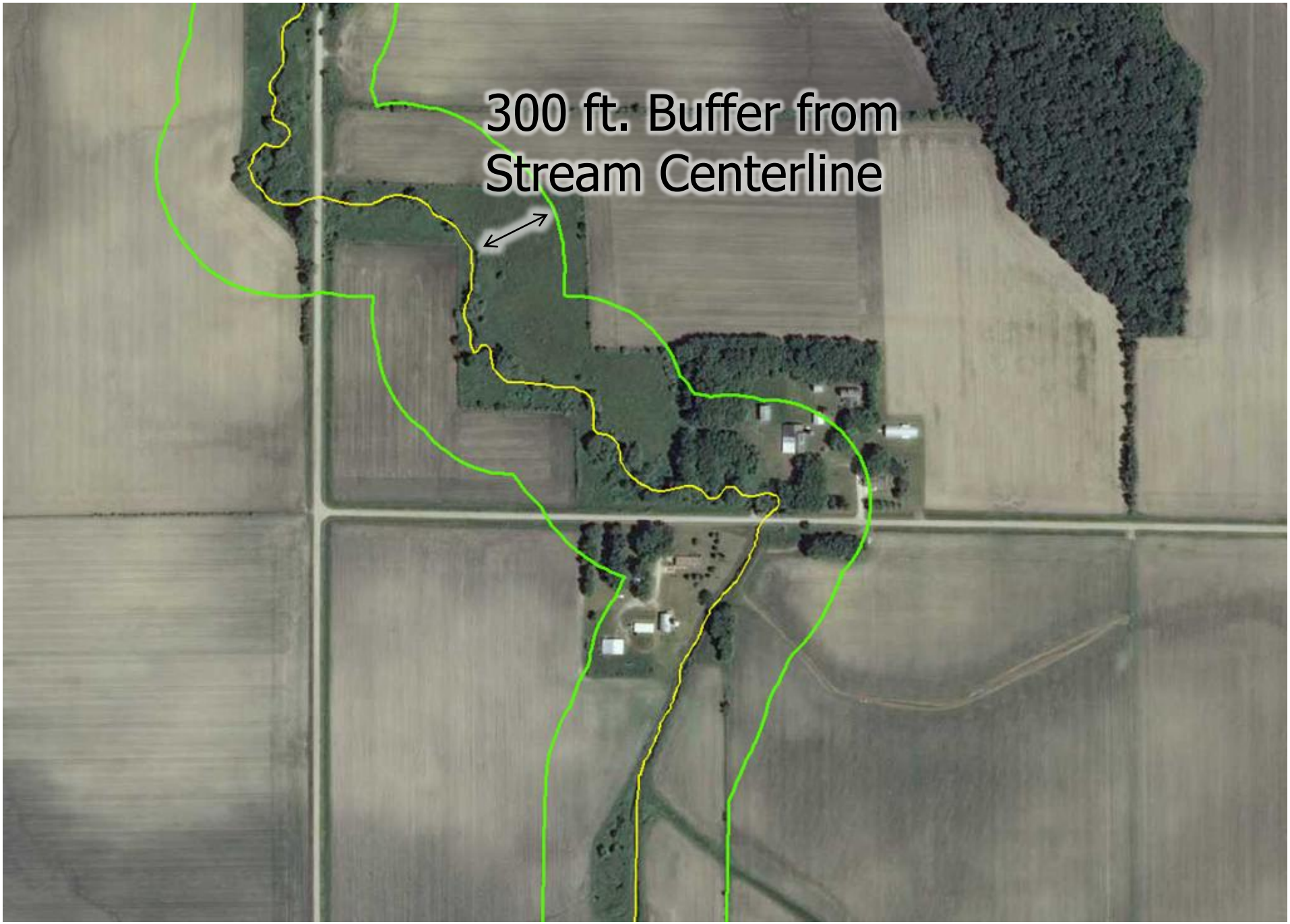

Over 3,800 Miles





Existing Data

Retrace Streams


300 ft. Buffer from
Stream Centerline

32100
24000
61200
61200
13230
24000
24000
42000
24000
62100
32100
61200
24000
24000
62100
13230
32100
32100
23200
23200
13230
13230
24000
61200
61200
32100
21000
23200
24000
13220
32100
61200
24000
24000
61200
62100
24000

32100
24000
61200
61200
13230
24000
24000
42000
24000
62100
32100
61200
24000
24000
62100
13230
32100
32100
23200
23200
13230
13230
61200
61200
32100
24000
21000
23200
24000
13220
32100
61200
24000
24000
61200
62100
24000

32100
24000
61200
61200
13230
24000
24000
42000
24000
62100
32100
61200
24000
24000
62100
13230
32100
32100
23200
23200
13230
13230
24000
61200
61200
32100
21000
23200
24000
13220
32100
61200
24000
24000
61200
62100
24000

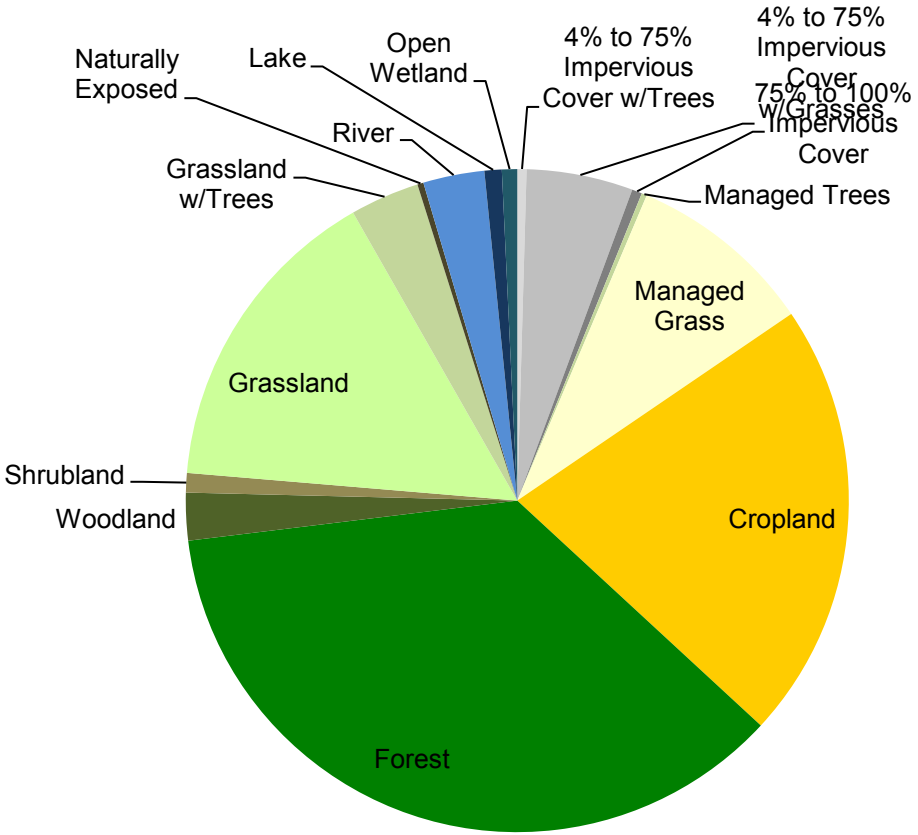
Landuse within
50 ft. Buffer from
Stream Centerline

Mission Accomplished

- At the end of May 2010, mapping concluded.
- All totaled, 60,000 individual polygons traced, representing 40 unique landuses.

Region-wide Results (300ft)

- 36% Forest
- 21% Cropland
- 15% Grassland
- 9% Managed Grassland
- 5% Impervious Cover w/Grasses

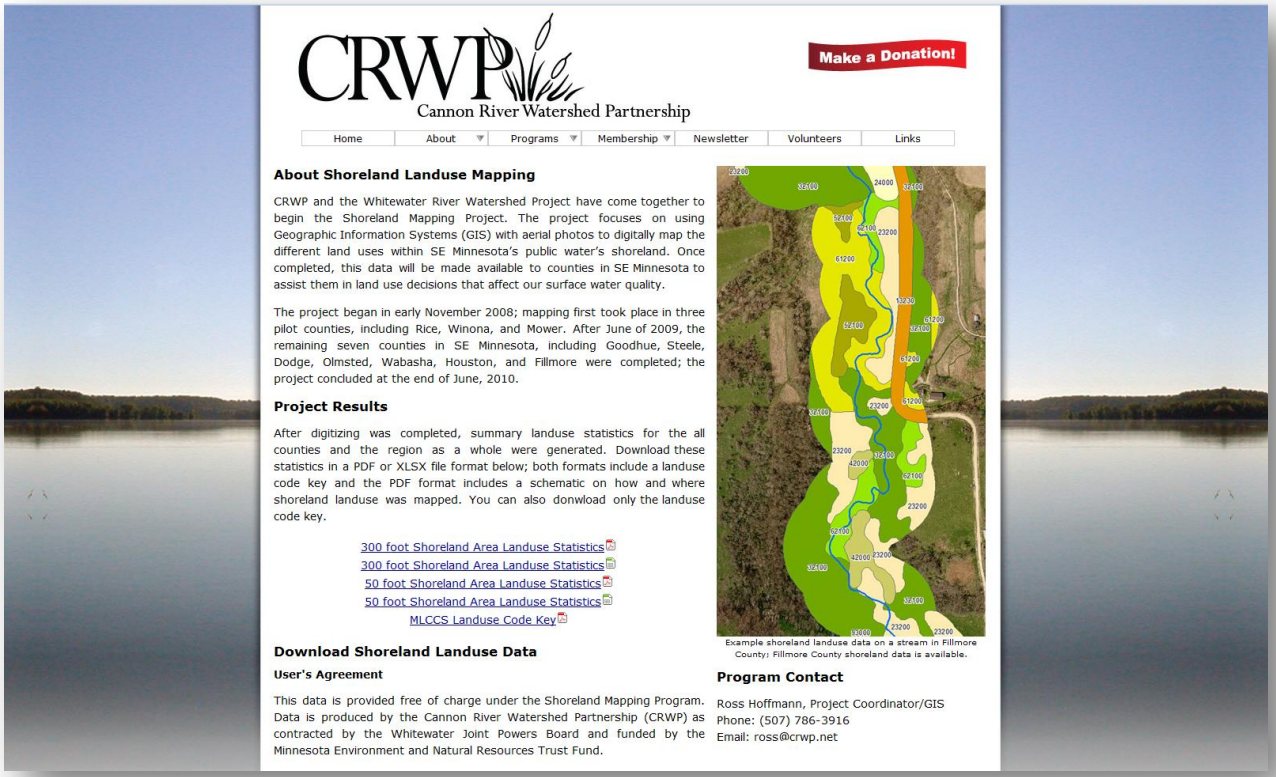


Data Available for Download

- Data is public, available to anyone; requires GIS.
- Data is not 100% accurate; not field verified.
- Landuse codes, high degree of accuracy at level one or two.
- Read user's agreement before downloading.

http://www.crwp.net/Programs/Conservation/ShorelandMapping/ShorelandMapping.html

Data Available for Download



CRWP
Cannon River Watershed Partnership

Make a Donation!

Home | About | Programs | Membership | Newsletter | Volunteers | Links

About Shoreland Landuse Mapping

CRWP and the Whitewater River Watershed Project have come together to begin the Shoreland Mapping Project. The project focuses on using Geographic Information Systems (GIS) with aerial photos to digitally map the different land uses within SE Minnesota's public water's shoreland. Once completed, this data will be made available to counties in SE Minnesota to assist them in land use decisions that affect our surface water quality.

The project began in early November 2008; mapping first took place in three pilot counties, including Rice, Winona, and Mower. After June of 2009, the remaining seven counties in SE Minnesota, including Goodhue, Steele, Dodge, Olmsted, Wabasha, Houston, and Fillmore were completed; the project concluded at the end of June, 2010.

Project Results

After digitizing was completed, summary landuse statistics for the all counties and the region as a whole were generated. Download these statistics in a PDF or XLSX file format below; both formats include a landuse code key and the PDF format includes a schematic on how and where shoreland landuse was mapped. You can also donwload only the landuse code key.

300 foot Shoreland Area Landuse Statistics
300 foot Shoreland Area Landuse Statistics
50 foot Shoreland Area Landuse Statistics
50 foot Shoreland Area Landuse Statistics
MLCCS Landuse Code Key

Download Shoreland Landuse Data

User's Agreement

This data is provided free of charge under the Shoreland Mapping Program. Data is produced by the Cannon River Watershed Partnership (CRWP) as contracted by the Whitewater Joint Powers Board and funded by the Minnesota Environment and Natural Resources Trust Fund.

Example shoreland landuse data on a stream in Fillmore County; Fillmore County shoreland data is available.

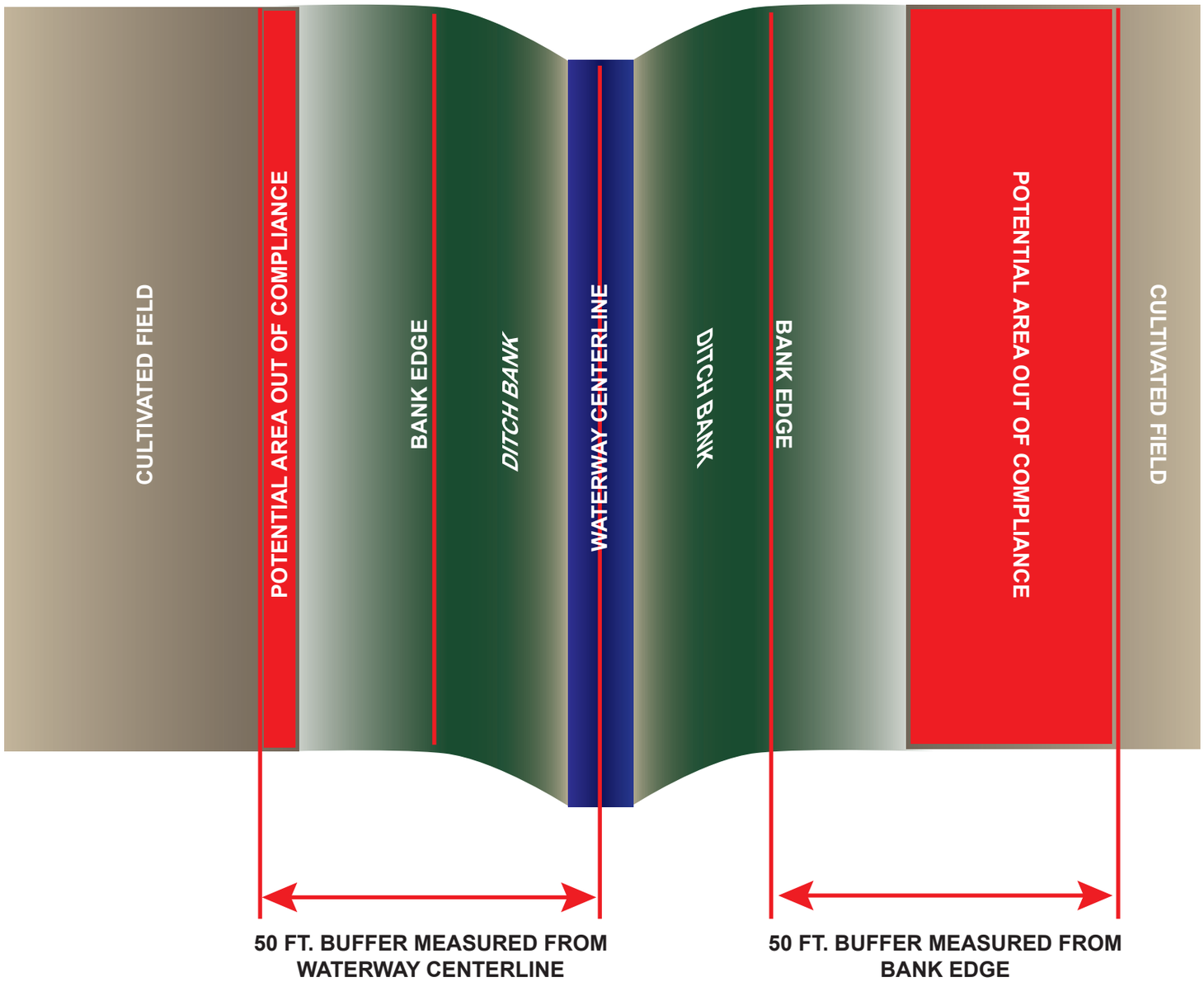
Program Contact

Ross Hoffmann, Project Coordinator/GIS
Phone: (507) 786-3916
Email: ross@crwp.net

http://www.crwp.net/Programs/Conservation/ShorelandMapping/ShorelandMapping.html

Questions?

Ross Hoffmann, Project Coordinator/GIS
Cannon River Watershed Partnership
8997 Eaves Ave.
Northfield, MN 55057
Phone: (507) 786-3916
Email: *ross@crwp.net*



ATTENTION

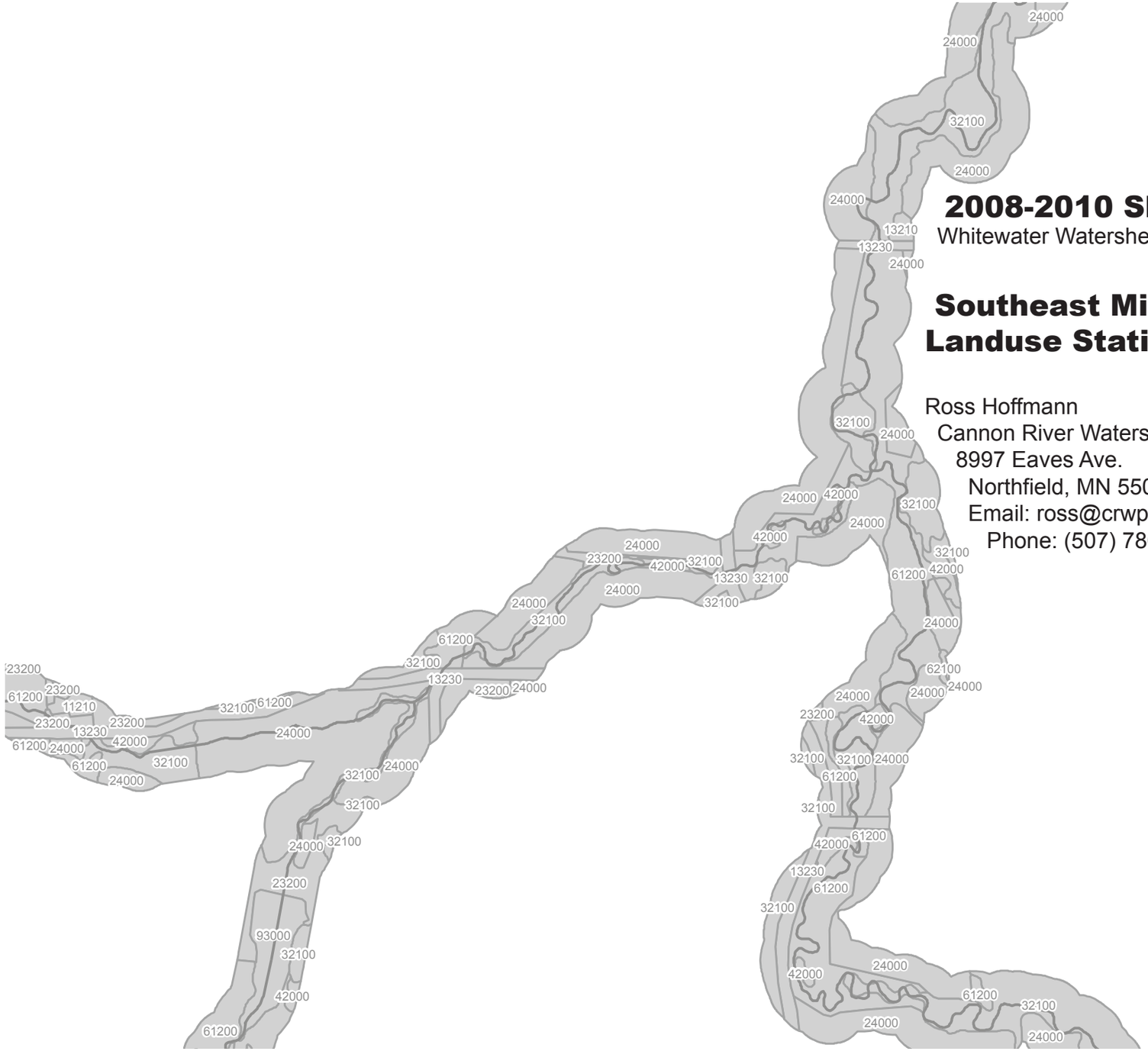
If using this information to identify possible areas out of compliance with local and/or state buffer rules, be aware that:

The 50 foot buffer statistics are computed from the stream centerline. These statistics do not take into account that on some streams, drainage ditches in particular, a buffer may be measured from the bank edge, not from the stream centerline. When measuring the buffer from the bank edge, this will yield a larger area that may be potentially out of compliance with local and/or state buffer rules (see figure).

These statistics for the 50 foot buffer area provide a broad regional overview and do not take into consideration local factors such as the above. Using GIS, these local factors can be adjusted for by using the 300 foot shoreland landuse data, digitizing the boundary where the buffer should be measured from, buffering the desired distance from that boundary, and clipping the 300 foot shoreland landuse data using this new buffer area. This will yield more accurate statistics in specific areas such as, for example, drainage ditches.

This data is provided free of charge under the Shoreland Mapping Program. Data is produced by the Cannon River Watershed Partnership (CRWP) as contracted by the Whitewater Joint Powers Board and funded by the Minnesota Environment and Natural Resources Trust Fund.

Data was digitized from 2008 FSA NAIP one-meter aerial photography and coded using a subset of the Minnesota Land Cover Classification System. While every effort was made to ensure the data correctly reflects land use, CRWP cannot guarantee 100% accuracy. Data is meant to reflect regional, very basic land use information (eg. forest, grassland, cropland, etc.) within 300 feet of DNR-protected river and stream centerlines for a given county. Data has not been verified in the field. Cannon River Watershed Partnership assumes no responsibility for how data is used or its end products.



2008-2010 Shoreland Mapping Project

Whitewater Watershed Project/Cannon River Watershed Partnership

Southeast Minnesota Public Water Shoreland Landuse Statistics - 50ft. Shoreland Area

Ross Hoffmann
Cannon River Watershed Partnership
8997 Eaves Ave.
Northfield, MN 55057
Email: ross@crwp.net
Phone: (507) 786-3916

Whitewater River Watershed Project

ENVIRONMENT AND NATURAL RESOURCES TRUST FUND

CRWP GIS
Cannon River Watershed Partnership

Project Detail:

Counties mapped include Dodge, Fillmore, Goodhue, Houston, Mower, Olmsted, Rice, Steele, Wabasha, and Winona.

Only public waterways as identified in the MN Department of Natural Resources' "24k Streams" GIS shapefile were mapped.

Landuse was primarily interpreted, mapped, and coded at a scale of 1:5,000 from 2008 FSA NAIP 1-meter resolution aerial photography for all counties.

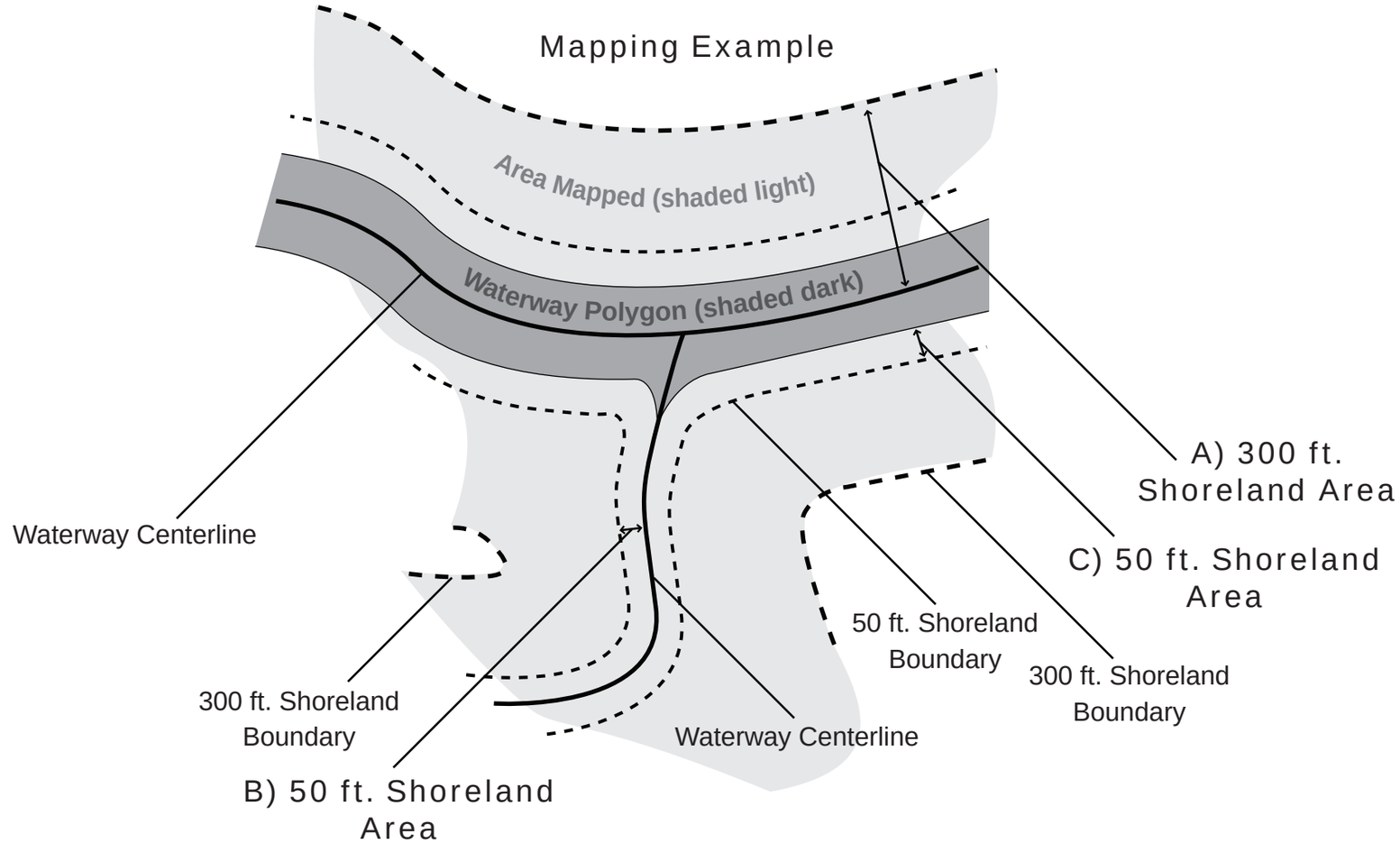
The 300 foot shoreland area is measured from the waterway centerline outward (perpendicular to flow), for a maximum diameter of 600 feet across the waterway (see **A** to right).

The 50 foot shoreland area is measured from the waterway centerline outward (perpendicular to flow) (see **B** to right), however, where a waterway is large enough to be mapped as a polygon, landuse within the 50 foot shoreland area is measured from the polygon edge outward (perpendicular to the shoreline) (see **C** to right).

While every effort was made to ensure the data correctly reflects landuse, CRWP cannot guarantee 100% accuracy; data is meant to reflect very basic landuse information (eg. forest, grassland, cropland, etc.)

Landuse codes are most accurate to level two only; landuse coding from level three and beyond has a high degree of interpretation (see example to right).

Mapping Example



Coding Level and Accuracy Example

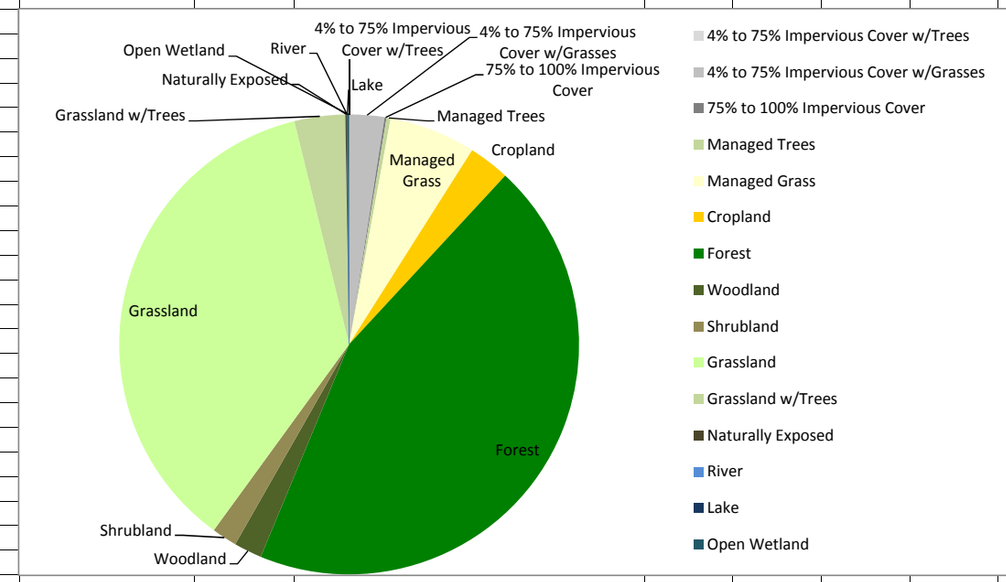
High Accuracy
- Level 1: **10000** - Impervious Surfaces
- Level 2: **11000** - Impervious Surfaces w/Tree Cover

Low Accuracy/ High Interpretation
- Level 3: **11200** - Impervious Surfaces w/Deciduous Tree Cover
- Level 4: **11210** - 4%-10% Impervious Cover w/Deciduous Tree Cover
- Level 5: **11213** - 4%-10% Impervious Cover w/Maple-Basswood Deciduous Tree Cover

Dodge

MLCCS Code	Polygon Count	Area (meters)	Area (acres)	Percentage	Landuse Description
11210	3	1036.16	0.26	0.01%	4% to 10% Impervious Cover w/Trees
11220	3	302.42	0.07	0.00%	11% to 25% Impervious Cover w/Trees
11230	3	145.69	0.04	0.00%	26% to 50% Impervious Cover w/Trees
13110	5	3532.30	0.87	0.03%	4% to 10% Impervious Cover w/Grasses and Sparse Trees
13120	10	2355.88	0.58	0.02%	11% to 25% Impervious Cover w/Grasses and Sparse Trees
13130	12	9466.06	2.34	0.08%	26% to 50% Impervious Cover w/Grasses and Sparse Trees
13140	1	579.12	0.14	0.00%	51% to 75% Impervious Cover w/Grasses and Sparse Trees
13210	6	1128.50	0.28	0.01%	4% to 10% Impervious Cover w/Grasses
13220	22	9445.30	2.33	0.08%	11% to 25% Impervious Cover w/Grasses
13230	218	272179.82	67.26	2.23%	26% to 50% Impervious Cover w/Grasses
13240	1	532.29	0.13	0.00%	51% to 75% Impervious Cover w/Grasses
14110	5	1414.09	0.35	0.01%	76% to 90% Impervious Cover w/Buildings and Pavement
14120	36	15761.71	3.89	0.13%	91% to 100% Impervious Cover w/Buildings and Pavement
14210	1	21.16	0.01	0.00%	0% to 10% Impervious Cover w/Exposed Earth
14220	1	666.07	0.16	0.01%	11% to 25% Impervious Cover w/Exposed Earth
21000	43	36464.90	9.01	0.30%	Planted, Maintained, or Cultivated Trees
23200	261	741225.31	183.16	6.07%	Planted and Maintained Grasses
24000	312	353623.39	87.38	2.89%	Cropland
32100	534	5425211.94	1340.60	44.41%	Upland Deciduous Forest
32200	1	124.97	0.03	0.00%	Wetland Forest
42000	129	239492.46	59.18	1.96%	Woodland
42200	1	90.37	0.02	0.00%	Wetland Woodland
52100	167	216194.83	53.42	1.77%	Upland Deciduous Shrublands
52300	2	797.01	0.20	0.01%	Wetland Deciduous Shrublands
61200	497	4322769.39	1068.18	35.39%	Upland Grassland
61300	6	86312.79	21.33	0.71%	Temporarily Flooded Grasslands
61500	2	917.33	0.23	0.01%	Seasonally Flooded Grasslands
61600	1	1912.67	0.47	0.02%	Semipermanently Flooded Grasslands
61800	3	4360.36	1.08	0.04%	Permanently Flooded Grasslands
62100	171	436947.09	107.97	3.58%	Grassland w/Sparse Trees
83210	16	13506.60	3.34	0.11%	Sandy and Gravel Shores
92000	1	2652.54	0.66	0.02%	Lake
93000	18	14834.81	3.67	0.12%	Open Wetland
TOTAL	**2492**	**12216005.32**	**3018.64**	**100.00%**	

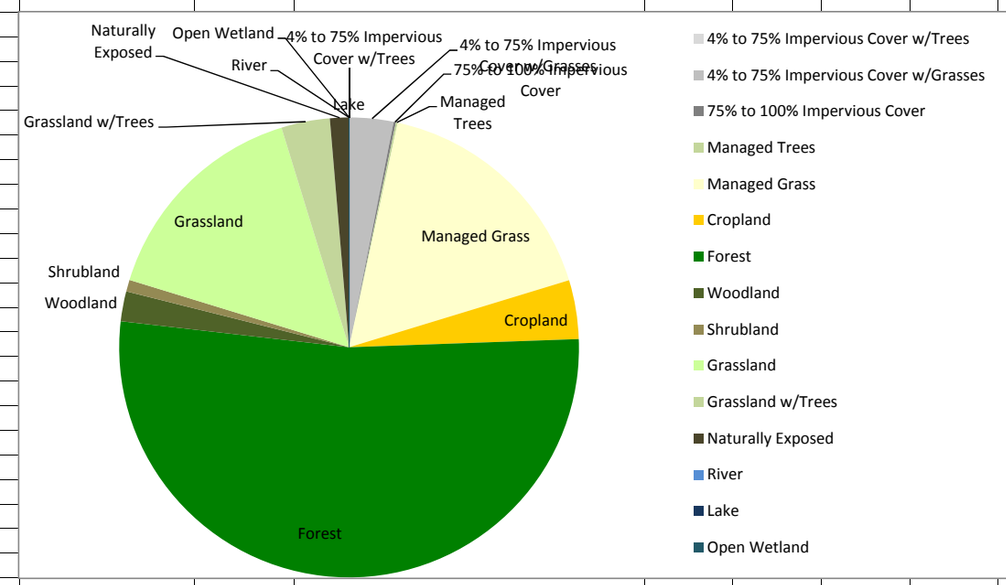
MLCCS Table Value	Table Data	Label
11000	0.01%	4% to 75% Impervious Cover w/Trees
13000	2.45%	4% to 75% Impervious Cover w/Grasses
14000	0.15%	75% to 100% Impervious Cover
21000	0.30%	Managed Trees
23000	6.07%	Managed Grass
24000	2.89%	Cropland
32000	44.41%	Forest
42000	1.96%	Woodland
52000	1.78%	Shrubland
61000	36.15%	Grassland
62000	3.58%	Grassland w/Trees
80000	0.11%	Naturally Exposed
~~91000~~	~~0.00%~~	~~River~~
92000	0.02%	Lake
93000	0.12%	Open Wetland



Fillmore

MLCCS Code	Polygon Count	Area (meters)	Area (acres)	Percentage	Landuse Description
11210	14	16146.88	3.99	0.05%	4% to 10% Impervious Cover w/Trees
11220	3	1954.61	0.48	0.01%	11% to 25% Impervious Cover w/Trees
11230	1	424.07	0.10	0.00%	26% to 50% Impervious Cover w/Trees
13110	11	3517.05	0.87	0.01%	4% to 10% Impervious Cover w/Grasses and Sparse Trees
13120	17	5115.54	1.26	0.02%	11% to 25% Impervious Cover w/Grasses and Sparse Trees
13130	5	1672.59	0.41	0.01%	26% to 50% Impervious Cover w/Grasses and Sparse Trees
13140	1	1719.52	0.42	0.01%	51% to 75% Impervious Cover w/Grasses and Sparse Trees
13210	21	8597.25	2.12	0.03%	4% to 10% Impervious Cover w/Grasses
13220	47	18046.79	4.46	0.06%	11% to 25% Impervious Cover w/Grasses
13230	469	934605.97	230.95	2.93%	26% to 50% Impervious Cover w/Grasses
13240	7	2602.77	0.64	0.01%	51% to 75% Impervious Cover w/Grasses
14110	4	1864.02	0.46	0.01%	76% to 90% Impervious Cover w/Buildings and Pavement
14120	61	29159.07	7.21	0.09%	91% to 100% Impervious Cover w/Buildings and Pavement
14210	17	20185.24	4.99	0.06%	0% to 10% Impervious Cover w/Exposed Earth
21000	21	36768.39	9.09	0.12%	Planted, Maintained, or Cultivated Trees
23200	964	5392777.55	1332.58	16.89%	Planted and Maintained Grasses
24000	716	1320612.84	326.33	4.14%	Cropland
32100	1625	16729404.29	4133.93	52.40%	Upland Deciduous Forest
42000	260	664614.78	164.23	2.08%	Woodland
42200	3	3567.21	0.88	0.01%	Wetland Woodland
52100	141	262064.20	64.76	0.82%	Upland Deciduous Shrublands
52300	4	2593.86	0.64	0.01%	Wetland Deciduous Shrublands
61200	956	4478629.37	1106.69	14.03%	Upland Grassland
61300	286	463372.36	114.50	1.45%	Temporarily Flooded Grasslands
61800	12	10263.72	2.54	0.03%	Permanently Flooded Grasslands
62100	383	983543.02	243.04	3.08%	Grassland w/Sparse Trees
62300	45	104392.28	25.80	0.33%	Temporarily Flooded Grassland w/Sparse Trees
83210	278	423099.42	104.55	1.33%	Sandy and Gravel Shores
93000	4	2526.01	0.62	0.01%	Open Wetland
TOTAL	**6376**	**31923840.66**	**7888.55**	**100.00%**	

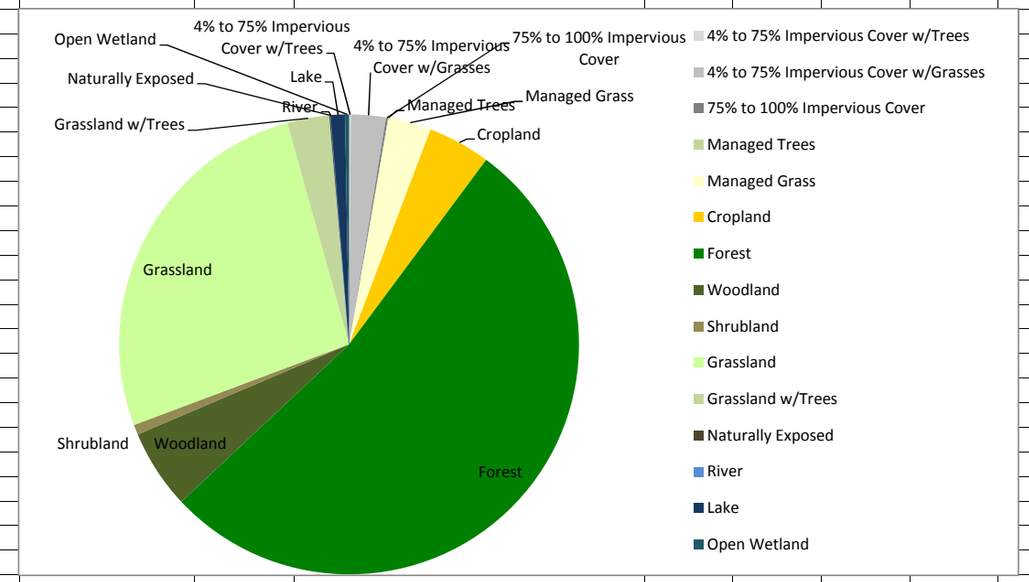
MLCCS Table Value	Table Data	Label
11000	0.05%	4% to 75% Impervious Cover w/Trees
13000	3.06%	4% to 75% Impervious Cover w/Grasses
14000	0.16%	75% to 100% Impervious Cover
21000	0.12%	Managed Trees
23000	16.89%	Managed Grass
24000	4.14%	Cropland
32000	52.40%	Forest
42000	2.09%	Woodland
52000	0.83%	Shrubland
61000	15.51%	Grassland
62000	3.41%	Grassland w/Trees
80000	1.33%	Naturally Exposed
~~91000~~	~~0.00%~~	~~River~~
92000	0.00%	Lake
93000	0.01%	Open Wetland



Goodhue

MLCCS Code	Polygon Count	Area (meters)	Area (acres)	Percentage	Landuse Description
11210	14	15215.16	3.76	0.06%	4% to 10% Impervious Cover w/Trees
11220	18	10221.98	2.53	0.04%	11% to 25% Impervious Cover w/Trees
11230	4	623.81	0.15	0.00%	26% to 50% Impervious Cover w/Trees
11240	1	2896.11	0.72	0.01%	51% to 75% Impervious Cover w/Trees
13110	19	7218.55	1.78	0.03%	4% to 10% Impervious Cover w/Grasses and Sparse Trees
13120	25	9967.80	2.46	0.04%	11% to 25% Impervious Cover w/Grasses and Sparse Trees
13130	7	2347.15	0.58	0.01%	26% to 50% Impervious Cover w/Grasses and Sparse Trees
13140	2	3213.99	0.79	0.01%	51% to 75% Impervious Cover w/Grasses and Sparse Trees
13210	14	4884.42	1.21	0.02%	4% to 10% Impervious Cover w/Grasses
13220	36	18484.61	4.57	0.07%	11% to 25% Impervious Cover w/Grasses
13230	375	578531.07	142.96	2.28%	26% to 50% Impervious Cover w/Grasses
13240	6	1600.29	0.40	0.01%	51% to 75% Impervious Cover w/Grasses
14110	5	3799.82	0.94	0.01%	76% to 90% Impervious Cover w/Buildings and Pavement
14120	44	29330.39	7.25	0.12%	91% to 100% Impervious Cover w/Buildings and Pavement
14210	2	104.38	0.03	0.00%	0% to 10% Impervious Cover w/Exposed Earth
21000	17	18051.63	4.46	0.07%	Planted, Maintained, or Cultivated Trees
23200	345	760059.16	187.81	2.99%	Planted and Maintained Grasses
24000	802	1117625.48	276.17	4.40%	Cropland
32100	768	13430885.77	3318.84	52.82%	Upland Deciduous Forest
32200	6	6835.94	1.69	0.03%	Wetland Forest
42000	354	1278283.21	315.87	5.03%	Woodland
42200	10	138983.52	34.34	0.55%	Wetland Woodland
52100	92	178141.00	44.02	0.70%	Upland Deciduous Shrublands
52300	1	164.97	0.04	0.00%	Wetland Deciduous Shrublands
61200	964	6275122.06	1550.62	24.68%	Upland Grassland
61300	45	340319.88	84.09	1.34%	Temporarily Flooded Grasslands
61400	6	15986.06	3.95	0.06%	Saturated Grasslands
61600	8	40352.93	9.97	0.16%	Semipermanently Flooded Grasslands
61700	4	20297.47	5.02	0.08%	Intermittently Exposed Grassland
61800	6	16846.82	4.16	0.07%	Permanently Flooded Grasslands
62100	213	648190.49	160.17	2.55%	Grassland w/Sparse Trees
62300	11	100761.25	24.90	0.40%	Temporarily Flooded Grassland w/Sparse Trees
83210	22	28363.73	7.01	0.11%	Sandy and Gravel Shores
92000	3	253152.77	62.56	1.00%	Lake
93000	8	70193.64	17.35	0.28%	Open Wetland
TOTAL	**4257**	**25427057.31**	**6283.16**	**100.00%**	

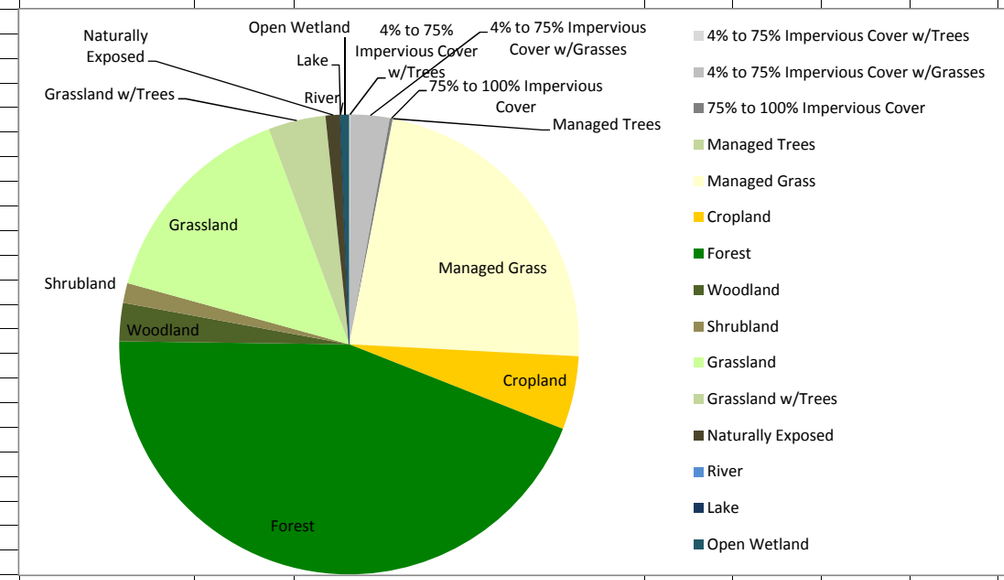
MLCCS Table Value	Table Data	Label
11000	0.11%	4% to 75% Impervious Cover w/Trees
13000	2.46%	4% to 75% Impervious Cover w/Grasses
14000	0.13%	75% to 100% Impervious Cover
21000	0.07%	Managed Trees
23000	2.99%	Managed Grass
24000	4.40%	Cropland
32000	52.85%	Forest
42000	5.57%	Woodland
52000	0.70%	Shrubland
61000	26.38%	Grassland
62000	2.95%	Grassland w/Trees
80000	0.11%	Naturally Exposed
~~91000~~	~~0.00%~~	~~River~~
92000	1.00%	Lake
93000	0.28%	Open Wetland



Houston

MLCCS Code	Polygon Count	Area (meters)	Area (acres)	Percentage	Landuse Description
11210	6	14797.10	3.66	0.09%	4% to 10% Impervious Cover w/Trees
11220	2	275.47	0.07	0.00%	11% to 25% Impervious Cover w/Trees
13110	8	6370.59	1.57	0.04%	4% to 10% Impervious Cover w/Grasses and Sparse Trees
13120	15	9058.82	2.24	0.06%	11% to 25% Impervious Cover w/Grasses and Sparse Trees
13140	1	669.10	0.17	0.00%	51% to 75% Impervious Cover w/Grasses and Sparse Trees
13210	25	16208.19	4.01	0.10%	4% to 10% Impervious Cover w/Grasses
13220	46	31259.63	7.72	0.20%	11% to 25% Impervious Cover w/Grasses
13230	234	365916.02	90.42	2.32%	26% to 50% Impervious Cover w/Grasses
13240	2	1269.81	0.31	0.01%	51% to 75% Impervious Cover w/Grasses
14120	45	23145.37	5.72	0.15%	91% to 100% Impervious Cover w/Buildings and Pavement
14210	9	8863.15	2.19	0.06%	0% to 10% Impervious Cover w/Exposed Earth
21000	12	5992.12	1.48	0.04%	Planted, Maintained, or Cultivated Trees
23200	541	3589664.53	887.03	22.76%	Planted and Maintained Grasses
24000	381	813005.06	200.90	5.16%	Cropland
32100	1010	6813355.41	1683.62	43.21%	Upland Deciduous Forest
32200	18	159804.50	39.49	1.01%	Wetland Forest
42000	184	391786.19	96.81	2.48%	Woodland
42200	9	33230.47	8.21	0.21%	Wetland Woodland
52100	112	211603.85	52.29	1.34%	Upland Deciduous Shrublands
52300	8	8830.12	2.18	0.06%	Wetland Deciduous Shrublands
61200	417	1883077.18	465.32	11.94%	Upland Grassland
61300	71	189489.84	46.82	1.20%	Temporarily Flooded Grasslands
61400	12	140909.61	34.82	0.89%	Saturated Grasslands
61500	14	44003.90	10.87	0.28%	Seasonally Flooded Grasslands
61600	5	5309.53	1.31	0.03%	Semipermanently Flooded Grasslands
61700	6	81460.60	20.13	0.52%	Intermittently Exposed Grassland
61800	8	24616.89	6.08	0.16%	Permanently Flooded Grasslands
62100	222	563780.45	139.31	3.58%	Grassland w/Sparse Trees
62300	25	74113.99	18.31	0.47%	Temporarily Flooded Grassland w/Sparse Trees
81100	2	3377.15	0.83	0.02%	Cliffs
83210	82	158154.13	39.08	1.00%	Sandy and Gravel Shores
92000	1	37.63	0.01	0.00%	Lake
93000	18	96155.74	23.76	0.61%	Open Wetland
TOTAL	**3551**	**15769592.16**	**3896.75**	**100.00%**	

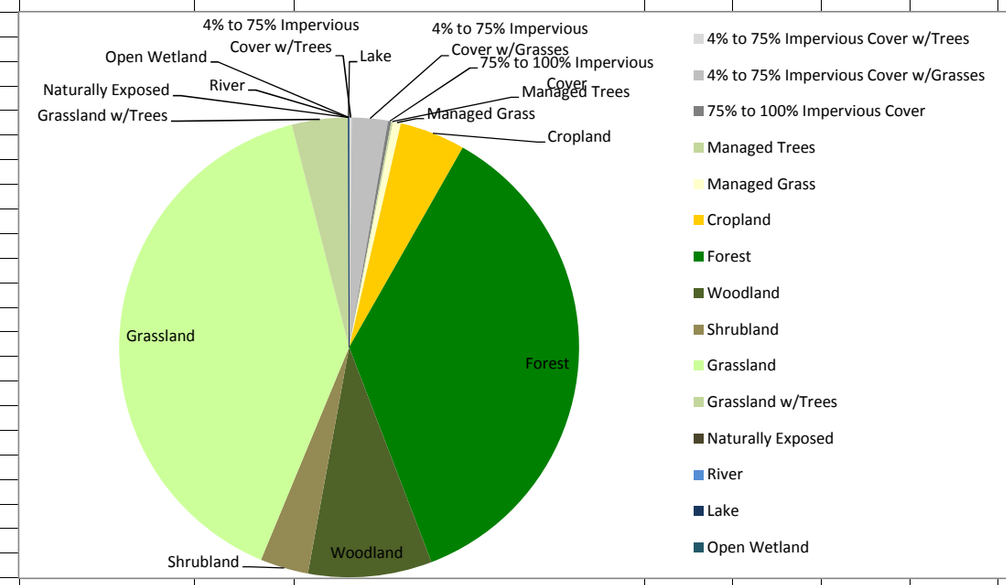
MLCCS Table Value	Table Data	Label
11000	0.10%	4% to 75% Impervious Cover w/Trees
13000	2.73%	4% to 75% Impervious Cover w/Grasses
14000	0.20%	75% to 100% Impervious Cover
21000	0.04%	Managed Trees
23000	22.76%	Managed Grass
24000	5.16%	Cropland
32000	44.22%	Forest
42000	2.70%	Woodland
52000	1.40%	Shrubland
61000	15.02%	Grassland
62000	4.05%	Grassland w/Trees
80000	1.02%	Naturally Exposed
~~91000~~	~~0.00%~~	~~River~~
92000	0.00%	Lake
93000	0.61%	Open Wetland



Mower

MLCCS Code	Polygon Count	Area (meters)	Area (acres)	Percentage	Landuse Description
11210	14	4391.22	1.09	0.02%	4% to 10% Impervious Cover w/Trees
11220	17	13525.36	3.34	0.06%	11% to 25% Impervious Cover w/Trees
11230	18	22325.25	5.52	0.11%	26% to 50% Impervious Cover w/Trees
11240	1	12.21	0.00	0.00%	51% to 75% Impervious Cover w/Trees
13110	14	9091.92	2.25	0.04%	4% to 10% Impervious Cover w/Grasses and Sparse Trees
13120	27	15884.67	3.93	0.08%	11% to 25% Impervious Cover w/Grasses and Sparse Trees
13130	13	9311.49	2.30	0.04%	26% to 50% Impervious Cover w/Grasses and Sparse Trees
13140	3	4643.90	1.15	0.02%	51% to 75% Impervious Cover w/Grasses and Sparse Trees
13210	15	12032.02	2.97	0.06%	4% to 10% Impervious Cover w/Grasses
13220	26	37298.41	9.22	0.18%	11% to 25% Impervious Cover w/Grasses
13230	369	433438.83	107.11	2.08%	26% to 50% Impervious Cover w/Grasses
13240	4	2108.11	0.52	0.01%	51% to 75% Impervious Cover w/Grasses
14110	9	8638.10	2.13	0.04%	76% to 90% Impervious Cover w/Buildings and Pavement
14120	37	33800.07	8.35	0.16%	91% to 100% Impervious Cover w/Buildings and Pavement
14210	12	7679.35	1.90	0.04%	0% to 10% Impervious Cover w/Exposed Earth
21000	22	24412.32	6.03	0.12%	Planted, Maintained, or Cultivated Trees
23200	132	115337.63	28.50	0.55%	Planted and Maintained Grasses
24000	676	961644.99	237.63	4.61%	Cropland
32100	480	5742487.59	1419.00	27.52%	Upland Deciduous Forest
32200	125	1760228.83	434.96	8.44%	Wetland Forest
42000	222	1399112.04	345.73	6.70%	Woodland
42200	56	414446.56	102.41	1.99%	Wetland Woodland
52100	266	661821.80	163.54	3.17%	Upland Deciduous Shrublands
52300	21	46020.10	11.37	0.22%	Wetland Deciduous Shrublands
61200	746	7234658.63	1787.72	34.67%	Upland Grassland
61300	154	1015041.35	250.82	4.86%	Temporarily Flooded Grasslands
61400	1	2333.69	0.58	0.01%	Saturated Grasslands
61600	7	3732.97	0.92	0.02%	Semipermanently Flooded Grasslands
61700	24	31122.68	7.69	0.15%	Intermittently Exposed Grassland
61800	5	1830.20	0.45	0.01%	Permanently Flooded Grasslands
62100	128	761882.49	188.27	3.65%	Grassland w/Sparse Trees
62300	15	64411.21	15.92	0.31%	Temporarily Flooded Grassland w/Sparse Trees
83210	2	2413.22	0.60	0.01%	Sandy and Gravel Shores
93000	8	10289.36	2.54	0.05%	Open Wetland
TOTAL	**3669**	**20867408.54**	**5156.45**	**100.00%**	

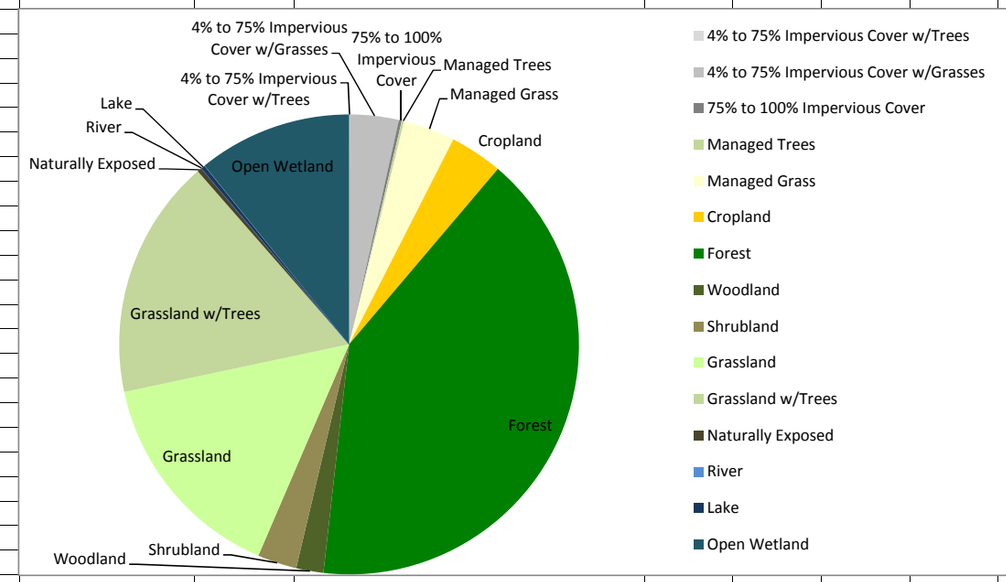
MLCCS Table Value	Table Data	Label
11000	0.19%	4% to 75% Impervious Cover w/Trees
13000	2.51%	4% to 75% Impervious Cover w/Grasses
14000	0.24%	75% to 100% Impervious Cover
21000	0.12%	Managed Trees
23000	0.55%	Managed Grass
24000	4.61%	Cropland
32000	35.95%	Forest
42000	8.69%	Woodland
52000	3.39%	Shrubland
61000	39.72%	Grassland
62000	3.96%	Grassland w/Trees
80000	0.01%	Naturally Exposed
~~91000~~	~~0.00%~~	~~River~~
92000	0.00%	Lake
93000	0.05%	Open Wetland



Olmsted

MLCCS Code	Polygon Count	Area (meters)	Area (acres)	Percentage	Landuse Description
11210	2	360.39	0.09	0.00%	4% to 10% Impervious Cover w/Trees
11230	2	7728.37	1.91	0.03%	26% to 50% Impervious Cover w/Trees
11240	1	13.55	0.00	0.00%	51% to 75% Impervious Cover w/Trees
13110	59	57020.08	14.09	0.26%	4% to 10% Impervious Cover w/Grasses and Sparse Trees
13120	117	219004.55	54.12	0.98%	11% to 25% Impervious Cover w/Grasses and Sparse Trees
13130	13	9118.66	2.25	0.04%	26% to 50% Impervious Cover w/Grasses and Sparse Trees
13140	8	10601.42	2.62	0.05%	51% to 75% Impervious Cover w/Grasses and Sparse Trees
13210	16	11158.86	2.76	0.05%	4% to 10% Impervious Cover w/Grasses
13220	18	42503.16	10.50	0.19%	11% to 25% Impervious Cover w/Grasses
13230	277	419318.58	103.62	1.88%	26% to 50% Impervious Cover w/Grasses
14110	6	3734.48	0.92	0.02%	76% to 90% Impervious Cover w/Buildings and Pavement
14120	12	11630.36	2.87	0.05%	91% to 100% Impervious Cover w/Buildings and Pavement
14210	12	16843.09	4.16	0.08%	0% to 10% Impervious Cover w/Exposed Earth
14220	1	763.75	0.19	0.00%	11% to 25% Impervious Cover w/Exposed Earth
14230	5	12490.53	3.09	0.06%	26% to 50% Impervious Cover w/Exposed Earth
21000	23	36090.90	8.92	0.16%	Planted, Maintained, or Cultivated Trees
23200	178	813312.53	200.97	3.64%	Planted and Maintained Grasses
24000	529	825506.03	203.99	3.70%	Cropland
32100	883	7421147.75	1833.81	33.25%	Upland Deciduous Forest
32200	138	1638848.41	404.97	7.34%	Wetland Forest
42000	77	414890.41	102.52	1.86%	Woodland
42200	6	10602.30	2.62	0.05%	Wetland Woodland
52100	119	516028.62	127.51	2.31%	Upland Deciduous Shrublands
52300	26	102885.46	25.42	0.46%	Wetland Deciduous Shrublands
61200	441	2659910.08	657.28	11.92%	Upland Grassland
61300	38	250373.54	61.87	1.12%	Temporarily Flooded Grasslands
61400	45	348723.66	86.17	1.56%	Saturated Grasslands
61500	20	129309.47	31.95	0.58%	Seasonally Flooded Grasslands
61600	3	1244.93	0.31	0.01%	Semipermanently Flooded Grasslands
61800	8	5286.85	1.31	0.02%	Permanently Flooded Grasslands
62100	410	3688106.33	911.35	16.53%	Grassland w/Sparse Trees
62300	7	80558.79	19.91	0.36%	Temporarily Flooded Grassland w/Sparse Trees
81100	17	76025.73	18.79	0.34%	Cliffs
83210	2	128.42	0.03	0.00%	Sandy and Gravel Shores
92000	3	56758.22	14.03	0.25%	Lake
93000	34	2418522.87	597.63	10.84%	Open Wetland
TOTAL	**3556**	**22316551.17**	**5514.54**	**100.00%**	

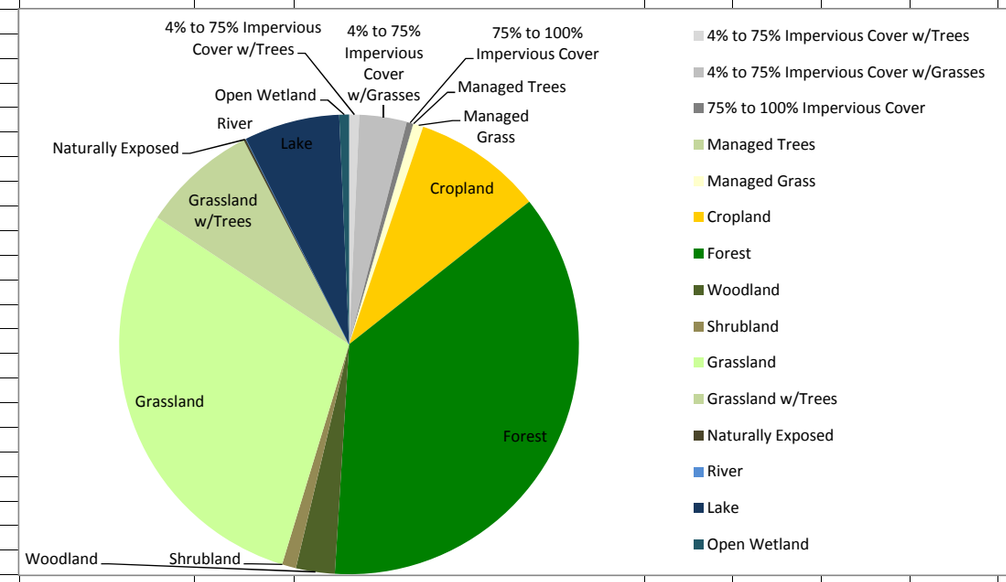
MLCCS Table Value	Table Data	Label
11000	0.04%	4% to 75% Impervious Cover w/Trees
13000	3.44%	4% to 75% Impervious Cover w/Grasses
14000	0.20%	75% to 100% Impervious Cover
21000	0.16%	Managed Trees
23000	3.64%	Managed Grass
24000	3.70%	Cropland
32000	40.60%	Forest
42000	1.91%	Woodland
52000	2.77%	Shrubland
61000	15.21%	Grassland
62000	16.89%	Grassland w/Trees
80000	0.34%	Naturally Exposed
~~91000~~	~~0.00%~~	~~River~~
92000	0.25%	Lake
93000	10.84%	Open Wetland



Rice

MLCCS Code	Polygon Count	Area (meters)	Area (acres)	Percentage	Landuse Description
11210	11	20135.25	4.98	0.11%	4% to 10% Impervious Cover w/Trees
11220	22	40034.05	9.89	0.22%	11% to 25% Impervious Cover w/Trees
11230	20	36220.34	8.95	0.20%	26% to 50% Impervious Cover w/Trees
11240	21	30699.48	7.59	0.17%	51% to 75% Impervious Cover w/Trees
13110	10	16161.08	3.99	0.09%	4% to 10% Impervious Cover w/Grasses and Sparse Trees
13120	38	54888.15	13.56	0.31%	11% to 25% Impervious Cover w/Grasses and Sparse Trees
13130	3	4905.63	1.21	0.03%	26% to 50% Impervious Cover w/Grasses and Sparse Trees
13210	37	53654.60	13.26	0.30%	4% to 10% Impervious Cover w/Grasses
13220	54	48880.81	12.08	0.27%	11% to 25% Impervious Cover w/Grasses
13230	234	368126.89	90.97	2.06%	26% to 50% Impervious Cover w/Grasses
13240	28	49003.50	12.11	0.27%	51% to 75% Impervious Cover w/Grasses
14110	15	17846.77	4.41	0.10%	76% to 90% Impervious Cover w/Buildings and Pavement
14120	41	50281.96	12.42	0.28%	91% to 100% Impervious Cover w/Buildings and Pavement
14210	1	256.65	0.06	0.00%	0% to 10% Impervious Cover w/Exposed Earth
14220	3	11519.52	2.85	0.06%	11% to 25% Impervious Cover w/Exposed Earth
21000	9	9113.06	2.25	0.05%	Planted, Maintained, or Cultivated Trees
23200	84	121326.72	29.98	0.68%	Planted and Maintained Grasses
24000	612	1628603.01	402.44	9.11%	Cropland
32100	574	6539649.91	1615.98	36.60%	Upland Deciduous Forest
32200	3	8809.03	2.18	0.05%	Wetland Forest
42000	86	487589.55	120.49	2.73%	Woodland
52100	85	176591.84	43.64	0.99%	Upland Deciduous Shrublands
61200	497	4322100.31	1068.01	24.19%	Upland Grassland
61400	72	708641.76	175.11	3.97%	Saturated Grasslands
61500	13	182130.83	45.01	1.02%	Seasonally Flooded Grasslands
61600	11	76296.41	18.85	0.43%	Semipermanently Flooded Grasslands
62100	174	1439319.67	355.66	8.06%	Grassland w/Sparse Trees
62300	1	12862.84	3.18	0.07%	Temporarily Flooded Grassland w/Sparse Trees
83210	25	32553.85	8.04	0.18%	Sandy and Gravel Shores
92000	20	1197296.57	295.86	6.70%	Lake
93000	27	122938.13	30.38	0.69%	Open Wetland
TOTAL	**2831**	**17868438.17**	**4415.39**	**100.00%**	

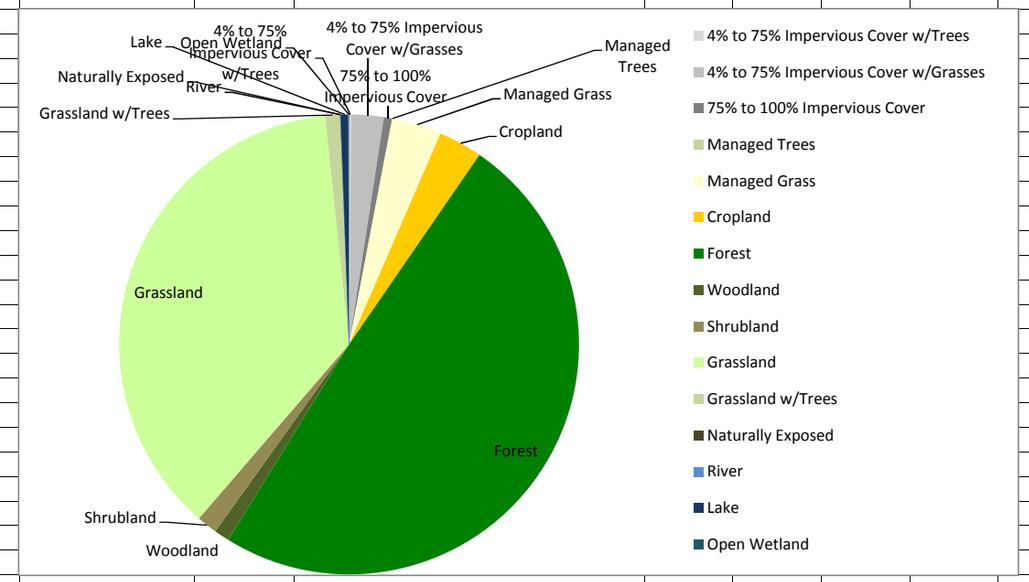
MLCCS Table Value	Table Data	Label
11000	0.71%	4% to 75% Impervious Cover w/Trees
13000	3.33%	4% to 75% Impervious Cover w/Grasses
14000	0.45%	75% to 100% Impervious Cover
21000	0.05%	Managed Trees
23000	0.68%	Managed Grass
24000	9.11%	Cropland
32000	36.65%	Forest
42000	2.73%	Woodland
52000	0.99%	Shrubland
61000	29.60%	Grassland
62000	8.13%	Grassland w/Trees
80000	0.18%	Naturally Exposed
~~91000~~	~~0.00%~~	~~River~~
92000	6.70%	Lake
93000	0.69%	Open Wetland



Steele

MLCCS Code	Polygon Count	Area (meters)	Area (acres)	Percentage	Landuse Description
11210	4	774.78	0.19	0.01%	4% to 10% Impervious Cover w/Trees
11220	8	6272.55	1.55	0.11%	11% to 25% Impervious Cover w/Trees
11230	2	1497.47	0.37	0.03%	26% to 50% Impervious Cover w/Trees
13110	1	846.49	0.21	0.01%	4% to 10% Impervious Cover w/Grasses and Sparse Trees
13120	12	6588.52	1.63	0.11%	11% to 25% Impervious Cover w/Grasses and Sparse Trees
13130	5	5680.36	1.40	0.10%	26% to 50% Impervious Cover w/Grasses and Sparse Trees
13140	1	560.43	0.14	0.01%	51% to 75% Impervious Cover w/Grasses and Sparse Trees
13210	1	0.68	0.00	0.00%	4% to 10% Impervious Cover w/Grasses
13220	24	22602.35	5.59	0.39%	11% to 25% Impervious Cover w/Grasses
13230	95	95860.46	23.69	1.64%	26% to 50% Impervious Cover w/Grasses
13240	1	594.01	0.15	0.01%	51% to 75% Impervious Cover w/Grasses
14110	4	530.63	0.13	0.01%	76% to 90% Impervious Cover w/Buildings and Pavement
14120	45	33191.58	8.20	0.57%	91% to 100% Impervious Cover w/Buildings and Pavement
14210	5	242.95	0.06	0.00%	0% to 10% Impervious Cover w/Exposed Earth
21000	8	1088.12	0.27	0.02%	Planted, Maintained, or Cultivated Trees
23200	127	204702.92	50.58	3.50%	Planted and Maintained Grasses
24000	128	180292.54	44.55	3.08%	Cropland
32100	301	2858432.01	706.33	48.81%	Upland Deciduous Forest
32200	8	24500.82	6.05	0.42%	Wetland Forest
42000	26	62390.03	15.42	1.07%	Woodland
52100	88	80380.69	19.86	1.37%	Upland Deciduous Shrublands
52300	5	4391.42	1.09	0.07%	Wetland Deciduous Shrublands
61200	195	1960927.36	484.56	33.49%	Upland Grassland
61300	48	187125.09	46.24	3.20%	Temporarily Flooded Grasslands
61400	6	15707.15	3.88	0.27%	Saturated Grasslands
61500	3	481.85	0.12	0.01%	Seasonally Flooded Grasslands
61600	4	1988.24	0.49	0.03%	Semipermanently Flooded Grasslands
61800	1	1141.19	0.28	0.02%	Permanently Flooded Grasslands
62100	34	60769.38	15.02	1.04%	Grassland w/Sparse Trees
83210	4	2231.40	0.55	0.04%	Sandy and Gravel Shores
92000	2	31149.96	7.70	0.53%	Lake
93000	12	2996.32	0.74	0.05%	Open Wetland
TOTAL	**1208**	**5855939.72**	**1447.03**	**100.00%**	

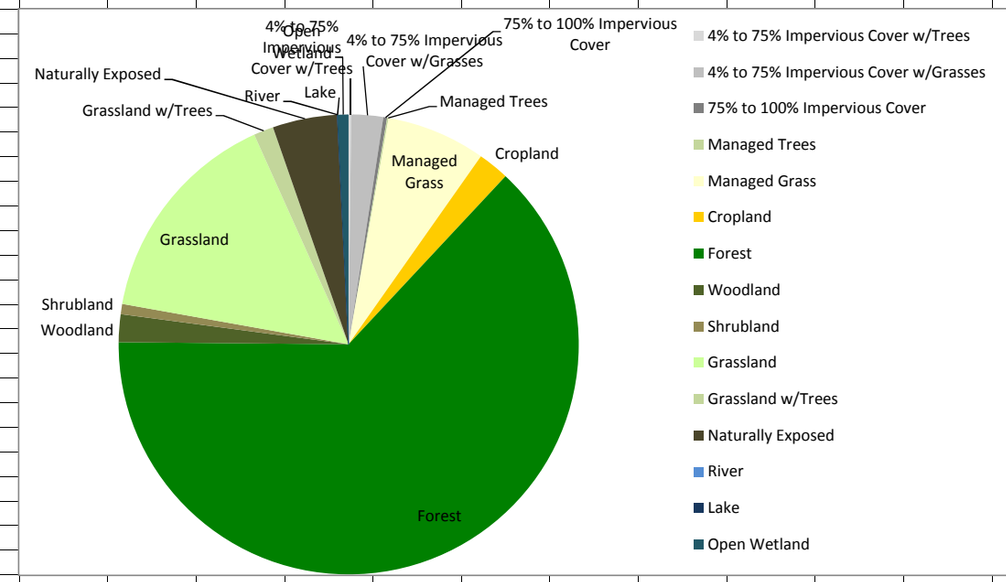
MLCCS Table Value	Table Data	Label
11000	0.15%	4% to 75% Impervious Cover w/Trees
13000	2.27%	4% to 75% Impervious Cover w/Grasses
14000	0.58%	75% to 100% Impervious Cover
21000	0.02%	Managed Trees
23000	3.50%	Managed Grass
24000	3.08%	Cropland
32000	49.23%	Forest
42000	1.07%	Woodland
52000	1.45%	Shrubland
61000	37.01%	Grassland
62000	1.04%	Grassland w/Trees
80000	0.04%	Naturally Exposed
~~91000~~	~~0.00%~~	~~River~~
92000	0.53%	Lake
93000	0.05%	Open Wetland



Wabasha

MLCCS Code	Polygon Count	Area (meters)	Area (acres)	Percentage	Landuse Description
11210	13	25838.31	6.38	0.18%	4% to 10% Impervious Cover w/Trees
11230	3	750.61	0.19	0.01%	26% to 50% Impervious Cover w/Trees
13110	9	11666.30	2.88	0.08%	4% to 10% Impervious Cover w/Grasses and Sparse Trees
13120	20	27091.14	6.69	0.19%	11% to 25% Impervious Cover w/Grasses and Sparse Trees
13130	4	5459.22	1.35	0.04%	26% to 50% Impervious Cover w/Grasses and Sparse Trees
13140	1	1743.33	0.43	0.01%	51% to 75% Impervious Cover w/Grasses and Sparse Trees
13210	8	5649.34	1.40	0.04%	4% to 10% Impervious Cover w/Grasses
13220	16	9182.23	2.27	0.06%	11% to 25% Impervious Cover w/Grasses
13230	152	263605.94	65.14	1.81%	26% to 50% Impervious Cover w/Grasses
13240	1	19.28	0.00	0.00%	51% to 75% Impervious Cover w/Grasses
14110	3	4065.43	1.00	0.03%	76% to 90% Impervious Cover w/Buildings and Pavement
14120	27	29408.01	7.27	0.20%	91% to 100% Impervious Cover w/Buildings and Pavement
14210	9	5968.92	1.48	0.04%	0% to 10% Impervious Cover w/Exposed Earth
21000	12	13235.24	3.27	0.09%	Planted, Maintained, or Cultivated Trees
23200	273	1015275.82	250.88	6.97%	Planted and Maintained Grasses
24000	256	319635.82	78.98	2.20%	Cropland
32100	537	9030667.28	2231.53	62.02%	Upland Deciduous Forest
32200	26	174085.83	43.02	1.20%	Wetland Forest
42000	141	278741.36	68.88	1.91%	Woodland
42200	8	4851.05	1.20	0.03%	Wetland Woodland
52100	63	94948.01	23.46	0.65%	Upland Deciduous Shrublands
52300	4	10443.09	2.58	0.07%	Wetland Deciduous Shrublands
61200	709	1736125.96	429.01	11.92%	Upland Grassland
61300	39	110196.97	27.23	0.76%	Temporarily Flooded Grasslands
61400	12	89763.85	22.18	0.62%	Saturated Grasslands
61500	21	96916.23	23.95	0.67%	Seasonally Flooded Grasslands
61600	16	61205.57	15.12	0.42%	Semipermanently Flooded Grasslands
61700	14	56714.24	14.01	0.39%	Intermittently Exposed Grassland
61800	18	97376.44	24.06	0.67%	Permanently Flooded Grasslands
62100	105	189223.88	46.76	1.30%	Grassland w/Sparse Trees
62300	2	14702.93	3.63	0.10%	Temporarily Flooded Grassland w/Sparse Trees
83210	273	661997.09	163.58	4.55%	Sandy and Gravel Shores
93000	12	114470.46	28.29	0.79%	Open Wetland
TOTAL	**2807**	**14561025.21**	**3598.11**	**100.00%**	

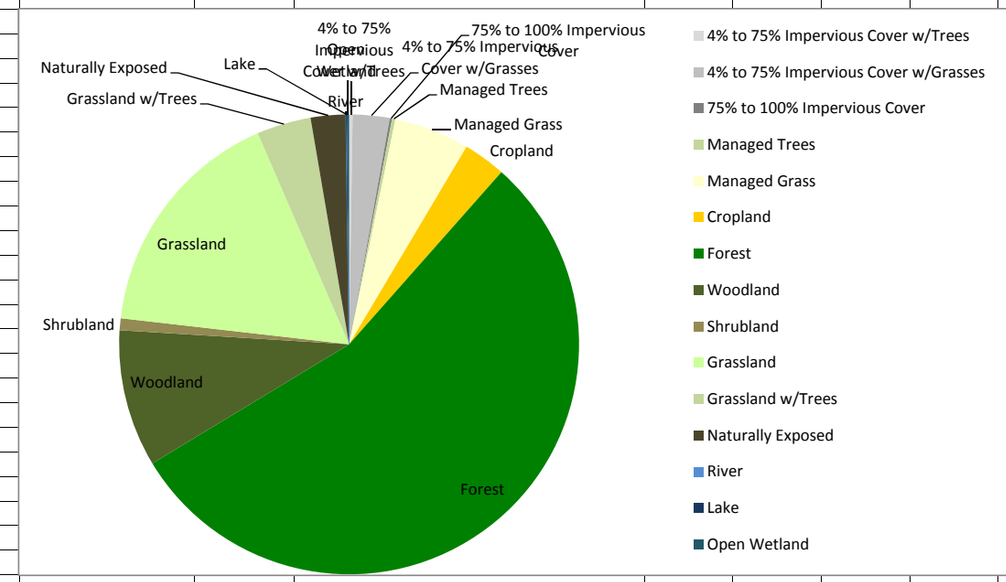
MLCCS Tab	Table Data	Label
11000	0.18%	4% to 75% Impervious Cover w/Trees
13000	2.23%	4% to 75% Impervious Cover w/Grasses
14000	0.27%	75% to 100% Impervious Cover
21000	0.09%	Managed Trees
23000	6.97%	Managed Grass
24000	2.20%	Cropland
32000	63.22%	Forest
42000	1.95%	Woodland
52000	0.72%	Shrubland
61000	15.44%	Grassland
62000	1.40%	Grassland w/Trees
80000	4.55%	Naturally Exposed
~~91000~~	~~0.00%~~	~~River~~
92000	0.00%	Lake
93000	0.79%	Open Wetland



Winona

MLCCS Code	Polygon Count	Area (meters)	Area (acres)	Percentage	Landuse Description
11210	25	29747.71	7.35	0.14%	4% to 10% Impervious Cover w/Trees
11220	18	18095.36	4.47	0.09%	11% to 25% Impervious Cover w/Trees
11230	5	4633.41	1.14	0.02%	26% to 50% Impervious Cover w/Trees
13110	18	34069.56	8.42	0.16%	4% to 10% Impervious Cover w/Grasses and Sparse Trees
13120	25	32314.67	7.99	0.15%	11% to 25% Impervious Cover w/Grasses and Sparse Trees
13130	11	2806.92	0.69	0.01%	26% to 50% Impervious Cover w/Grasses and Sparse Trees
13210	36	37561.80	9.28	0.18%	4% to 10% Impervious Cover w/Grasses
13220	23	15164.14	3.75	0.07%	11% to 25% Impervious Cover w/Grasses
13230	212	421538.15	104.16	2.00%	26% to 50% Impervious Cover w/Grasses
13240	4	1533.84	0.38	0.01%	51% to 75% Impervious Cover w/Grasses
14110	3	4920.82	1.22	0.02%	76% to 90% Impervious Cover w/Buildings and Pavement
14120	17	16187.49	4.00	0.08%	91% to 100% Impervious Cover w/Buildings and Pavement
14210	10	13848.02	3.42	0.07%	0% to 10% Impervious Cover w/Exposed Earth
21000	21	47777.04	11.81	0.23%	Planted, Maintained, or Cultivated Trees
23200	335	1121060.88	277.02	5.31%	Planted and Maintained Grasses
24000	330	626787.76	154.88	2.97%	Cropland
32100	587	11357976.52	2806.62	53.84%	Upland Deciduous Forest
32200	19	206582.17	51.05	0.98%	Wetland Forest
42000	335	2033905.81	502.59	9.64%	Woodland
42200	2	345.31	0.09	0.00%	Wetland Woodland
52100	93	178404.72	44.08	0.85%	Upland Deciduous Shrublands
61200	688	3344512.87	826.45	15.86%	Upland Grassland
61300	16	63549.16	15.70	0.30%	Temporarily Flooded Grasslands
61400	1	5294.46	1.31	0.03%	Saturated Grasslands
61500	2	1928.10	0.48	0.01%	Seasonally Flooded Grasslands
61600	12	33845.17	8.36	0.16%	Semipermanently Flooded Grasslands
61700	9	53113.30	13.12	0.25%	Intermittently Exposed Grassland
61800	9	17738.29	4.38	0.08%	Permanently Flooded Grasslands
62100	251	783576.35	193.63	3.71%	Grassland w/Sparse Trees
62300	4	18163.39	4.49	0.09%	Temporarily Flooded Grassland w/Sparse Trees
83210	177	518781.23	128.19	2.46%	Sandy and Gravel Shores
92000	1	12957.32	3.20	0.06%	Lake
93000	5	35567.81	8.79	0.17%	Open Wetland
TOTAL	**3304**	**21094289.57**	**5212.51**	**100.00%**	

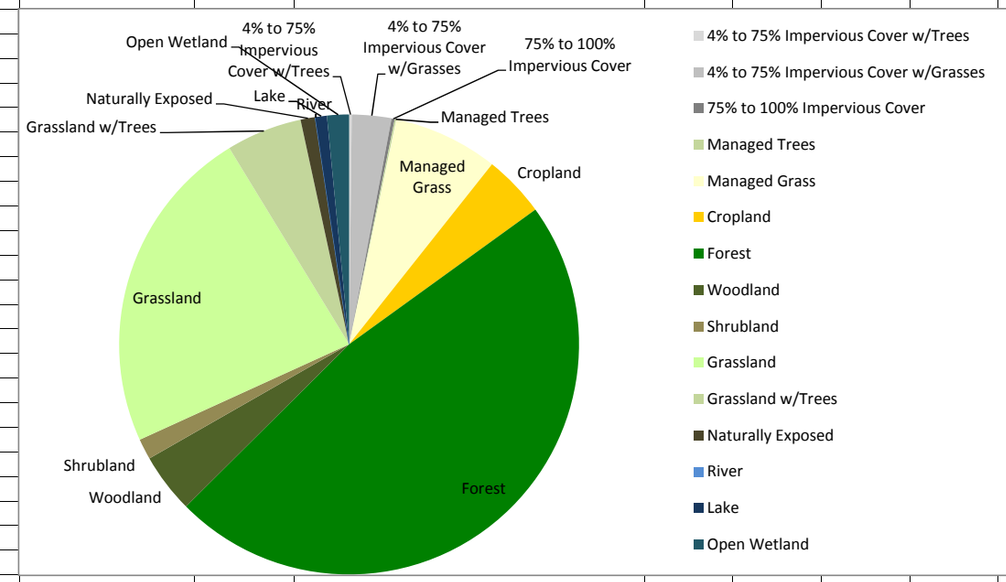
MLCCS Table Value	Table Data	Label
11000	0.25%	4% to 75% Impervious Cover w/Trees
13000	2.58%	4% to 75% Impervious Cover w/Grasses
14000	0.17%	75% to 100% Impervious Cover
21000	0.23%	Managed Trees
23000	5.31%	Managed Grass
24000	2.97%	Cropland
32000	54.82%	Forest
42000	9.64%	Woodland
52000	0.85%	Shrubland
61000	16.69%	Grassland
62000	3.80%	Grassland w/Trees
80000	2.46%	Naturally Exposed
~~91000~~	~~0.00%~~	~~River~~
92000	0.06%	Lake
93000	0.17%	Open Wetland



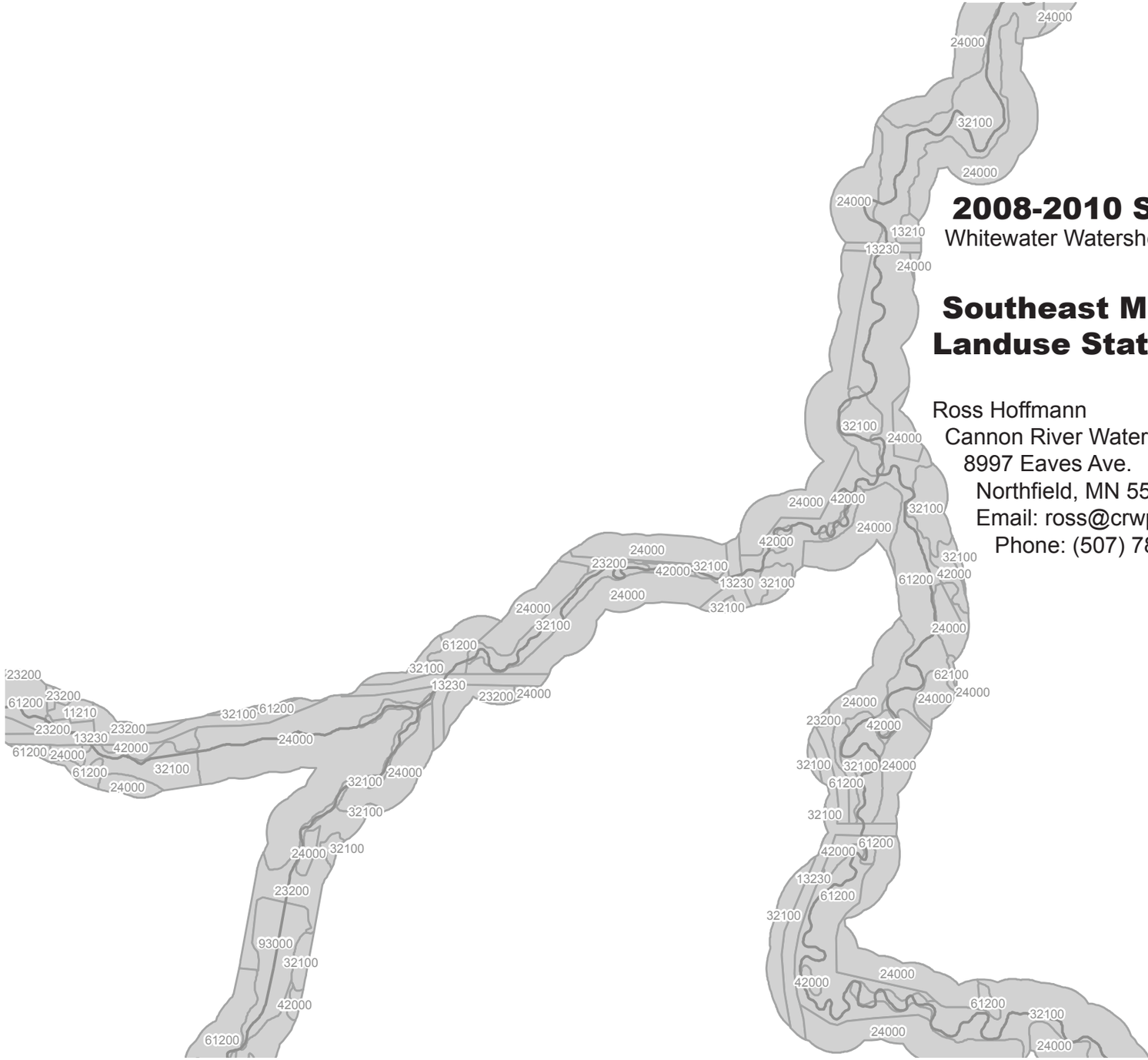
Region

MLCCS Code	Polygon Count	Area (meters)	Area (acres)	Percentage	Landuse Description
11210	106	128442.96	31.74	0.07%	4% to 10% Impervious Cover w/Trees
11220	91	90681.81	22.41	0.05%	11% to 25% Impervious Cover w/Trees
11230	58	74349.02	18.37	0.04%	26% to 50% Impervious Cover w/Trees
11240	24	33621.36	8.31	0.02%	51% to 75% Impervious Cover w/Trees
13110	154	149493.93	36.94	0.08%	4% to 10% Impervious Cover w/Grasses and Sparse Trees
13120	306	382269.76	94.46	0.20%	11% to 25% Impervious Cover w/Grasses and Sparse Trees
13130	73	50768.08	12.55	0.03%	26% to 50% Impervious Cover w/Grasses and Sparse Trees
13140	18	23730.81	5.86	0.01%	51% to 75% Impervious Cover w/Grasses and Sparse Trees
13210	179	150875.66	37.28	0.08%	4% to 10% Impervious Cover w/Grasses
13220	312	252867.42	62.48	0.13%	11% to 25% Impervious Cover w/Grasses
13230	2635	4153121.75	1026.26	2.21%	26% to 50% Impervious Cover w/Grasses
13240	54	59263.91	14.64	0.03%	51% to 75% Impervious Cover w/Grasses
14110	54	46814.16	11.57	0.02%	76% to 90% Impervious Cover w/Buildings and Pavement
14120	365	271896.01	67.19	0.14%	91% to 100% Impervious Cover w/Buildings and Pavement
14210	78	74012.91	18.29	0.04%	0% to 10% Impervious Cover w/Exposed Earth
14220	5	12949.33	3.20	0.01%	11% to 25% Impervious Cover w/Exposed Earth
14230	5	12490.53	3.09	0.01%	26% to 50% Impervious Cover w/Exposed Earth
21000	188	228993.71	56.59	0.12%	Planted, Maintained, or Cultivated Trees
23200	3240	13874743.06	3428.52	7.38%	Planted and Maintained Grasses
24000	4742	8147336.91	2013.25	4.34%	Cropland
32100	7299	85349218.47	21090.25	45.42%	Upland Deciduous Forest
32200	344	3979820.51	983.44	2.12%	Wetland Forest
42000	1814	7250805.83	1791.71	3.86%	Woodland
42200	95	606116.80	149.77	0.32%	Wetland Woodland
52100	1226	2576179.55	636.59	1.37%	Upland Deciduous Shrublands
52300	71	176126.04	43.52	0.09%	Wetland Deciduous Shrublands
61200	6110	38217833.20	9443.83	20.34%	Upland Grassland
61300	703	2705780.98	668.61	1.44%	Temporarily Flooded Grasslands
61400	155	1327360.23	328.00	0.71%	Saturated Grasslands
61500	75	455687.71	112.60	0.24%	Seasonally Flooded Grasslands
61600	67	225888.42	55.82	0.12%	Semipermanently Flooded Grasslands
61700	57	242708.29	59.97	0.13%	Intermittently Exposed Grassland
61800	70	179460.76	44.35	0.10%	Permanently Flooded Grasslands
62100	2091	9555339.14	2361.18	5.09%	Grassland w/Sparse Trees
62300	110	469966.68	116.13	0.25%	Temporarily Flooded Grassland w/Sparse Trees
81100	19	79402.88	19.62	0.04%	Cliffs
83210	881	1841229.08	454.98	0.98%	Sandy and Gravel Shores
92000	31	1554005.01	384.00	0.83%	Lake
93000	146	2888495.14	713.76	1.54%	Open Wetland
TOTAL	**34051**	**187900147.84**	**46431.14**	**100.00%**	

MLCCS Table Value	Table Data	Label
11000	0.17%	4% to 75% Impervious Cover w/Trees
13000	2.78%	4% to 75% Impervious Cover w/Grasses
14000	0.22%	75% to 100% Impervious Cover
21000	0.12%	Managed Trees
23000	7.38%	Managed Grass
24000	4.34%	Cropland
32000	47.54%	Forest
42000	4.18%	Woodland
52000	1.46%	Shrubland
61000	23.07%	Grassland
62000	5.34%	Grassland w/Trees
80000	1.02%	Naturally Exposed
~~91000~~	~~0.00%~~	~~River~~
92000	0.83%	Lake
93000	1.54%	Open Wetland



MLCCS code	Code Description
0	Unknown
10000	Artificial surfaces
11000	Artificial Surfaces w/Tree Cover
11210	4% to 10% Impervious Cover w/Trees
11220	11% to 25% Impervious Cover w/Trees
11230	26% to 50% Impervious Cover w/Trees
11240	51% to 75% Impervious Cover w/Trees
13000	Artificial Surfaces w/Grass Cover
13110	4% to 10% Impervious Cover w/Grasses and Sparse Trees
13120	11% to 25% Impervious Cover w/Grasses and Sparse Trees
13130	26% to 50% Impervious Cover w/Grasses and Sparse Trees
13140	51% to 75% Impervious Cover w/Grasses and Sparse Trees
13210	4% to 10% Impervious Cover w/Grasses
13220	11% to 25% Impervious Cover w/Grasses
13230	26% to 50% Impervious Cover w/Grasses
13240	51% to 75% Impervious Cover w/Grasses
14000	Artificial Surfaces w/Buildings and Pavement
14110	76% to 90% Impervious Cover w/Buildings and Pavement
14120	91% to 100% Impervious Cover w/Buildings and Pavement
14200	Artificially Exposed Earth
14210	0% to 10% Impervious Cover w/Exposed Earth
14220	11% to 25% Impervious Cover w/Exposed Earth
14230	26% to 50% Impervious Cover w/Exposed Earth
20000	Planted or Cultivated Vegetation
21000	Planted, Maintained, or Cultivated Trees
21100	Planted, Maintained, or Cultivated Coniferous Trees
21200	Planted, Maintained, or Cultivated Deciduous Trees
21300	Planted, Maintained, or Cultivated Mixed Trees
23200	Planted and Maintained Grasses
23211	Planted and Maintained Short Grasses
23212	Planted and Maintained Long Grasses
24000	Cropland
24110	Cropland on Upland Soils
24120	Cropland on Hydric Soils
30000	Forests
31100	Upland Coniferous Forest
31200	Wetland Coniferous Forest
32100	Upland Forest
32100	Upland Deciduous Forest
32200	Wetland Forest
32200	Wetland Deciduous Forest
32200	Wetland Forest
33100	Upland Mixed Forest
42000	Woodland
42200	Wetland Woodland
50000	Shrublands
51100	Wetland Coniferous/Evergreen Shrublands
52100	Upland Shrublands
52100	Upland Deciduous Shrublands
52300	Wetland Shrublands
52300	Wetland Deciduous Shrublands
60000	Herbaceous
61200	Upland Grassland
61300	Temporarily Flooded Grasslands
61400	Saturated Grasslands
61500	Seasonally Flooded Grasslands
61600	Semipermanently Flooded Grasslands
61700	Intermittently Exposed Grassland
61800	Permanently Flooded Grasslands
62100	Grassland w/Sparse Trees
62300	Temporarily Flooded Grassland w/Sparse Trees
80000	Sparse Vegetation
81100	Cliffs
81200	Upland Sparse Vegetation
82000	Upland Naturally Exposed Earth
83200	Wetland Sparse Vegetation
83210	Sandy and Gravel Shores
83310	Mud Flats
90000	Water
91000	River
92000	Lake
93000	Open Wetland



2008-2010 Shoreland Mapping Project

Whitewater Watershed Project/Cannon River Watershed Partnership

Southeast Minnesota Public Water Shoreland Landuse Statistics - 300ft. Shoreland Area

Ross Hoffmann
Cannon River Watershed Partnership
8997 Eaves Ave.
Northfield, MN 55057
Email: ross@crwp.net
Phone: (507) 786-3916

ENVIRONMENT AND NATURAL RESOURCES TRUST FUND

CRWP GIS
Cannon River Watershed Partnership

Project Detail:

Counties mapped include Dodge, Fillmore, Goodhue, Houston, Mower, Olmsted, Rice, Steele, Wabasha, and Winona.

Only public waterways as identified in the MN Department of Natural Resources' "24k Streams" GIS shapefile were mapped.

Landuse was primarily interpreted, mapped, and coded at a scale of 1:5,000 from 2008 FSA NAIP 1-meter resolution aerial photography for all counties.

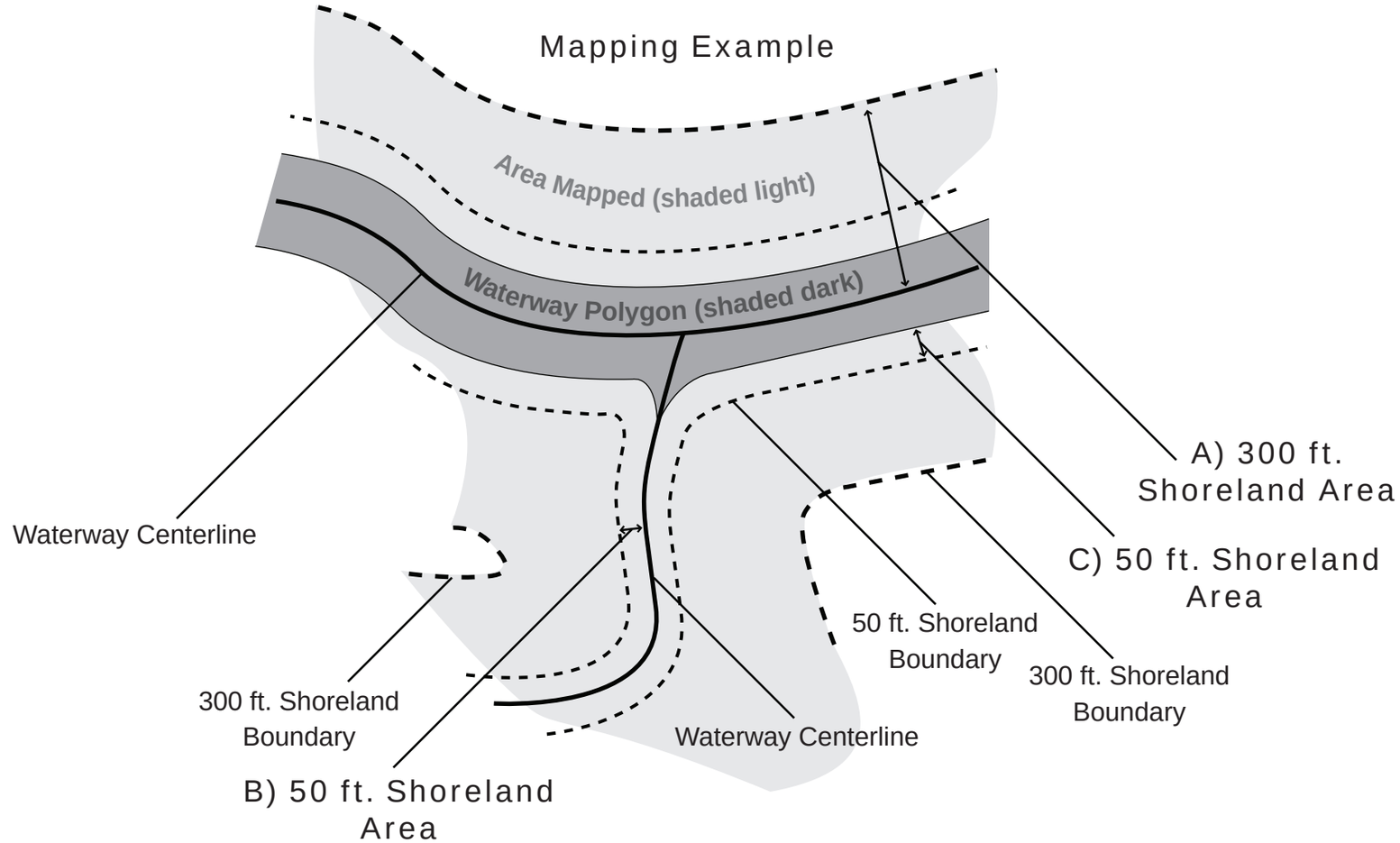
The 300 foot shoreland area is measured from the waterway centerline outward (perpendicular to flow), for a maximum diameter of 600 feet across the waterway (see **A** to right).

The 50 foot shoreland area is measured from the waterway centerline outward (perpendicular to flow) (see **B** to right), however, where a waterway is large enough to be mapped as a polygon, landuse within the 50 foot shoreland area is measured from the polygon edge outward (perpendicular to the shoreline) (see **C** to right).

While every effort was made to ensure the data correctly reflects landuse, CRWP cannot guarantee 100% accuracy; data is meant to reflect very basic landuse information (eg. forest, grassland, cropland, etc.)

Landuse codes are most accurate to level two only; landuse coding from level three and beyond has a high degree of interpretation (see example to right).

Mapping Example



Coding Level and Accuracy Example

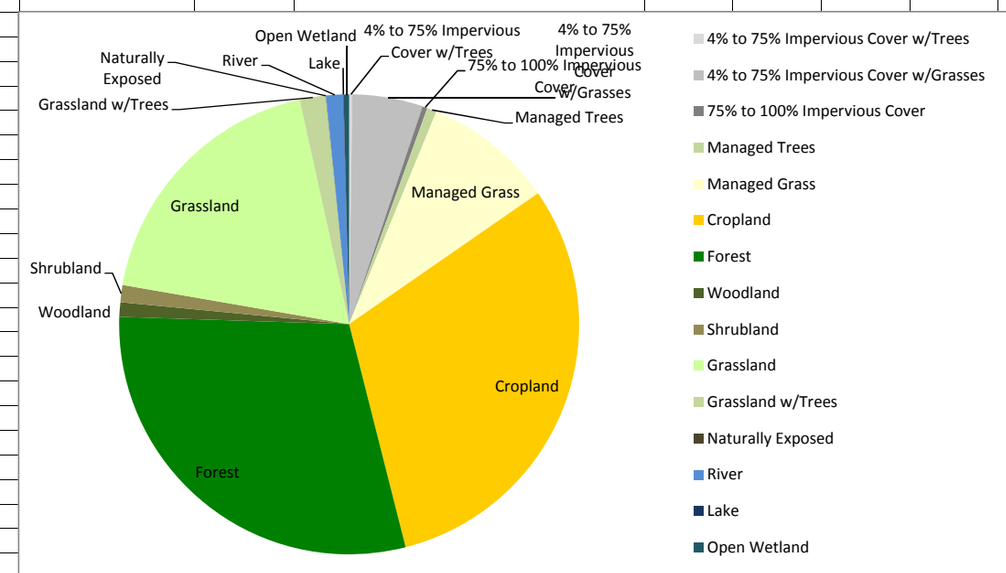
High Accuracy
- Level 1: **10000** - Impervious Surfaces
- Level 2: **11000** - Impervious Surfaces w/Tree Cover

Low Accuracy/ High Interpretation
- Level 3: **11200** - Impervious Surfaces w/Deciduous Tree Cover
- Level 4: **11210** - 4%-10% Impervious Cover w/Deciduous Tree Cover
- Level 5: **11213** - 4%-10% Impervious Cover w/Maple-Basswood Deciduous Tree Cover

Dodge

MLCCS Code	Polygon Count	Area (meters)	Area (acres)	Percentage	Landuse Description
11210	22	41082.13	10.15	0.06%	4% to 10% Impervious Cover w/Trees
11220	39	86947.69	21.49	0.13%	11% to 25% Impervious Cover w/Trees
11230	10	25027.65	6.18	0.04%	26% to 50% Impervious Cover w/Trees
13110	17	58513.89	14.46	0.09%	4% to 10% Impervious Cover w/Grasses and Sparse Trees
13120	44	172689.66	42.67	0.26%	11% to 25% Impervious Cover w/Grasses and Sparse Trees
13130	29	132930.96	32.85	0.20%	26% to 50% Impervious Cover w/Grasses and Sparse Trees
13140	1	6235.36	1.54	0.01%	51% to 75% Impervious Cover w/Grasses and Sparse Trees
13210	31	129420.84	31.98	0.19%	4% to 10% Impervious Cover w/Grasses
13220	79	321502.90	79.45	0.48%	11% to 25% Impervious Cover w/Grasses
13230	294	2468189.71	609.90	3.68%	26% to 50% Impervious Cover w/Grasses
13240	12	33536.64	8.29	0.05%	51% to 75% Impervious Cover w/Grasses
14110	12	57244.76	14.15	0.09%	76% to 90% Impervious Cover w/Buildings and Pavement
14120	59	141314.61	34.92	0.21%	91% to 100% Impervious Cover w/Buildings and Pavement
14210	4	19822.93	4.90	0.03%	0% to 10% Impervious Cover w/Exposed Earth
14220	1	8219.74	2.03	0.01%	11% to 25% Impervious Cover w/Exposed Earth
21000	129	448783.36	110.90	0.67%	Planted, Maintained, or Cultivated Trees
23200	700	6124600.72	1513.42	9.14%	Planted and Maintained Grasses
24000	981	20572079.45	5083.47	30.71%	Cropland
32100	832	19736897.68	4877.09	29.46%	Upland Deciduous Forest
42000	214	690944.16	170.74	1.03%	Woodland
52100	273	788543.84	194.85	1.18%	Upland Deciduous Shrublands
52300	2	10282.83	2.54	0.02%	Wetland Deciduous Shrublands
61200	810	12382458.03	3059.77	18.48%	Upland Grassland
61300	11	192781.17	47.64	0.29%	Temporarily Flooded Grasslands
61500	4	15304.73	3.78	0.02%	Seasonally Flooded Grasslands
61600	3	8462.82	2.09	0.01%	Semipermanently Flooded Grasslands
61700	1	544.45	0.13	0.00%	Intermittently Exposed Grassland
61800	9	10464.16	2.59	0.02%	Permanently Flooded Grasslands
62100	273	1217264.16	300.79	1.82%	Grassland w/Sparse Trees
83210	17	17697.26	4.37	0.03%	Sandy and Gravel Shores
91000	12	794656.88	196.36	1.19%	River
92000	1	15592.91	3.85	0.02%	Lake
93000	75	264302.62	65.31	0.39%	Open Wetland
TOTAL	**5001**	**66994340.67**	**16554.66**	**100.00%**	

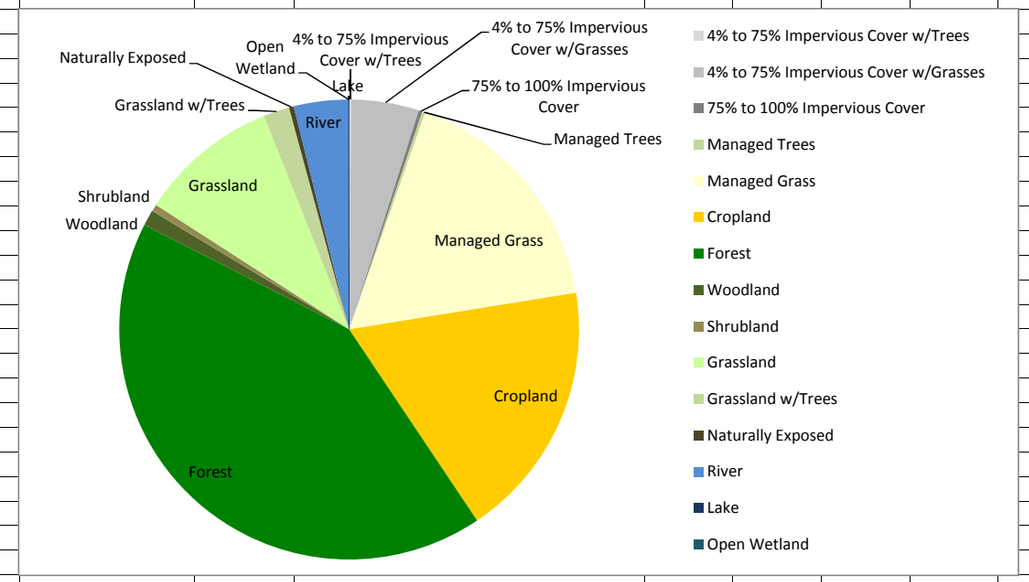
MLCCS Table Value	Table Data	Label
11000	0.23%	4% to 75% Impervious Cover w/Trees
13000	4.96%	4% to 75% Impervious Cover w/Grasses
14000	0.34%	75% to 100% Impervious Cover
21000	0.67%	Managed Trees
23000	9.14%	Managed Grass
24000	30.71%	Cropland
32000	29.46%	Forest
42000	1.03%	Woodland
52000	1.19%	Shrubland
61000	18.82%	Grassland
62000	1.82%	Grassland w/Trees
80000	0.03%	Naturally Exposed
91000	1.19%	River
92000	0.02%	Lake
93000	0.39%	Open Wetland



Fillmore

MLCCS Code	Polygon Count	Area (meters)	Area (acres)	Percentage	Landuse Description
11210	52	158519.51	39.17	0.09%	4% to 10% Impervious Cover w/Trees
11220	26	58890.15	14.55	0.03%	11% to 25% Impervious Cover w/Trees
11230	12	31962.96	7.90	0.02%	26% to 50% Impervious Cover w/Trees
13110	40	110469.25	27.30	0.06%	4% to 10% Impervious Cover w/Grasses and Sparse Trees
13120	72	247779.15	61.23	0.14%	11% to 25% Impervious Cover w/Grasses and Sparse Trees
13130	25	79361.50	19.61	0.04%	26% to 50% Impervious Cover w/Grasses and Sparse Trees
13140	3	16653.05	4.12	0.01%	51% to 75% Impervious Cover w/Grasses and Sparse Trees
13210	88	273037.53	67.47	0.15%	4% to 10% Impervious Cover w/Grasses
13220	191	616398.21	152.32	0.35%	11% to 25% Impervious Cover w/Grasses
13230	603	7031556.26	1737.54	3.96%	26% to 50% Impervious Cover w/Grasses
13240	18	78159.66	19.31	0.04%	51% to 75% Impervious Cover w/Grasses
14110	6	40807.62	10.08	0.02%	76% to 90% Impervious Cover w/Buildings and Pavement
14120	91	219024.17	54.12	0.12%	91% to 100% Impervious Cover w/Buildings and Pavement
14210	32	213999.32	52.88	0.12%	0% to 10% Impervious Cover w/Exposed Earth
14220	1	3076.56	0.76	0.00%	11% to 25% Impervious Cover w/Exposed Earth
21000	68	359753.62	88.90	0.20%	Planted, Maintained, or Cultivated Trees
23200	1945	30328083.15	7494.23	17.08%	Planted and Maintained Grasses
24000	1614	32220286.31	7961.81	18.15%	Cropland
32100	2416	74446194.06	18396.06	41.93%	Upland Deciduous Forest
42000	379	1957056.03	483.60	1.10%	Woodland
42200	3	4507.81	1.11	0.00%	Wetland Woodland
52100	262	870632.80	215.14	0.49%	Upland Deciduous Shrublands
52300	4	10666.90	2.64	0.01%	Wetland Deciduous Shrublands
61200	1632	16473589.09	4070.71	9.28%	Upland Grassland
61300	297	906158.90	223.92	0.51%	Temporarily Flooded Grasslands
61800	46	71206.05	17.60	0.04%	Permanently Flooded Grasslands
62100	579	3032692.63	749.39	1.71%	Grassland w/Sparse Trees
62300	48	223342.91	55.19	0.13%	Temporarily Flooded Grassland w/Sparse Trees
83210	278	593917.86	146.76	0.33%	Sandy and Gravel Shores
91000	73	6847877.06	1692.15	3.86%	River
93000	18	37105.20	9.17	0.02%	Open Wetland
TOTAL	**10922**	**177562765.27**	**43876.72**	**100.00%**	

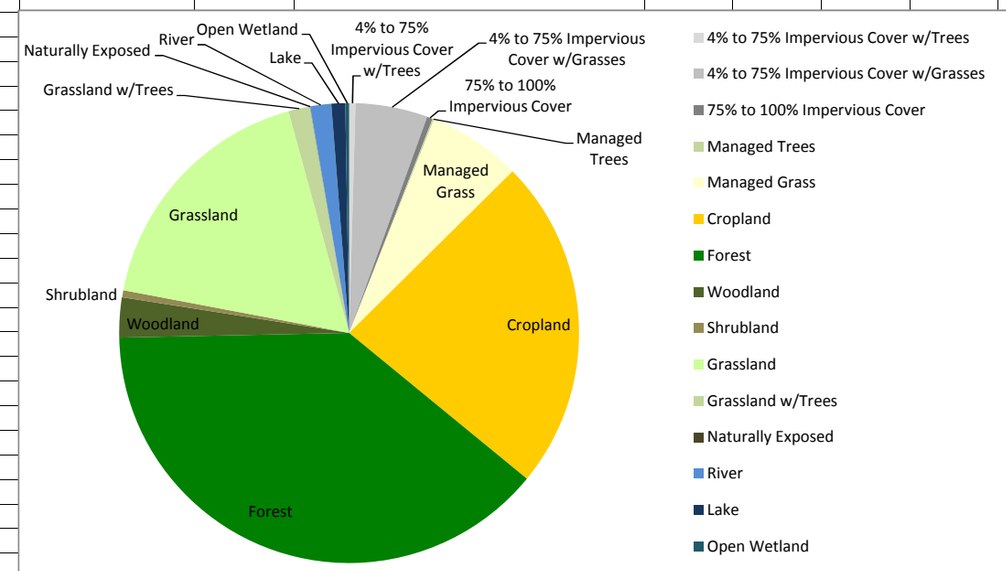
MLCCS Table Value	Table Data	Label
11000	0.14%	4% to 75% Impervious Cover w/Trees
13000	4.76%	4% to 75% Impervious Cover w/Grasses
14000	0.27%	75% to 100% Impervious Cover
21000	0.20%	Managed Trees
23000	17.08%	Managed Grass
24000	18.15%	Cropland
32000	41.93%	Forest
42000	1.10%	Woodland
52000	0.50%	Shrubland
61000	9.83%	Grassland
62000	1.83%	Grassland w/Trees
80000	0.33%	Naturally Exposed
91000	3.86%	River
92000	0.00%	Lake
93000	0.02%	Open Wetland



Goodhue

MLCCS Code	Polygon Count	Area (meters)	Area (acres)	Percentage	Landuse Description
11210	62	242204.11	59.85	0.17%	4% to 10% Impervious Cover w/Trees
11220	64	280014.71	69.19	0.20%	11% to 25% Impervious Cover w/Trees
11230	14	77056.01	19.04	0.06%	26% to 50% Impervious Cover w/Trees
11240	2	15485.20	3.83	0.01%	51% to 75% Impervious Cover w/Trees
13110	43	205564.57	50.80	0.15%	4% to 10% Impervious Cover w/Grasses and Sparse Trees
13120	77	369657.66	91.34	0.26%	11% to 25% Impervious Cover w/Grasses and Sparse Trees
13130	17	122600.77	30.30	0.09%	26% to 50% Impervious Cover w/Grasses and Sparse Trees
13140	8	82609.81	20.41	0.06%	51% to 75% Impervious Cover w/Grasses and Sparse Trees
13210	74	240221.58	59.36	0.17%	4% to 10% Impervious Cover w/Grasses
13220	157	628592.09	155.33	0.45%	11% to 25% Impervious Cover w/Grasses
13230	514	5385397.14	1330.76	3.86%	26% to 50% Impervious Cover w/Grasses
13240	12	68508.94	16.93	0.05%	51% to 75% Impervious Cover w/Grasses
14110	18	134033.81	33.12	0.10%	76% to 90% Impervious Cover w/Buildings and Pavement
14120	64	275100.41	67.98	0.20%	91% to 100% Impervious Cover w/Buildings and Pavement
14210	14	110703.26	27.36	0.08%	0% to 10% Impervious Cover w/Exposed Earth
14220	1	10550.68	2.61	0.01%	11% to 25% Impervious Cover w/Exposed Earth
21000	34	142255.57	35.15	0.10%	Planted, Maintained, or Cultivated Trees
23200	832	9155893.72	2262.47	6.56%	Planted and Maintained Grasses
24000	1591	32570605.36	8048.37	23.34%	Cropland
32100	1204	54020374.65	13348.73	38.72%	Upland Deciduous Forest
32200	12	62078.91	15.34	0.04%	Wetland Forest
42000	490	3646061.71	900.96	2.61%	Woodland
42200	14	260290.24	64.32	0.19%	Wetland Woodland
52100	152	666737.77	164.75	0.48%	Upland Deciduous Shrublands
52300	11	49499.34	12.23	0.04%	Wetland Deciduous Shrublands
61200	1578	22797038.79	5633.27	16.34%	Upland Grassland
61300	61	1432119.10	353.88	1.03%	Temporarily Flooded Grasslands
61400	18	165493.60	40.89	0.12%	Saturated Grasslands
61500	6	49160.78	12.15	0.04%	Seasonally Flooded Grasslands
61600	16	167928.44	41.50	0.12%	Semipermanently Flooded Grasslands
61700	5	90074.91	22.26	0.06%	Intermittently Exposed Grassland
61800	27	81263.02	20.08	0.06%	Permanently Flooded Grasslands
62100	305	1826437.47	451.32	1.31%	Grassland w/Sparse Trees
62300	15	270820.30	66.92	0.19%	Temporarily Flooded Grassland w/Sparse Trees
83210	23	42579.34	10.52	0.03%	Sandy and Gravel Shores
91000	18	2044553.17	505.22	1.47%	River
92000	4	1378157.93	340.55	0.99%	Lake
93000	14	352771.74	87.17	0.25%	Open Wetland
TOTAL	**7571**	**139520496.63**	**34476.27**	**100.00%**	

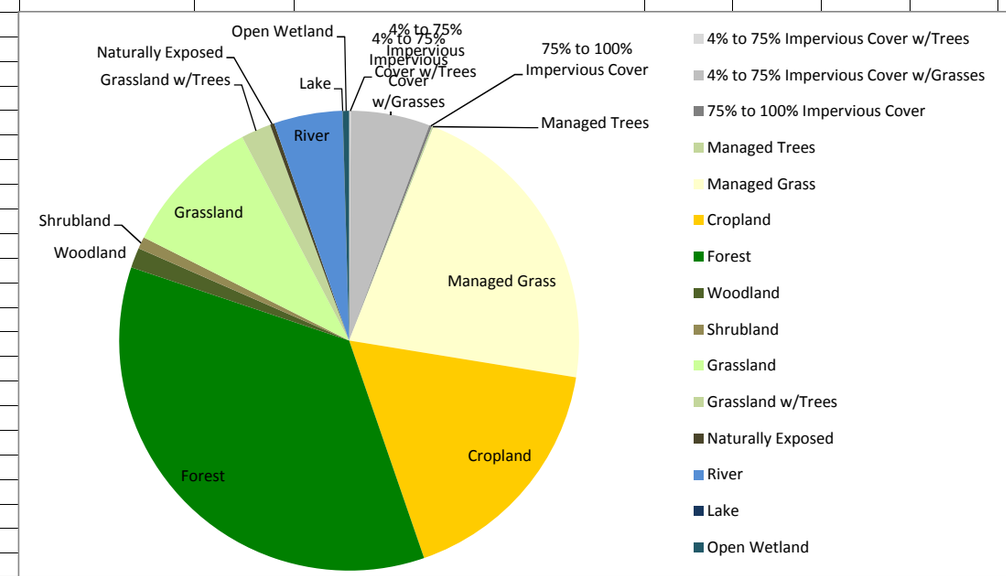
MLCCS Table Value	Table Data	Label
11000	0.44%	4% to 75% Impervious Cover w/Trees
13000	5.09%	4% to 75% Impervious Cover w/Grasses
14000	0.38%	75% to 100% Impervious Cover
21000	0.10%	Managed Trees
23000	6.56%	Managed Grass
24000	23.34%	Cropland
32000	38.76%	Forest
42000	2.80%	Woodland
52000	0.51%	Shrubland
61000	17.76%	Grassland
62000	1.50%	Grassland w/Trees
80000	0.03%	Naturally Exposed
91000	1.47%	River
92000	0.99%	Lake
93000	0.25%	Open Wetland



Houston

MLCCS Code	Polygon Count	Area (meters)	Area (acres)	Percentage	Landuse Description
11210	19	78014.78	19.28	0.09%	4% to 10% Impervious Cover w/Trees
11220	13	29878.38	7.38	0.03%	11% to 25% Impervious Cover w/Trees
13110	23	80354.91	19.86	0.09%	4% to 10% Impervious Cover w/Grasses and Sparse Trees
13120	40	145507.52	35.96	0.17%	11% to 25% Impervious Cover w/Grasses and Sparse Trees
13130	4	22374.95	5.53	0.03%	26% to 50% Impervious Cover w/Grasses and Sparse Trees
13140	1	23789.37	5.88	0.03%	51% to 75% Impervious Cover w/Grasses and Sparse Trees
13210	66	233457.86	57.69	0.27%	4% to 10% Impervious Cover w/Grasses
13220	157	587988.81	145.30	0.67%	11% to 25% Impervious Cover w/Grasses
13230	355	3775953.58	933.06	4.30%	26% to 50% Impervious Cover w/Grasses
13240	2	13191.33	3.26	0.02%	51% to 75% Impervious Cover w/Grasses
14120	46	33501.71	8.28	0.04%	91% to 100% Impervious Cover w/Buildings and Pavement
14210	14	126109.42	31.16	0.14%	0% to 10% Impervious Cover w/Exposed Earth
21000	25	107977.91	26.68	0.12%	Planted, Maintained, or Cultivated Trees
23200	1080	18945980.17	4681.65	21.57%	Planted and Maintained Grasses
24000	818	15068969.76	3723.62	17.16%	Cropland
32100	1781	30428430.35	7519.03	34.65%	Upland Deciduous Forest
32200	24	707258.67	174.77	0.81%	Wetland Forest
42000	263	1111936.35	274.77	1.27%	Woodland
42200	13	118280.97	29.23	0.13%	Wetland Woodland
52100	195	685109.21	169.29	0.78%	Upland Deciduous Shrublands
52300	14	51995.49	12.85	0.06%	Wetland Deciduous Shrublands
61200	701	6776222.66	1674.44	7.72%	Upland Grassland
61300	88	519730.00	128.43	0.59%	Temporarily Flooded Grasslands
61400	17	558652.92	138.05	0.64%	Saturated Grasslands
61500	16	147668.48	36.49	0.17%	Seasonally Flooded Grasslands
61600	11	60406.88	14.93	0.07%	Semipermanently Flooded Grasslands
61700	11	485639.29	120.00	0.55%	Intermittently Exposed Grassland
61800	20	130383.21	32.22	0.15%	Permanently Flooded Grasslands
62100	341	1629212.99	402.59	1.86%	Grassland w/Sparse Trees
62300	30	229802.13	56.79	0.26%	Temporarily Flooded Grassland w/Sparse Trees
81100	2	4741.08	1.17	0.01%	Cliffs
83210	84	257754.84	63.69	0.29%	Sandy and Gravel Shores
91000	24	4229679.21	1045.18	4.82%	River
92000	1	34395.39	8.50	0.04%	Lake
93000	47	382843.80	94.60	0.44%	Open Wetland
TOTAL	**6346**	**87823194.35**	**21701.58**	**100.00%**	

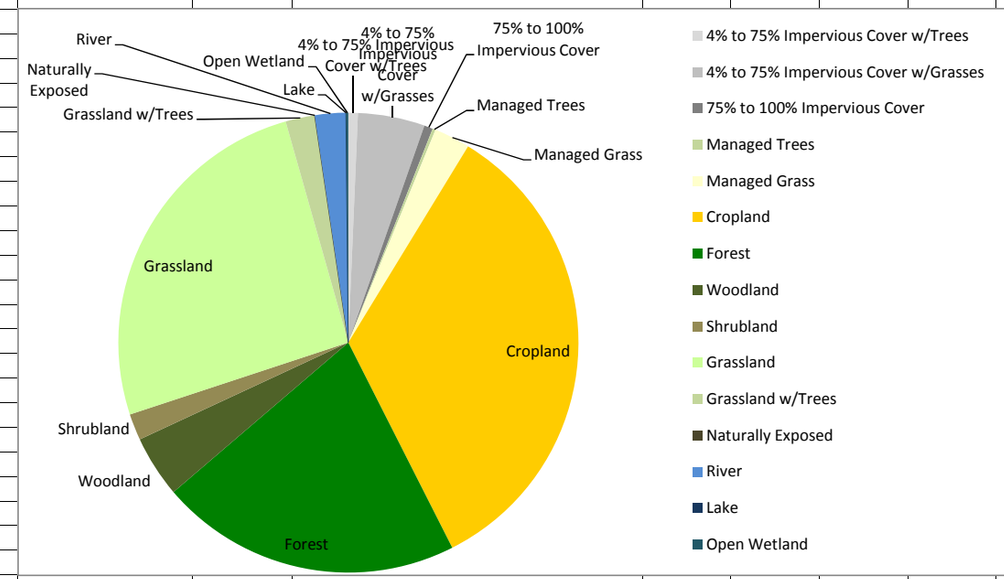
MLCCS Table Value	Table Data	Label
11000	0.12%	4% to 75% Impervious Cover w/Trees
13000	5.56%	4% to 75% Impervious Cover w/Grasses
14000	0.18%	75% to 100% Impervious Cover
21000	0.12%	Managed Trees
23000	21.57%	Managed Grass
24000	17.16%	Cropland
32000	35.45%	Forest
42000	1.40%	Woodland
52000	0.84%	Shrubland
61000	9.88%	Grassland
62000	2.12%	Grassland w/Trees
80000	0.29%	Naturally Exposed
91000	4.82%	River
92000	0.04%	Lake
93000	0.44%	Open Wetland



Mower

MLCCS Code	Polygon Count	Area (meters)	Area (acres)	Percentage	Landuse Description
11210	42	158090.57	39.07	0.14%	4% to 10% Impervious Cover w/Trees
11220	48	231274.02	57.15	0.20%	11% to 25% Impervious Cover w/Trees
11230	49	340969.27	84.26	0.30%	26% to 50% Impervious Cover w/Trees
11240	5	22351.67	5.52	0.02%	51% to 75% Impervious Cover w/Trees
13110	33	211080.59	52.16	0.18%	4% to 10% Impervious Cover w/Grasses and Sparse Trees
13120	56	423360.43	104.61	0.37%	11% to 25% Impervious Cover w/Grasses and Sparse Trees
13130	33	206480.98	51.02	0.18%	26% to 50% Impervious Cover w/Grasses and Sparse Trees
13140	5	54176.49	13.39	0.05%	51% to 75% Impervious Cover w/Grasses and Sparse Trees
13210	56	258760.20	63.94	0.23%	4% to 10% Impervious Cover w/Grasses
13220	89	551024.18	136.16	0.48%	11% to 25% Impervious Cover w/Grasses
13230	434	3627075.46	896.27	3.15%	26% to 50% Impervious Cover w/Grasses
13240	13	79576.13	19.66	0.07%	51% to 75% Impervious Cover w/Grasses
14110	34	208766.97	51.59	0.18%	76% to 90% Impervious Cover w/Buildings and Pavement
14120	74	298730.49	73.82	0.26%	91% to 100% Impervious Cover w/Buildings and Pavement
14210	33	178448.40	44.10	0.16%	0% to 10% Impervious Cover w/Exposed Earth
14220	2	14081.86	3.48	0.01%	11% to 25% Impervious Cover w/Exposed Earth
21000	60	242144.05	59.84	0.21%	Planted, Maintained, or Cultivated Trees
23200	348	2903437.90	717.46	2.53%	Planted and Maintained Grasses
24000	1593	38898252.52	9611.97	33.83%	Cropland
32100	626	18300573.64	4522.17	15.92%	Upland Deciduous Forest
32200	129	6076879.52	1501.63	5.29%	Wetland Forest
42000	272	3735547.45	923.07	3.25%	Woodland
42200	62	1264046.30	312.35	1.10%	Wetland Woodland
52100	381	1943822.80	480.33	1.69%	Upland Deciduous Shrublands
52300	30	183719.87	45.40	0.16%	Wetland Deciduous Shrublands
61200	1084	25411664.44	6279.36	22.10%	Upland Grassland
61300	210	3816582.85	943.10	3.32%	Temporarily Flooded Grasslands
61400	3	16466.91	4.07	0.01%	Saturated Grasslands
61500	1	4549.20	1.12	0.00%	Seasonally Flooded Grasslands
61600	15	80400.99	19.87	0.07%	Semipermanently Flooded Grasslands
61700	55	119798.39	29.60	0.10%	Intermittently Exposed Grassland
61800	18	41796.37	10.33	0.04%	Permanently Flooded Grasslands
62100	149	2162667.24	534.41	1.88%	Grassland w/Sparse Trees
62300	19	190238.73	47.01	0.17%	Temporarily Flooded Grassland w/Sparse Trees
83210	2	2413.22	0.60	0.00%	Sandy and Gravel Shores
91000	58	2509877.90	620.20	2.18%	River
93000	61	196207.86	48.48	0.17%	Open Wetland
TOTAL	**6182**	**114965335.87**	**28408.55**	**100.00%**	

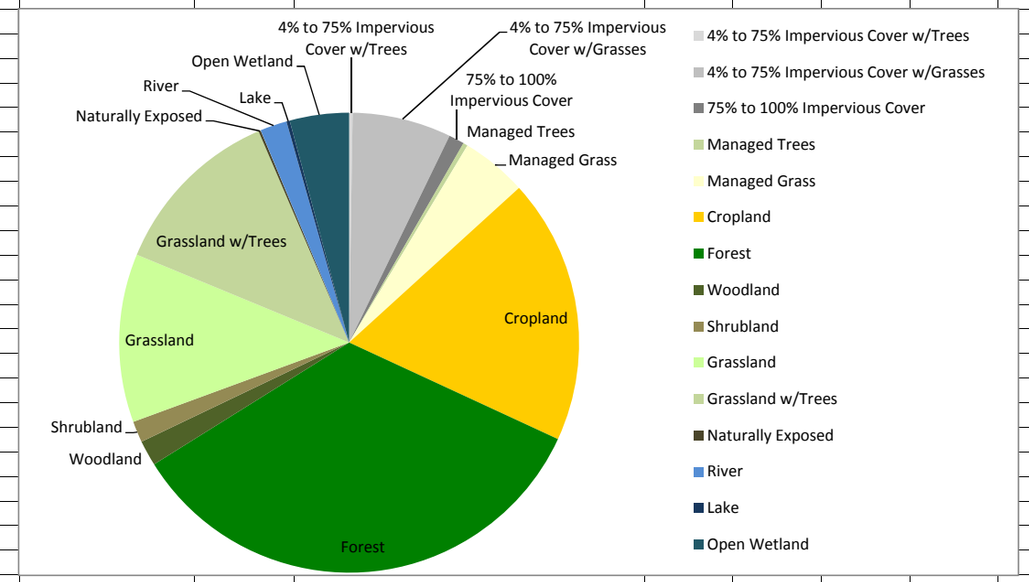
MLCCS Table Value	Table Data	Label
11000	0.65%	4% to 75% Impervious Cover w/Trees
13000	4.71%	4% to 75% Impervious Cover w/Grasses
14000	0.61%	75% to 100% Impervious Cover
21000	0.21%	Managed Trees
23000	2.53%	Managed Grass
24000	33.83%	Cropland
32000	21.20%	Forest
42000	4.35%	Woodland
52000	1.85%	Shrubland
61000	25.65%	Grassland
62000	2.05%	Grassland w/Trees
80000	0.00%	Naturally Exposed
91000	2.18%	River
92000	0.00%	Lake
93000	0.17%	Open Wetland



Olmsted

MLCCS Code	Polygon Count	Area (meters)	Area (acres)	Percentage	Landuse Description
11210	18	92793.03	22.93	0.08%	4% to 10% Impervious Cover w/Trees
11220	15	26014.16	6.43	0.02%	11% to 25% Impervious Cover w/Trees
11230	20	148815.48	36.77	0.12%	26% to 50% Impervious Cover w/Trees
11240	7	14247.57	3.52	0.01%	51% to 75% Impervious Cover w/Trees
13110	205	1105705.21	273.23	0.92%	4% to 10% Impervious Cover w/Grasses and Sparse Trees
13120	336	2429387.77	600.31	2.02%	11% to 25% Impervious Cover w/Grasses and Sparse Trees
13130	89	348177.91	86.04	0.29%	26% to 50% Impervious Cover w/Grasses and Sparse Trees
13140	48	254599.13	62.91	0.21%	51% to 75% Impervious Cover w/Grasses and Sparse Trees
13210	58	260850.53	64.46	0.22%	4% to 10% Impervious Cover w/Grasses
13220	58	492878.31	121.79	0.41%	11% to 25% Impervious Cover w/Grasses
13230	406	3479434.72	859.79	2.89%	26% to 50% Impervious Cover w/Grasses
13240	2	7152.68	1.77	0.01%	51% to 75% Impervious Cover w/Grasses
14110	57	253021.04	62.52	0.21%	76% to 90% Impervious Cover w/Buildings and Pavement
14120	96	542995.79	134.18	0.45%	91% to 100% Impervious Cover w/Buildings and Pavement
14210	30	389222.50	96.18	0.32%	0% to 10% Impervious Cover w/Exposed Earth
14220	2	24697.58	6.10	0.02%	11% to 25% Impervious Cover w/Exposed Earth
14230	10	103816.36	25.65	0.09%	26% to 50% Impervious Cover w/Exposed Earth
21000	159	382452.75	94.51	0.32%	Planted, Maintained, or Cultivated Trees
23200	345	5582192.29	1379.39	4.64%	Planted and Maintained Grasses
24000	1132	22451058.61	5547.78	18.65%	Cropland
32100	1416	35135556.87	8682.19	29.19%	Upland Deciduous Forest
32200	174	6073800.31	1500.87	5.05%	Wetland Forest
42000	132	2122674.43	524.52	1.76%	Woodland
42200	11	36889.78	9.12	0.03%	Wetland Woodland
52100	182	1510444.32	373.24	1.25%	Upland Deciduous Shrublands
52300	33	283071.68	69.95	0.24%	Wetland Deciduous Shrublands
61200	756	11585447.65	2862.83	9.62%	Upland Grassland
61300	48	765546.64	189.17	0.64%	Temporarily Flooded Grasslands
61400	83	1338242.77	330.69	1.11%	Saturated Grasslands
61500	27	429554.93	106.15	0.36%	Seasonally Flooded Grasslands
61600	6	25275.04	6.25	0.02%	Semipermanently Flooded Grasslands
61800	13	115504.96	28.54	0.10%	Permanently Flooded Grasslands
62100	677	14607504.02	3609.59	12.13%	Grassland w/Sparse Trees
62300	7	216206.01	53.43	0.18%	Temporarily Flooded Grassland w/Sparse Trees
81100	21	186822.72	46.16	0.16%	Cliffs
83210	4	4978.45	1.23	0.00%	Sandy and Gravel Shores
91000	16	2274345.28	562.00	1.89%	River
92000	11	267351.33	66.06	0.22%	Lake
93000	130	5018942.54	1240.21	4.17%	Open Wetland
TOTAL	**6840**	**120387673.15**	**29748.44**	**100.00%**	

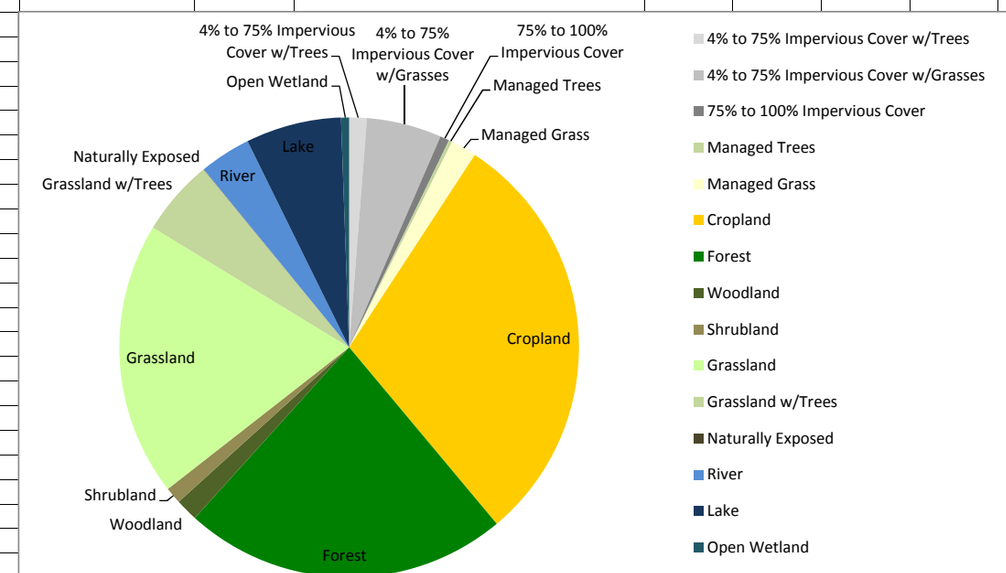
MLCCS Table Value	Table Data	Label
11000	0.23%	4% to 75% Impervious Cover w/Trees
13000	6.96%	4% to 75% Impervious Cover w/Grasses
14000	1.09%	75% to 100% Impervious Cover
21000	0.32%	Managed Trees
23000	4.64%	Managed Grass
24000	18.65%	Cropland
32000	34.23%	Forest
42000	1.79%	Woodland
52000	1.49%	Shrubland
61000	11.84%	Grassland
62000	12.31%	Grassland w/Trees
80000	0.16%	Naturally Exposed
91000	1.89%	River
92000	0.22%	Lake
93000	4.17%	Open Wetland



Rice

MLCCS Code	Polygon Count	Area (meters)	Area (acres)	Percentage	Landuse Description
11210	21	146116.20	36.11	0.14%	4% to 10% Impervious Cover w/Trees
11220	44	443519.27	109.60	0.44%	11% to 25% Impervious Cover w/Trees
11230	22	327047.37	80.82	0.32%	26% to 50% Impervious Cover w/Trees
11240	32	330777.01	81.74	0.33%	51% to 75% Impervious Cover w/Trees
13110	15	150319.79	37.14	0.15%	4% to 10% Impervious Cover w/Grasses and Sparse Trees
13120	49	664750.40	164.26	0.66%	11% to 25% Impervious Cover w/Grasses and Sparse Trees
13130	4	46674.06	11.53	0.05%	26% to 50% Impervious Cover w/Grasses and Sparse Trees
13210	65	662192.19	163.63	0.66%	4% to 10% Impervious Cover w/Grasses
13220	84	855254.06	211.34	0.85%	11% to 25% Impervious Cover w/Grasses
13230	261	2477827.71	612.28	2.46%	26% to 50% Impervious Cover w/Grasses
13240	32	453242.34	112.00	0.45%	51% to 75% Impervious Cover w/Grasses
14110	22	226704.47	56.02	0.22%	76% to 90% Impervious Cover w/Buildings and Pavement
14120	53	267380.11	66.07	0.27%	91% to 100% Impervious Cover w/Buildings and Pavement
14210	11	80596.08	19.92	0.08%	0% to 10% Impervious Cover w/Exposed Earth
14220	3	70910.70	17.52	0.07%	11% to 25% Impervious Cover w/Exposed Earth
21000	21	244218.50	60.35	0.24%	Planted, Maintained, or Cultivated Trees
23200	162	1825709.67	451.14	1.81%	Planted and Maintained Grasses
24000	1037	29957031.05	7402.54	29.72%	Cropland
32100	719	22921028.50	5663.91	22.74%	Upland Deciduous Forest
32200	4	37088.35	9.16	0.04%	Wetland Forest
42000	108	1589200.75	392.70	1.58%	Woodland
52100	144	1172178.18	289.65	1.16%	Upland Deciduous Shrublands
61200	679	14884136.28	3677.95	14.77%	Upland Grassland
61400	89	3259113.71	805.34	3.23%	Saturated Grasslands
61500	15	899849.51	222.36	0.89%	Seasonally Flooded Grasslands
61600	12	399689.95	98.77	0.40%	Semipermanently Flooded Grasslands
62100	193	5347475.81	1321.39	5.31%	Grassland w/Sparse Trees
62300	1	46216.62	11.42	0.05%	Temporarily Flooded Grassland w/Sparse Trees
83210	25	39860.95	9.85	0.04%	Sandy and Gravel Shores
91000	45	3626162.17	896.04	3.60%	River
92000	20	6775995.83	1674.39	6.72%	Lake
93000	36	564710.11	139.54	0.56%	Open Wetland
TOTAL	**4028**	**100792977.70**	**24906.49**	**100.00%**	

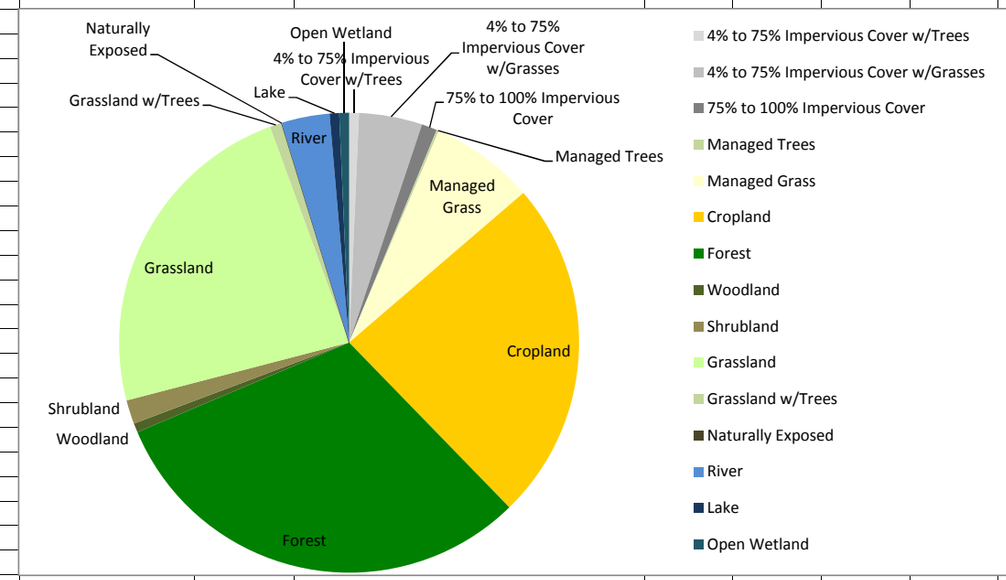
MLCCS Table Value	Table Data	Label
11000	1.24%	4% to 75% Impervious Cover w/Trees
13000	5.27%	4% to 75% Impervious Cover w/Grasses
14000	0.64%	75% to 100% Impervious Cover
21000	0.24%	Managed Trees
23000	1.81%	Managed Grass
24000	29.72%	Cropland
32000	22.78%	Forest
42000	1.58%	Woodland
52000	1.16%	Shrubland
61000	19.29%	Grassland
62000	5.35%	Grassland w/Trees
80000	0.04%	Naturally Exposed
91000	3.60%	River
92000	6.72%	Lake
93000	0.56%	Open Wetland



Steele

MLCCS Code	Polygon Count	Area (meters)	Area (acres)	Percentage	Landuse Description
11210	21	59290.61	14.65	0.19%	4% to 10% Impervious Cover w/Trees
11220	23	73285.79	18.11	0.23%	11% to 25% Impervious Cover w/Trees
11230	16	82731.91	20.44	0.26%	26% to 50% Impervious Cover w/Trees
11240	1	5864.15	1.45	0.02%	51% to 75% Impervious Cover w/Trees
13110	7	21801.73	5.39	0.07%	4% to 10% Impervious Cover w/Grasses and Sparse Trees
13120	31	103521.03	25.58	0.32%	11% to 25% Impervious Cover w/Grasses and Sparse Trees
13130	20	111374.44	27.52	0.35%	26% to 50% Impervious Cover w/Grasses and Sparse Trees
13140	2	15040.31	3.72	0.05%	51% to 75% Impervious Cover w/Grasses and Sparse Trees
13210	5	8657.47	2.14	0.03%	4% to 10% Impervious Cover w/Grasses
13220	61	272137.29	67.25	0.85%	11% to 25% Impervious Cover w/Grasses
13230	117	869610.34	214.89	2.71%	26% to 50% Impervious Cover w/Grasses
13240	3	20770.38	5.13	0.06%	51% to 75% Impervious Cover w/Grasses
14110	10	23060.36	5.70	0.07%	76% to 90% Impervious Cover w/Buildings and Pavement
14120	73	269692.13	66.64	0.84%	91% to 100% Impervious Cover w/Buildings and Pavement
14210	8	57561.27	14.22	0.18%	0% to 10% Impervious Cover w/Exposed Earth
21000	29	45812.81	11.32	0.14%	Planted, Maintained, or Cultivated Trees
23200	287	2349820.24	580.65	7.33%	Planted and Maintained Grasses
24000	334	7697584.60	1902.11	24.02%	Cropland
32100	475	9765605.55	2413.13	30.47%	Upland Deciduous Forest
32200	13	140244.13	34.66	0.44%	Wetland Forest
42000	48	203738.96	50.35	0.64%	Woodland
42200	2	2308.99	0.57	0.01%	Wetland Woodland
52100	159	485227.15	119.90	1.51%	Upland Deciduous Shrublands
52300	8	49987.18	12.35	0.16%	Wetland Deciduous Shrublands
61200	319	6542247.33	1616.62	20.42%	Upland Grassland
61300	64	847437.59	209.41	2.64%	Temporarily Flooded Grasslands
61400	10	76480.26	18.90	0.24%	Saturated Grasslands
61500	6	9202.39	2.27	0.03%	Seasonally Flooded Grasslands
61600	9	30747.53	7.60	0.10%	Semipermanently Flooded Grasslands
61700	1	7131.23	1.76	0.02%	Intermittently Exposed Grassland
61800	6	9136.88	2.26	0.03%	Permanently Flooded Grasslands
62100	58	259981.52	64.24	0.81%	Grassland w/Sparse Trees
62300	1	1294.12	0.32	0.00%	Temporarily Flooded Grassland w/Sparse Trees
83210	5	4275.73	1.06	0.01%	Sandy and Gravel Shores
91000	30	1086629.35	268.51	3.39%	River
92000	5	213975.21	52.87	0.67%	Lake
93000	53	221460.62	54.72	0.69%	Open Wetland
TOTAL	**2320**	**32044729**	**7918**	**100.00%**	

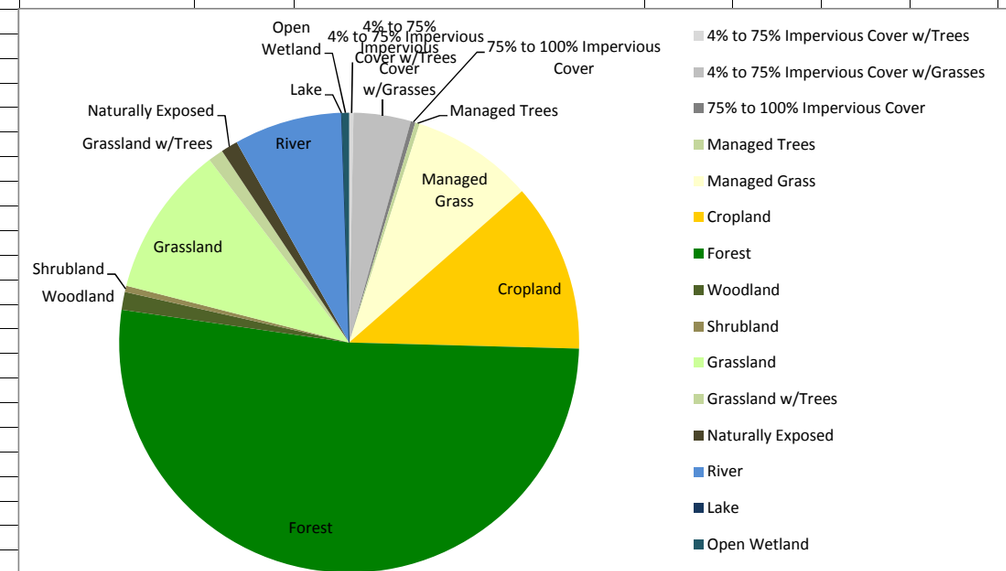
MLCCS Table Value	Table Data	Label
11000	0.69%	4% to 75% Impervious Cover w/Trees
13000	4.44%	4% to 75% Impervious Cover w/Grasses
14000	1.09%	75% to 100% Impervious Cover
21000	0.14%	Managed Trees
23000	7.33%	Managed Grass
24000	24.02%	Cropland
32000	30.91%	Forest
42000	0.64%	Woodland
52000	1.67%	Shrubland
61000	23.47%	Grassland
62000	0.82%	Grassland w/Trees
80000	0.01%	Naturally Exposed
91000	3.39%	River
92000	0.67%	Lake
93000	0.69%	Open Wetland



Wabasha

MLCCS Code	Polygon Count	Area (meters)	Area (acres)	Percentage	Landuse Description
11210	30	200223.12	49.48	0.25%	4% to 10% Impervious Cover w/Trees
11220	11	29074.76	7.18	0.04%	11% to 25% Impervious Cover w/Trees
11230	4	27025.15	6.68	0.03%	26% to 50% Impervious Cover w/Trees
13110	26	132586.28	32.76	0.16%	4% to 10% Impervious Cover w/Grasses and Sparse Trees
13120	45	252978.40	62.51	0.31%	11% to 25% Impervious Cover w/Grasses and Sparse Trees
13130	7	40311.74	9.96	0.05%	26% to 50% Impervious Cover w/Grasses and Sparse Trees
13140	1	10524.04	2.60	0.01%	51% to 75% Impervious Cover w/Grasses and Sparse Trees
13210	43	139497.65	34.47	0.17%	4% to 10% Impervious Cover w/Grasses
13220	67	240408.84	59.41	0.29%	11% to 25% Impervious Cover w/Grasses
13230	215	2464289.67	608.94	3.02%	26% to 50% Impervious Cover w/Grasses
13240	3	7131.68	1.76	0.01%	51% to 75% Impervious Cover w/Grasses
14110	5	29861.69	7.38	0.04%	76% to 90% Impervious Cover w/Buildings and Pavement
14120	39	128715.74	31.81	0.16%	91% to 100% Impervious Cover w/Buildings and Pavement
14210	24	93221.89	23.04	0.11%	0% to 10% Impervious Cover w/Exposed Earth
21000	46	260920.29	64.47	0.32%	Planted, Maintained, or Cultivated Trees
23200	583	7006866.63	1731.43	8.58%	Planted and Maintained Grasses
24000	562	9707903.83	2398.88	11.88%	Cropland
32100	873	41723296.66	10310.05	51.07%	Upland Deciduous Forest
32200	32	645292.30	159.46	0.79%	Wetland Forest
42000	188	986226.10	243.70	1.21%	Woodland
42200	10	39961.63	9.87	0.05%	Wetland Woodland
52100	115	318911.50	78.80	0.39%	Upland Deciduous Shrublands
52300	5	42816.71	10.58	0.05%	Wetland Deciduous Shrublands
61200	1089	6349580.26	1569.02	7.77%	Upland Grassland
61300	45	454798.45	112.38	0.56%	Temporarily Flooded Grasslands
61400	19	254499.74	62.89	0.31%	Saturated Grasslands
61500	28	501490.95	123.92	0.61%	Seasonally Flooded Grasslands
61600	26	574787.23	142.03	0.70%	Semipermanently Flooded Grasslands
61700	26	274352.61	67.79	0.34%	Intermittently Exposed Grassland
61800	42	278998.74	68.94	0.34%	Permanently Flooded Grasslands
62100	170	814997.99	201.39	1.00%	Grassland w/Sparse Trees
62300	2	46240.34	11.43	0.06%	Temporarily Flooded Grassland w/Sparse Trees
83210	273	968613.15	239.35	1.19%	Sandy and Gravel Shores
91000	41	6214159.62	1535.55	7.61%	River
93000	26	433178.94	107.04	0.53%	Open Wetland
TOTAL	**4721**	**81693744.32**	**20186.96**	**100.00%**	

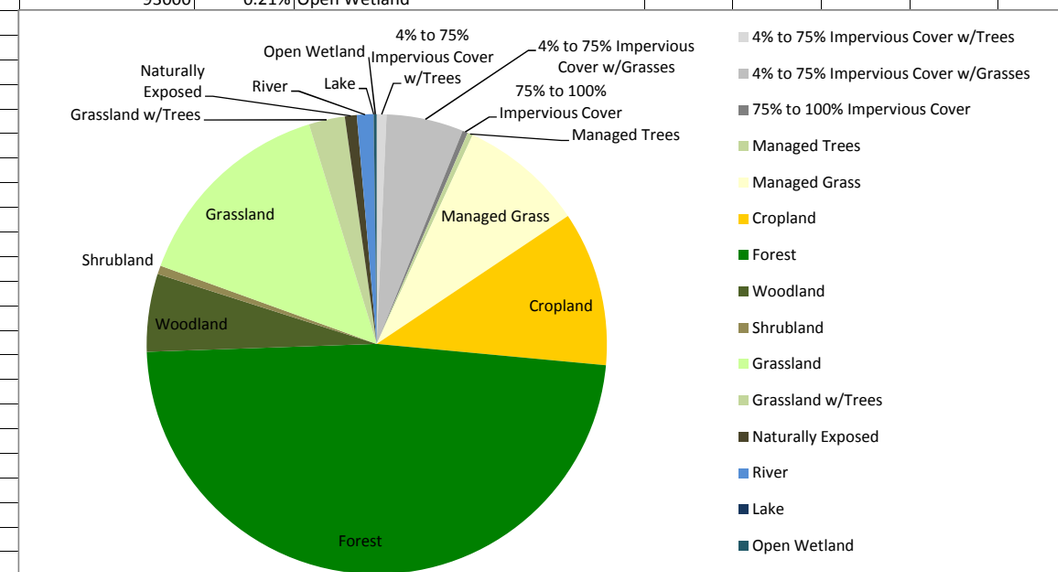
MLCCS Table Value	Table Data	Label
11000	0.31%	4% to 75% Impervious Cover w/Trees
13000	4.02%	4% to 75% Impervious Cover w/Grasses
14000	0.31%	75% to 100% Impervious Cover
21000	0.32%	Managed Trees
23000	8.58%	Managed Grass
24000	11.88%	Cropland
32000	51.86%	Forest
42000	1.26%	Woodland
52000	0.44%	Shrubland
61000	10.64%	Grassland
62000	1.05%	Grassland w/Trees
80000	1.19%	Naturally Exposed
91000	7.61%	River
92000	0.00%	Lake
93000	0.53%	Open Wetland



Winona

MLCCS Code	Polygon Count	Area (meters)	Area (acres)	Percentage	Landuse Description
11210	75	353754.49	87.41	0.31%	4% to 10% Impervious Cover w/Trees
11220	51	324721.15	80.24	0.28%	11% to 25% Impervious Cover w/Trees
11230	8	85703.35	21.18	0.07%	26% to 50% Impervious Cover w/Trees
11240	2	4955.33	1.22	0.00%	51% to 75% Impervious Cover w/Trees
13110	53	342038.63	84.52	0.30%	4% to 10% Impervious Cover w/Grasses and Sparse Trees
13120	63	448178.27	110.75	0.39%	11% to 25% Impervious Cover w/Grasses and Sparse Trees
13130	28	231857.26	57.29	0.20%	26% to 50% Impervious Cover w/Grasses and Sparse Trees
13210	80	417916.69	103.27	0.37%	4% to 10% Impervious Cover w/Grasses
13220	75	346917.10	85.73	0.30%	11% to 25% Impervious Cover w/Grasses
13230	282	4348495.42	1074.54	3.80%	26% to 50% Impervious Cover w/Grasses
13240	11	64085.04	15.84	0.06%	51% to 75% Impervious Cover w/Grasses
14110	11	69519.31	17.18	0.06%	76% to 90% Impervious Cover w/Buildings and Pavement
14120	40	272718.73	67.39	0.24%	91% to 100% Impervious Cover w/Buildings and Pavement
14210	14	78549.93	19.41	0.07%	0% to 10% Impervious Cover w/Exposed Earth
21000	44	427066.95	105.53	0.37%	Planted, Maintained, or Cultivated Trees
23200	602	10022784.33	2476.68	8.76%	Planted and Maintained Grasses
24000	663	12445939.25	3075.46	10.88%	Cropland
32100	906	53967446.36	13335.65	47.19%	Upland Deciduous Forest
32200	19	908564.94	224.51	0.79%	Wetland Forest
42000	450	6249082.23	1544.18	5.46%	Woodland
42200	1	444.15	0.11	0.00%	Wetland Woodland
52100	139	684673.21	169.19	0.60%	Upland Deciduous Shrublands
61200	998	15980035.99	3948.75	13.97%	Upland Grassland
61300	23	202546.35	50.05	0.18%	Temporarily Flooded Grasslands
61400	4	26703.71	6.60	0.02%	Saturated Grasslands
61500	5	8100.44	2.00	0.01%	Seasonally Flooded Grasslands
61600	19	233761.40	57.76	0.20%	Semipermanently Flooded Grasslands
61700	19	282263.62	69.75	0.25%	Intermittently Exposed Grassland
61800	19	90683.70	22.41	0.08%	Permanently Flooded Grasslands
62100	361	2871567.05	709.58	2.51%	Grassland w/Sparse Trees
62300	4	27427.82	6.78	0.02%	Temporarily Flooded Grassland w/Sparse Trees
83210	181	956965.68	236.47	0.84%	Sandy and Gravel Shores
91000	57	1323750.66	327.11	1.16%	River
92000	1	32191.56	7.95	0.03%	Lake
93000	17	236522.76	58.45	0.21%	Open Wetland
TOTAL	**5325**	**114367932.83**	**28260.93**	**100.00%**	

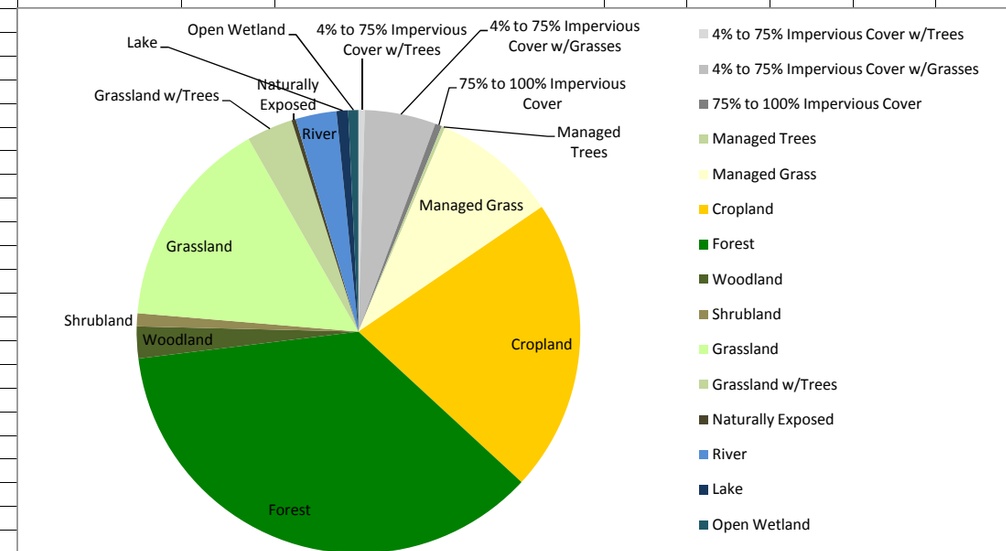
MLCCS Table Value	Table Data	Label
11000	0.67%	4% to 75% Impervious Cover w/Trees
13000	5.42%	4% to 75% Impervious Cover w/Grasses
14000	0.37%	75% to 100% Impervious Cover
21000	0.37%	Managed Trees
23000	8.76%	Managed Grass
24000	10.88%	Cropland
32000	47.98%	Forest
42000	5.46%	Woodland
52000	0.60%	Shrubland
61000	14.71%	Grassland
62000	2.53%	Grassland w/Trees
80000	0.84%	Naturally Exposed
91000	1.16%	River
92000	0.03%	Lake
93000	0.21%	Open Wetland



Region

MLCCS Code	Polygon Count	Area (meters)	Area (acres)	Percentage	Landuse Description
11210	362	1530088.55	378.09	0.15%	4% to 10% Impervious Cover w/Trees
11220	334	1583620.08	391.32	0.15%	11% to 25% Impervious Cover w/Trees
11230	155	1146339.14	283.27	0.11%	26% to 50% Impervious Cover w/Trees
11240	49	393680.93	97.28	0.04%	51% to 75% Impervious Cover w/Trees
13110	462	2418434.85	597.61	0.23%	4% to 10% Impervious Cover w/Grasses and Sparse Trees
13120	813	5257810.30	1299.23	0.51%	11% to 25% Impervious Cover w/Grasses and Sparse Trees
13130	256	1342144.57	331.65	0.13%	26% to 50% Impervious Cover w/Grasses and Sparse Trees
13140	69	463627.57	114.56	0.04%	51% to 75% Impervious Cover w/Grasses and Sparse Trees
13210	566	2624012.53	648.41	0.25%	4% to 10% Impervious Cover w/Grasses
13220	1018	4913101.78	1214.05	0.47%	11% to 25% Impervious Cover w/Grasses
13230	3481	35927830.02	8877.96	3.47%	26% to 50% Impervious Cover w/Grasses
13240	108	825354.81	203.95	0.08%	51% to 75% Impervious Cover w/Grasses
14110	175	1043020.03	257.74	0.10%	76% to 90% Impervious Cover w/Buildings and Pavement
14120	635	2449173.89	605.20	0.24%	91% to 100% Impervious Cover w/Buildings and Pavement
14210	184	1348235.00	333.16	0.13%	0% to 10% Impervious Cover w/Exposed Earth
14220	10	131537.12	32.50	0.01%	11% to 25% Impervious Cover w/Exposed Earth
14230	10	103816.36	25.65	0.01%	26% to 50% Impervious Cover w/Exposed Earth
21000	615	2661385.81	657.64	0.26%	Planted, Maintained, or Cultivated Trees
23200	6884	94245368.83	23288.54	9.10%	Planted and Maintained Grasses
24000	10325	221589710.72	54756.01	21.39%	Cropland
32100	11248	360445404.32	89068.00	34.79%	Upland Deciduous Forest
32200	407	14651207.12	3620.39	1.41%	Wetland Forest
42000	2544	22292468.16	5508.59	2.15%	Woodland
42200	116	1726729.87	426.68	0.17%	Wetland Woodland
52100	2002	9126280.78	2255.15	0.88%	Upland Deciduous Shrublands
52300	107	682040.01	168.54	0.07%	Wetland Deciduous Shrublands
61200	9646	139182420.51	34392.73	13.43%	Upland Grassland
61300	847	9137701.05	2257.98	0.88%	Temporarily Flooded Grasslands
61400	243	5695653.62	1407.43	0.55%	Saturated Grasslands
61500	108	2064881.42	510.24	0.20%	Seasonally Flooded Grasslands
61600	117	1581460.28	390.79	0.15%	Semipermanently Flooded Grasslands
61700	118	1259804.50	311.30	0.12%	Intermittently Exposed Grassland
61800	200	829437.08	204.96	0.08%	Permanently Flooded Grasslands
62100	3106	33769800.87	8344.70	3.26%	Grassland w/Sparse Trees
62300	127	1251588.97	309.27	0.12%	Temporarily Flooded Grassland w/Sparse Trees
81100	23	191563.80	47.34	0.02%	Cliffs
83210	892	2889056.48	713.90	0.28%	Sandy and Gravel Shores
91000	374	30951691.30	7648.33	2.99%	River
92000	43	8717660.16	2154.18	0.84%	Lake
93000	477	7708046.18	1904.70	0.74%	Open Wetland
TOTAL	**59256**	**1036153189.40**	**256039.03**	**100.00%**	

MLCCS Table Value	Table Data	Label
11000	0.45%	4% to 75% Impervious Cover w/Trees
13000	5.19%	4% to 75% Impervious Cover w/Grasses
14000	0.49%	75% to 100% Impervious Cover
21000	0.26%	Managed Trees
23000	9.10%	Managed Grass
24000	21.39%	Cropland
32000	36.20%	Forest
42000	2.32%	Woodland
52000	0.95%	Shrubland
61000	15.42%	Grassland
62000	3.38%	Grassland w/Trees
80000	0.30%	Naturally Exposed
91000	2.99%	River
92000	0.84%	Lake
93000	0.74%	Open Wetland



MLCCS code	Code Description
0	Unknown
10000	Artificial surfaces
11000	Artificial Surfaces w/Tree Cover
11210	4% to 10% Impervious Cover w/Trees
11220	11% to 25% Impervious Cover w/Trees
11230	26% to 50% Impervious Cover w/Trees
11240	51% to 75% Impervious Cover w/Trees
13000	Artificial Surfaces w/Grass Cover
13110	4% to 10% Impervious Cover w/Grasses and Sparse Trees
13120	11% to 25% Impervious Cover w/Grasses and Sparse Trees
13130	26% to 50% Impervious Cover w/Grasses and Sparse Trees
13140	51% to 75% Impervious Cover w/Grasses and Sparse Trees
13210	4% to 10% Impervious Cover w/Grasses
13220	11% to 25% Impervious Cover w/Grasses
13230	26% to 50% Impervious Cover w/Grasses
13240	51% to 75% Impervious Cover w/Grasses
14000	Artificial Surfaces w/Buildings and Pavement
14110	76% to 90% Impervious Cover w/Buildings and Pavement
14120	91% to 100% Impervious Cover w/Buildings and Pavement
14200	Artificially Exposed Earth
14210	0% to 10% Impervious Cover w/Exposed Earth
14220	11% to 25% Impervious Cover w/Exposed Earth
14230	26% to 50% Impervious Cover w/Exposed Earth
20000	Planted or Cultivated Vegetation
21000	Planted, Maintained, or Cultivated Trees
21100	Planted, Maintained, or Cultivated Coniferous Trees
21200	Planted, Maintained, or Cultivated Deciduous Trees
21300	Planted, Maintained, or Cultivated Mixed Trees
23200	Planted and Maintained Grasses
23211	Planted and Maintained Short Grasses
23212	Planted and Maintained Long Grasses
24000	Cropland
24110	Cropland on Upland Soils
24120	Cropland on Hydric Soils
30000	Forests
31100	Upland Coniferous Forest
31200	Wetland Coniferous Forest
32100	Upland Forest
32100	Upland Deciduous Forest
32200	Wetland Forest
32200	Wetland Deciduous Forest
32200	Wetland Forest
33100	Upland Mixed Forest
42000	Woodland
42200	Wetland Woodland
50000	Shrublands
51100	Wetland Coniferous/Evergreen Shrublands
52100	Upland Shrublands
52100	Upland Deciduous Shrublands
52300	Wetland Shrublands
52300	Wetland Deciduous Shrublands
60000	Herbaceous
61200	Upland Grassland
61300	Temporarily Flooded Grasslands
61400	Saturated Grasslands
61500	Seasonally Flooded Grasslands
61600	Semipermanently Flooded Grasslands
61700	Intermittently Exposed Grassland
61800	Permanently Flooded Grasslands
62100	Grassland w/Sparse Trees
62300	Temporarily Flooded Grassland w/Sparse Trees
80000	Sparse Vegetation
81100	Cliffs
81200	Upland Sparse Vegetation
82000	Upland Naturally Exposed Earth
83200	Wetland Sparse Vegetation
83210	Sandy and Gravel Shores
83310	Mud Flats
90000	Water
91000	River
92000	Lake
93000	Open Wetland

2007 & 2008 Project Abstract
For the Period Ending June 30, 2011

PROJECT TITLE: Intra-Lake Zoning to Protect Sensitive Lakeshore Areas
PROJECT MANAGER: Paul Radomski
AFFILIATION: Minnesota DNR
MAILING ADDRESS: 1601 Minnesota Drive
CITY/STATE/ZIP: Brainerd, MN 56401
PHONE: 218-828-8643
E-MAIL: paul.radomski@state.mn.us
WEBSITE: http://www.dnr.state.mn.us/eco/sli
FUNDING SOURCE: Environment and Natural Resources Trust Fund
LEGAL CITATION: ML 2007, Chap. 30, Sec. 2, Subd. 5(h); ML 2008, Chap. 367, Sec. 2, Subd. 4(e)

APPROPRIATION AMOUNT: $235,000 (2007: 110,000; 2008: 125,000)

Overall Project Outcome and Results

Protection of critical fish and wildlife habitat, particularly for 'species in greatest conservation need', is necessary given the substantial near-shore habitat losses estimated to date and the losses projected with future shoreland development. This cooperative Cass County/State project identified sensitive shoreland for the county's largest and most valuable waters. The project used objective, science-based criteria to identify sensitive shoreland parcels. Cass County selected seventeen lakes that were the highest priority for assessment (e.g., Ten Mile, Woman, and Leech). The objectives of this project were to: (1) identify and map sensitive shorelands, (2) develop and adopt shoreland ordinances to provide greater protection to sensitive areas, and (3) propose and implement zoning districts for identified sensitive shorelands.

Biological surveys were completed on the 17 priority lakes, as well as three connecting waterbodies.Species presence was recorded in extensive spatial detail. Botanists documented a total of 69 native aquatic plant taxa, including 42 submerged and free-floating, 7 floating-leaf, and 20 emergent taxa. Surveyors mapped over 2,000 acres of bulrush, and over 6,000 acres of other emergent and floating-leaf plant stands. Seventeen unique or rare plant species were documented. Biologists recorded four fish species in greatest conservation need. Pugnose shiners were the most widespread of these species, and were recorded on 10 study lakes. Longear sunfish, least darters, and greater redhorse were collected on four lakes each. Biologists documented 161 bird species, including 45 species in greatest conservation need. Four of these species are listed as Threatened in Minnesota and seven species are of Special Concern status. Mink and green frog breeding locations were identified on all surveyed lakes.

A total of 190.2 miles of shoreline, representing 40% of the total shoreline miles, were identified as sensitive. Nearly 28,000 acres of shoreland were identified as sensitive. Cass County proposed and adopted innovative zoning provisions within their shoreland ordinance to protect water quality and near-shore habitat.

Project Results Use and Dissemination

We completed sensitive lakeshore assessments on the 17 priority lakes, as well as three connecting waterbodies. Lake reports summarizing sensitive lakeshore assessments were completed for the 20 lakes. These reports describe the results of the biological surveys and provide maps of identified sensitive lakeshore. Reports were distributed to Cass County as well as to interested lake associations, organizations, and individuals. They are also available online at: http://www.dnr.state.mn.us/eco/sli

Public presentations explaining the sensitive area identification process and results were given to the Cass County Board of Commissioners, Cass County Planning Commission, Association of Cass County Lake Associations, U.S. Forest Service, multiple lake associations, and many other groups.

Several organizations have used the sensitive lakeshore identification information to help protect critical and vulnerable lakeshore areas. In 2010, Cass County received Environment & Natural Resource Trust Fund monies to provide assistance for donation of conservation easements to protect sensitive shoreland parcels in Cass County. The Leech Lake Area Watershed Foundation has identified large, undeveloped parcels that when overlaid with areas of sensitive shoreland have become priorities for conservation easements and acquisition. Recently implemented conservation easements on Wabedo Lake properties protect from development over 3500 feet of shoreline and nearly 70 acres of shoreland. Additional conservation easements that will protect another three to five miles of shoreline are currently in process. In addition, the information has been utilized within the DNR to help identify priority conservation areas (e.g., aquatic management areas). Finally, a project funded by an Outdoor Heritage Appropriation to the Leech Lake Area Watershed Foundation, Minnesota Land Trust, and DNR will pay for acquisition-related expenses and monitoring costs of donated permanent conservation easements on sensitive shorelands in north central Minnesota.

Cass County developed and adopted sensitive lakeshore and conservation subdivision ordinances. Other local governments are considering these ordinances for their own use. Crow Wing County modified Cass County's ordinance provisions for sensitive lakeshore protection, as the county is pursuing sensitive lakeshore zoning districts to better protect areas in their jurisdiction. In addition, the DNR used Cass County's conservation subdivision ordinance within its draft state shoreland standards.

Environment and Natural Trust Fund 2007 & 2008 Work Program
Final Report

Date of Report: August 15, 2011
Final Report
Date of Work program Approval: 2007 5(h) 6/5/07 / 2008 4(e) Jun 2008
Project Completion Date: June 30, 2011

I. PROJECT TITLE: Intra-Lake Zoning to Protect Sensitive Lakeshore Areas

Project Manager: Paul Radomski
Affiliation: Minnesota DNR
Mailing Address: 1601 Minnesota Drive
City / State / Zip : Brainerd, MN 56401
Telephone Number: 218-833-8643
E-mail Address: paul.radomski@state.mn.us
Fax Number: 218-828-6043
Web Page address: http://www.dnr.state.mn.us/eco/sli
Location: Cass County

Total Trust Fund Project Budget:	**2007**	**2008**	**Total**
Trust Fund Appropriation:	**$110,000**	**$125,000**	**$235,000**
Minus Amount Spent:	**$110,000**	**$124,836**	**$234,836**
Equal Balance:	**$0**	**$164**	**$164**

Legal Citation:
ML 2007, Chap. 30, Sec. 2, Subd. 5(h).
Appropriation Language: $110,000 is from the trust fund to the commissioner of natural resources in cooperation with Cass County to identify sensitive shorelines of the highest priority lakes to protect water quality and near-shore habitat through improved shoreland zoning by Cass County.

ML 2008, Chap. 367, Sec. 2, Subd. 4(e).
Appropriation Language: $125,000 is from the trust fund to the commissioner of natural resources for the second appropriation for a cooperative effort with Cass County to identify sensitive shorelines for the highest priority lakes and develop innovative zoning in Cass County to protect water quality and near-shore habitat. This appropriation is available until June 30, 2011, at which time the project must be completed and final products delivered, unless an earlier date is specified in the work program.

II. and III. FINAL PROJECT SUMMARY:

Protection of critical fish and wildlife habitat, particularly for 'species in greatest conservation need', is necessary given the substantial near-shore habitat losses estimated to date and the losses projected with future shoreland development. This cooperative Cass County/State project identified sensitive shoreland for the county's

largest and most valuable waters. The project used objective, science-based criteria to identify sensitive shoreland parcels. Cass County selected seventeen lakes that were the highest priority for assessment (e.g., Ten Mile, Woman, and Leech). The objectives of this project were to: (1) identify and map sensitive shorelands, (2) develop and adopt shoreland ordinances to provide greater protection to sensitive areas, and (3) propose and implement zoning districts for identified sensitive shorelands.

Biological surveys were completed on the 17 priority lakes, as well as three connecting waterbodies. Species presence was recorded in extensive spatial detail. Botanists documented a total of 69 native aquatic plant taxa, including 42 submerged and free-floating, 7 floating-leaf, and 20 emergent taxa. Surveyors mapped over 2,000 acres of bulrush, and over 6,000 acres of other emergent and floating-leaf plant stands. Seventeen unique or rare plant species were documented. Biologists recorded four fish species in greatest conservation need. Pugnose shiners were the most widespread of these species, and were recorded on 10 study lakes. Longear sunfish, least darters, and greater redhorse were collected on four lakes each. Biologists documented 161 bird species, including 45 species in greatest conservation need. Four of these species are listed as Threatened in Minnesota and seven species are of Special Concern status. Mink and green frog breeding locations were identified on all surveyed lakes.

A total of 190.2 miles of shoreline, representing 40% of the total shoreline miles, were identified as sensitive. Nearly 28,000 acres of shoreland were identified as sensitive. Cass County proposed and adopted innovative zoning provisions within their shoreland ordinance to protect water quality and near-shore habitat.

IV. OUTLINE OF PROJECT RESULTS*:*

Result 1: Identify and Map Sensitive Shorelands

Description: Conduct comprehensive field surveys of aquatic and near-shore habitat and animal presence using Minnesota's Sensitive Lakeshore Survey Protocol. Surveys will be completed for 17 of the highest priority lakes in Cass County. Ecological models will be used to assist in the determination of sensitive areas. Criteria in a spatial ecological model will come from the science-based surveys, and the value of the shoreland with regard to aquatic habitat and vulnerability to water quality degradation will be objectively assessed. Lake-specific reports and digital GIS files will be produced and delivered to Cass County.

Summary Budget Information for Result 1:

	2007	**2008**	**Total**
Trust Fund Budget:	**$110,000**	**$115,000**	**$225,000**
Amount Spent:	**$110,000**	**$114,836**	**$224,836**
Balance:	**$0**	**$164**	**$164**

Deliverable	**Completion Date**	**Budget**	**Status**

1. 4 lakes surveyed & mapped	Jun 2008	$58,000	complete
2. 5 lakes surveyed & mapped	Jun 2009	$60,000	complete
3. map critical habitat on Leech Lake	Jun 2010	$37,000	complete
4. 7 lakes surveyed & mapped	Jun 2010	$70,000	complete

Final Report Summary: We completed sensitive lakeshore assessments on the 17 priority lakes, as well as three connecting waterbodies. Aquatic plant surveys were completed, including the mapping of vulnerable bulrush beds on all lakes. Fish, bird and frog surveys were completed and locations of species presence were documented. An ecological model based on fundamental conservation principles was used to assess lakeshore sensitivity. The model incorporated the results of the biological surveys and analysis of additional data (e.g., soils, wetland presence, County Biological Survey data, etc.). A total of 15 attributes were used to identify sensitive lakeshore. Scores for each of the attributes were summed, and the resulting total score represents an index of sensitivity. Once the total score index was determined, clusters with similar values were identified using GIS. These areas were buffered and defined as most likely highly sensitive lakeshore. Lake reports summarizing sensitive lakeshore assessments were completed for the 20 lakes. These reports describe the results of the biological surveys and provide maps of identified sensitive lakeshore. These reports were distributed to Cass County as well as to interested lake associations, organizations, and individuals. They are also available online at:
http://www.dnr.state.mn.us/eco/sli

Public presentations explaining the sensitive area identification process and results were given to the Cass County Board of Commissioners, Cass County Planning Commission, Association of Cass County Lake Associations, U.S. Forest Service, multiple lake associations, and many other groups.

Result 2: Cass County Ordinance Development and Adoption for Sensitive Shorelands

Description: Cass County's Environmental Services staff will develop provisions in their land use ordinance that will require conservation-oriented development standards for reclassified bays and sensitive area districts. Minnesota's Alternative Shoreland Management Standards (version 1, December 12, 2005) will be used to provide guidance in the ordinance revision process. All required processes for public input, review and comment will be adhered to, including the rights afforded to challenge such proposed changes.

Summary Budget Information for Result 2:

	2007	**2008**	**Total**
Trust Fund Budget:	**$0**	**$2,500**	**$2,500**
Amount Spent:	**$0**	**$2,500**	**$2,500**
Balance:	**$0**	**$0**	**$0**

Deliverable	**Completion Date**	**Budget**	**Status**

1. Revised ordinance	Sept 2009	$2,500	complete

Completion Date: January 1, 2010 (ordinance went into effect)

Final Report Summary: On January 1, 2010, a new Cass County sensitive lakeshore ordinance went into effect. The ordinance details the process for shoreland reclassification based on sensitive lakeshore surveys of Result 1. The county process includes township involvement, Planning Commission review and decision-making criteria, public hearings, and DNR verification and approval. Sensitive lakeshores can be reclassified as resource protection districts or bays of lakes can be reclassified into the Natural Environment shoreland classification. New developments within reclassified shorelands will receive the most protective and the highest standards in the county, which exceed current state standards.

The purpose of this reclassification is to accommodate limited rural residential housing, agricultural uses and forest management activities in a fashion that protects sensitive lakeshores from the adverse effects of intensive development. This new ordinance will help minimize disturbance to critical aquatic and shoreland habitat, prevent damage from erosion, floods, siltation and water turbidity, prevent the loss of vegetation, fish, wildlife and natural habitat, protect the quality of ground and surface waters, and conserve natural and scenic areas within and adjacent to riparian areas for the community's benefit.

In addition, Cass County developed a conservation subdivision ordinance that the DNR is using as a draft state standard.

Result 3: Propose and Implement Zoning Districts for Sensitive Areas

Description: Cass County's Planning Commission will review locations and maps of sensitive shorelines. They will then propose and implement resource protection zoning districts based on the resources and conditions assessed in Result 1. Any districting or reclassification will proceed following Cass County's ordinance provisions on land use reclassification.

Summary Budget Information for Result 3:

	2007	**2008**	**Total**
Trust Fund Budget:	**$0**	**$7,500**	**$7,500**
Amount Spent:	**$0**	**$7,500**	**$7,500**
Balance:	**$0**	**$0**	**$0**

Deliverable	**Completion Date**	**Budget**	**Status**
1. Implement Zoning for 2 to 4 lakes	Oct 2009	5,000	
2. Implement Zoning for 2 to 4 lakes	Jun 2010	2,500	
3. Implement Zoning for 4 to 9 lakes	Jun 2011	0	

Completion Date:

Final Report Summary: Cass County reviewed locations and maps of sensitive areas and held numerous meetings with interested organizations on reclassification procedures. To date, no resource protection districts have been created to provide greater protection to identified sensitive lakeshore. Several organizations have used the sensitive lakeshore identification information to help protect critical and vulnerable lakeshore areas. The Leech Lake Area Watershed Foundation has mapped large, undeveloped parcels on each of the study lakes. These parcels, when overlaid with areas of sensitive shoreland, have become priorities for conservation easements and acquisition. Several landowners on Wabedo Lake recently implemented conservation easements on four properties, protecting from development over 3500 feet of shoreline and nearly 70 acres of shoreland. Additional conservation easements that will protect another three to five miles of shoreline are currently in process.

V. TOTAL TRUST FUND PROJECT BUDGET:

Staff or Contract Services: $198,000 total (2007: $84,000; 2008: $114,000); unclassified Natural Resource Specialist
Equipment: $37,000 total (2007: $31,000; 2008: $6,000)
Development: $ 0
Restoration: $ 0
Acquisition, including easements: $ 0

TOTAL TRUST FUND PROJECT BUDGET: $235,000 (2007: $110,000; 2008: $125,000)

Explanation of Capital Expenditures Greater Than $3,500: From the 2007 appropriation, $16,000 for one watercraft suitable for electrofishing, seining and trap net deployment. This equipment will continue to be used for its useful life within the DNR for comprehensive field surveys of aquatic and near-shore habitat and animal presence.

VI. OTHER FUNDS & PARTNERS:

A. Project Partners: Cass County, Environmental Services Department, John Sumption, Director ($10,000). Leech Lake Reservation, Division of Resources Management (LLRDRM), John Ringle.

B. Other Funds Proposed to be Spent during the Project Period: Four other funds were used to complete the project. Federal funding via a State Wildlife Grant and State funding to the Minnesota Department of Natural Resources were used. Cass County funded their activities related to this project ($25,000 per year in inkind value), and LLRDRM funded their activities ($10,000 in inkind value for field surveys).

C. Past Spending: SWG: $115,000 in FY09 state match; SWG: $150,000 in FY08; State: $150,000 in FY08; SWG: $135,000 in FY07; State: $150,000 in FY07 used to develop survey protocol. DNR staff provided additional technical advice to Cass County in FY06.

D. Time: This was a multi-year project ending on June 30, 2011. Several openwater seasons were needed to complete field surveys. The DNR completed its field work in FY10, and implementation of revised zoning ordinances in Cass County will continue.

VII. DISSEMINATION:

We completed sensitive lakeshore assessments on the 17 priority lakes, as well as three connecting waterbodies. Lake reports summarizing sensitive lakeshore assessments were completed for the 20 lakes. These reports describe the results of the biological surveys and provide maps of identified sensitive lakeshore. Reports were distributed to Cass County as well as to interested lake associations, organizations, and individuals. They are also available online at: http://www.dnr.state.mn.us/eco/sli

Public presentations explaining the sensitive area identification process and results were given to the Cass County Board of Commissioners, Cass County Planning Commission, Association of Cass County Lake Associations, U.S. Forest Service, multiple lake associations, and many other groups.

Several organizations have used the sensitive lakeshore identification information to help protect critical and vulnerable lakeshore areas. In 2010, Cass County received Environment & Natural Resource Trust Fund monies to provide assistance for donation of conservation easements to protect sensitive shoreland parcels in Cass County. The Leech Lake Area Watershed Foundation has identified large, undeveloped parcels that when overlaid with areas of sensitive shoreland have become priorities for conservation easements and acquisition. Recently implemented conservation easements on Wabedo Lake properties protect from development over 3500 feet of shoreline and nearly 70 acres of shoreland. Additional conservation easements that will protect another three to five miles of shoreline are currently in process. In addition, the information has been utilized within the DNR to help identify priority conservation areas (e.g., aquatic management areas). Finally, a project funded by an Outdoor Heritage Appropriation to the Leech Lake Area Watershed Foundation, Minnesota Land Trust, and DNR will pay for acquisition-related expenses and monitoring costs of donated permanent conservation easements on sensitive shorelands in north central Minnesota.

Cass County developed and adopted sensitive lakeshore and conservation subdivision ordinances. Other local governments are considering these ordinances for their own use. Crow Wing County modified Cass County's ordinance provisions for sensitive lakeshore protection, as the county is pursuing sensitive lakeshore zoning districts to better protect areas in their jurisdiction. In addition, the DNR used Cass County's conservation subdivision ordinance within its draft state shoreland standards.

VIII. REPORTING REQUIREMENTS:

Periodic work program progress reports were submitted on January 2008, November 2008, March 2009, November 2009, March 2010, and November 2010.

Figure 1. Locations of study lakes in Cass County.

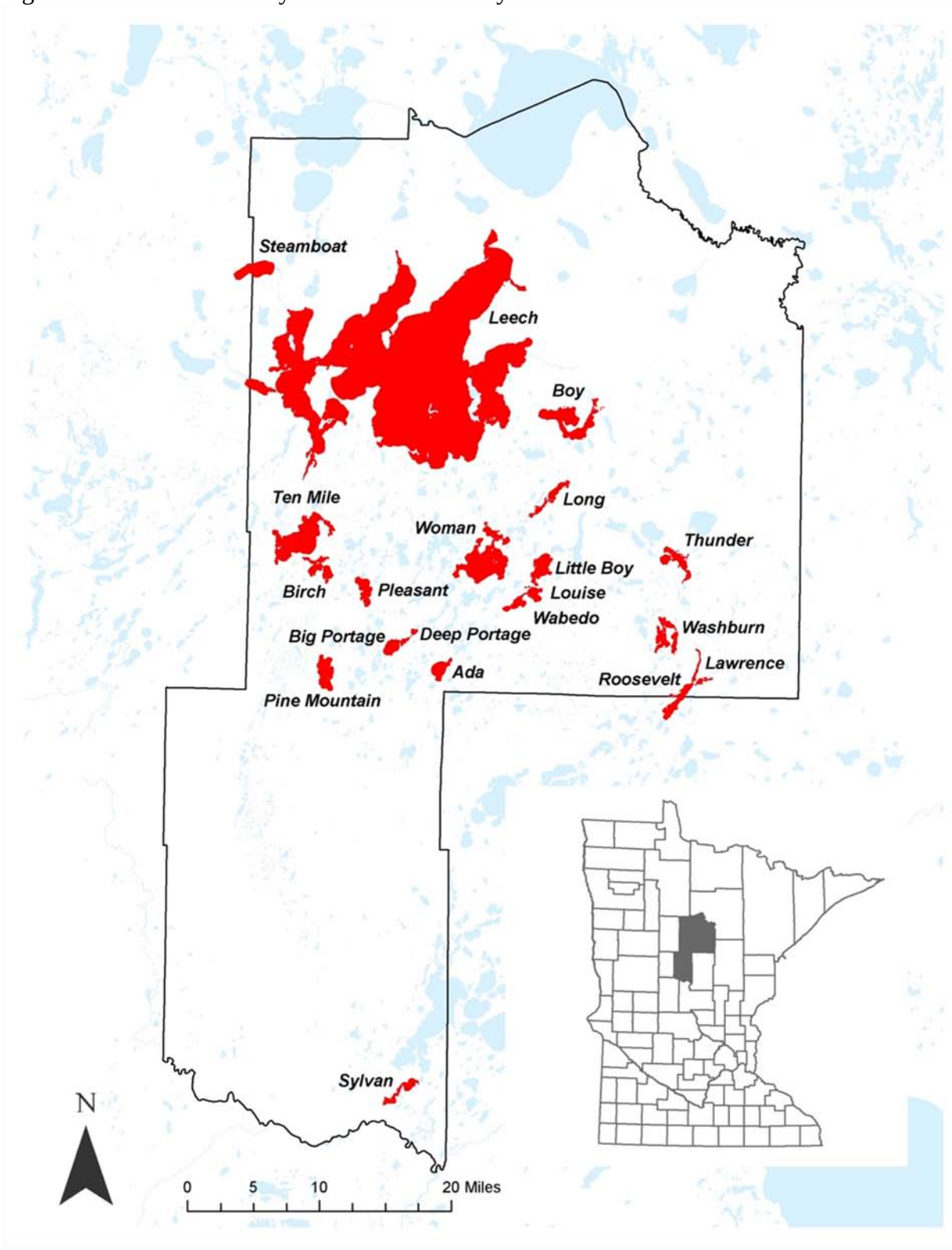


Table 1. Sensitive Lakeshore project study lakes.

Lake name	DOW number	Lake area (acres)	Shoreland area (acres)	Shoreline length (mi)
Ada	11-0250-00	1044	1096	7.5
Big Portage	11-0308-00	956	1131	7.7
Birch	11-0412-00	1262	1825	15.7
Boy	11-0143-00	3404	3412	25.9
Deep Portage	11-0237-00	129	416	1.9
Lawrence	11-0053-00	224	729	4.8
Leech	11-0203-00	~109000	25942	229.3
Little Boy	11-0167-00	1396	1412	10.0
Long	11-0142-00	926	1827	15.6
Louise	11-0537-00	22	305	1.2
Pine Mountain	11-0411-00	1657	1374	9.5
Pleasant	11-0383-00	1038	1214	9.0
Roosevelt	11-0043-00	1561	2597	18.4
Steamboat	11-0504-00	1761	1401	8.2
Sylvan	11-0304-00	882	1553	11.1
Ten Mile	11-0413-00	4640	3120	25.2
Thunder	11-0062-00	1316	1966	15.9
Wabedo	11-0171-00	1272	1704	11.3
Washburn	11-0059-00	1768	2188	19.5
Woman	11-0201-00	5360	3980	30.7

Table 2. Summary of aquatic vegetation survey results, 2006 – 2010.

Lake Name	Total acres	Acres surveyed	Number of survey points	Total aquatic taxa[a]	Submerged/ free-floating taxa	Floating-leaf taxa	Emergent taxa	Bulrush acres mapped	Other acres mapped	Unique/ rare species
Ada	1044	424	479	42	28	4	10	10	41	7
Big Portage	956	901	833	28	22	4	2	14	378	3
Birch	1262	755	1046	41	27	6	8	50	50	7
Boy	3404	2007	919	34	24	3	7	170	608	2
Deep Portage	123	31	132	18	11	4	3	13	2	3
Lawrence	225	87	351	33	23	3	7	36	8	2
Leech[b]	109415	57994	NA	NA	NA	NA	NA	1315	4613	NA
Little Boy	1396	466	577	35	22	4	9	163	39	1
Long	926	356	1501	45	29	5	11	3	34	10
Louise	33	–	85	26	19	3	4	0	12	1
Pine Mountain	1657	737	829	39	22	5	12	153	150	2
Pleasant	1038	410	503	38	26	4	8	3	51	6
Roosevelt	1561	390	992	37	24	6	7	32	20	0
Steamboat	1761	532	632	30	20	3	7	90	27	1
Sylvan	882	367	420	35	25	4	6	6	125	4
Ten Mile	4640	1316	1465	47	28	6	13	NA[c]	NA	7
Thunder	1316	226	1160	33	21	4	8	36	9	1
Wabedo	1272	295	526	27	17	5	5	39	55	0
Washburn	1768	748	703	55	34	5	16	NA	NA	6
Woman	5360	1953	2126	41	28	4	9	NA	NA	6

[a] Total aquatic taxa, submerged/free-floating taxa, floating-leaf taxa, and emergent taxa numbers were obtained from grid point-intercept surveys and near-shore surveys. Wetland and terrestrial plant species recorded during near-shore surveys are not included in these results. Plant taxa documented by the Minnesota County Biological Survey are not included with these results. In addition, the totals include only native plant taxa.

[b] Results include only those collected during the Sensitive Lakeshore Survey project. Some Leech Lake results are not included, as the grid point-intercept plant surveys that took place on this lake were conducted as part of another project.

[c] NA - Minnesota Department of Natural Resources Area Fisheries crews conducted the emergent and floating-leaf plant bed mapping on Ten Mile, Washburn, and Woman Lakes.

Table 3. Unique and rare plant species documented during grid point-intercept and near-shore vegetation surveys, 2006 – 2008.

		Ada	Big Portage	Birch	Boy	Deep Portage	Lawrence	Leech[a]	Little Boy	Long	Louise	Pine Mtn	Pleasant	Roosevelt	Steamboat	Sylvan	Ten Mile	Thunder	Wabedo	Washburn	Woman
Bog rosemary	*Andromeda glaucophylla*				x			–													
Water arum	*Calla palustris*	x		x		x		–				x	x				x				x
Wiregrass sedge	*Carex lasiocarpa*							–				x					x				x
Leatherleaf	*Chamaedaphne calyculata*			x				–													
Three-way sedge	*Dulichium arundinaceum*	x		x				–	x	x							x			x	x
Pipewort	*Eriocaulon aquaticum*							–		x	x										
Cottongrass	*Eriophorum* sp.					x		–													
Mare's tail	*Hippurus vulgaris*							–					x		x						
Leafless watermilfoil	*Myriophyllum tenellum*							–		x										x	
Vasey's pondweed	*Potamogeton vaseyi*							–		x											
Creeping spearwort	*Ranunculus flammula*	x						–		x										x	
Water bulrush	*Schoenoplectus subterminalis*	x						–		x			x			x	x			x	
Narrow-leaved burreed	*Sparganium angustifolium*							–		x										x	
Floating-leaved burreed	*Sparganium fluctuans*			x				–													
Humped bladderwort	*Utricularia gibba*	x	x	x				–		x			x			x	x				x
Flat-leaved bladderwort	*Utricularia intermedia*	x	x	x	x	x	x	–		x			x			x	x	x		x	x
Lesser bladderwort	*Utricularia minor*	x	x	x			x	–		x			x			x	x				x

[a] Results include only those collected during the Sensitive Lakeshore Survey project. Leech Lake results are not included, as the grid point-intercept plant surveys that took place on this lake were conducted as part of another project.

Table 4. Aquatic plant taxa list. Includes all native aquatic plant taxa documented during Sensitive Lakeshore surveys, 2006 – 2008.

Description	Common Name	Scientific Name
Submerged/free-floating	Watermoss	Not identified to genus
	Water marigold	*Bidens beckii*
	Coontail	*Ceratophyllum demersum*
	Muskgrass	*Chara* sp.
	Canada waterweed	*Elodea canadensis*
	Pipewort	*Eriocaulon aquaticum*
	Water stargrass	*Heteranthera dubia*
	Mare's tail	*Hippuris vulgaris*
	Quillwort	*Isoetes* sp.
	Lesser duckweed	*Lemna minor*
	Star duckweed	*Lemna trisulca*
	Northern watermilfoil	*Myriophyllum sibiricum*
	Leafless watermilfoil	*Myriophyllum tenellum*
	Whorled watermilfoil	*Myriophyllum verticillatum*
	Bushy pondweed	*Najas flexilis*
	Southern naiad	*Najas guadalupensis*
	Stonewort	*Nitella* sp.
	Large-leaf pondweed	*Potamogeton amplifolius*
	Ribbon pondweed	*Potamogeton epihydrus*
	Leafy pondweed	*Potamogeton foliosus*
	Fries' pondweed	*Potamogeton friesii*
	Variable pondweed	*Potamogeton gramineus*
	Illinois pondweed	*Potamogeton illinoensis*
	White-stem pondweed	*Potamogeton praelongus*
	Very small/small pondweed	*Potamogeton pusillus*
	Clasping-leaf pondweed	*Potamogeton richardsonii*
	Robbin's pondweed	*Potamogeton robbinsii*
	Snail-seed pondweed	*Potamogeton spirillus*
	Straight-leaved pondweed	*Potamogeton strictifolius*
	Vasey's pondweed	*Potamogeton vaseyi*
	Flat-stem pondweed	*Potamogeton zosteriformis*
	White water buttercup	*Ranunculus aquatilis*
	Creeping spearwort	*Ranunculus flammula*
	Water bulrush	*Schoenoplectus subterminalis*
	Greater duckweed	*Spirodela polyrhiza*
	Sago pondweed	*Stuckenia pectinata*
	Humped bladderwort	*Utricularia gibba*
	Flat-leaved bladderwort	*Utricularia intermedia*
	Lesser bladderwort	*Utricularia minor*
	Greater bladderwort	*Utricularia vulgaris*
	Wild celery	*Vallisneria americana*
	Watermeal	*Wolffia* sp.

Table 4, continued.

Description	Common Name	Scientific Name
Floating-leaf	Watershield	*Brasenia schreberi*
	Yellow waterlily	*Nuphar variegata*
	White waterlily	*Nymphaea odorata*
	Floating-leaf smartweed	*Persicaria amphibia (Polygonum amphibium)*
	Floating-leaf pondweed	*Potamogeton natans*
	Narrow-leaved burreed	*Sparganium angustifolium*
	Narrowleaf burreed	*Sparganium emersum*
Emergent	Water arum	*Calla palustris*
	Sedges	*Carex* spp.
	Three-way sedge	*Dulichium arundinaceum*
	Needlegrass	*Eleocharis acicularis*
	Spikerush	*Eleocharis erythropoda*
	Small spikerush	*Eleocharis palustris*
	Water horsetail	*Equisetum fluviatile*
	Soft rush	*Juncus effusus*
	Juncus	*Juncus* sp.
	Giant cane	*Phragmites australis*
	Arum-leaved arrowhead	*Sagittaria cuneata*
	Broad-leaved arrowhead	*Sagittaria latifolia*
	Sessile-fruited arrowhead	*Sagittaria rigida*
	Hard-stem bulrush	*Schoenoplectus acutus*
	Three-square bulrush	*Schoenoplectus pungens*
	Soft-stem bulrush	*Schoenoplectus tabernaemontani*
	Nuttall's burreed	*Sparganium americanum*
	Giant burreed	*Sparganium eurycarpum*
	Broad-leaf cattail	*Typha latifolia*
	Wild rice	*Zizania palustris*

Table 5. Frogs and toads recorded during frog surveys, 2007 – 2009. Incidental anuran detections during Sensitive Lakeshore fish, bird, and aquatic plant surveys are also included.

Common Name	Scientific Name	Ada	Big Portage	Birch	Boy	Deep Portage	Lawrence	Leech	Little Boy	Long	Louise	Pine Mtn	Pleasant	Roosevelt	Steamboat	Sylvan	Ten Mile	Thunder	Wabedo	Washburn	Woman
Green frog	*Rana clamitans*	x	x	x	x	x	x	x	x	x	–	x	x	x		x	x	x	x	x	x
Mink frog	*Rana septentrionalis*	x	x	x	x			x		x	–	x	x	x		x	x			x	x
American toad	*Bufo americanus*							x			–								x	x	
Gray treefrog	*Hyla versicolor*		x	x	x	x	x	x	x	x	–	x	x	x	x	x	x	x	x	x	x
Northern leopard frog	*Rana pipiens*							x		x	–	x						x			
Spring peeper	*Pseudacris crucifer*		x					x		x	–					x					
Wood frog	*Rana sylvatica*							x			–										

Table 6. Fish species of greatest conservation need and proxy species recorded during nongame fish surveys, 2006 – 2008.

Common Name	Scientific Name	Ada	Big Portage	Birch	Boy	Deep Portage	Lawrence	Leech	Little Boy	Long	Louise	Pine Mtn	Pleasant	Roosevelt	Steamboat	Sylvan	Ten Mile	Thunder	Wabedo	Washburn	Woman
Pugnose shiner	*Notropis anogenus*	x	x	x	x			–	x				x		x		x		x		x
Longear sunfish	*Lepomis megalotis*					x	x	–									x				x
Least darter	*Etheostoma microperca*						x	–						x			x	x			
Greater redhorse	*Moxostoma valenciennesi*				x			–	x					x						x	
Blackchin shiner	*Notropis heterodon*	x	x	x	x	x	x	–	x	x		x	x		x	x	x	x	x	x	x
Blacknose shiner	*Notropis heterolepis*	x	x	x	x	x		–	x	x	x	x	x	x	x	x	x	x		x	x
Banded killifish	*Fundulus diaphanus*	x	x	x	x	x	x	–	x	x		x		x	x	x	x	x	x	x	x

Table 7. Fish species list. Includes all species documented during Sensitive Lakeshore surveys, 2006 – 2008.

Description	**Common Name**	**Scientific Name**
Bowfins	Bowfin	*Amia calva*
Minnows/carps	Spotfin shiner	*Cyprinella spiloptera*
	Common shiner	*Luxilus cornutus*
	Hornyhead chub	*Nocomis biguttatus*
	Golden shiner	*Notemigonus crysoleucas*
	Pugnose shiner	*Notropis anogenus*
	Emerald shiner	*Notropis atherinoides*
	Blackchin shiner	*Notropis heterodon*
	Blacknose shiner	*Notropis heterolepis*
	Spottail shiner	*Notropis hudsonius*
	Mimic shiner	*Notropis volucellus*
	Northern redbelly dace	*Phoxinus eos*
	Finescale dace	*Phoxinus neogaeus*
	Bluntnose minnow	*Pimephales notatus*
	Fathead minnow	*Pimephales promelas*
	Longnose dace	*Rhinichthys cataractae*
	Creek chub	*Semotilus atromaculatus*
Suckers	White sucker	*Catostomus commersonii*
	Shorthead redhorse	*Moxostoma macrolepidotum*
	Greater redhorse	*Moxostoma valenciennesi*
North American freshwater catfishes	Black bullhead	*Ameiurus melas*
	Yellow bullhead	*Ameiurus natalis*
	Brown bullhead	*Ameiurus nebulosus*
	Tadpole madtom	*Noturus gyrinus*
Pikes	Northern pike	*Esox lucius*
	Muskellunge	*Esox masquinongy*
Mudminnows	Central mudminnow	*Umbra limi*
Salmon	Cisco	*Coregonus artedi*
Burbots	Burbot	*Lota lota*
Killifishes	Banded killifish	*Fundulus diaphanus*
Sticklebacks	Brook stickleback	*Culaea inconstans*
Sculpins	Mottled sculpin	*Cottus bairdii*
Sunfishes	Rock bass	*Ambloplites rupestris*
	Green sunfish	*Lepomis cyanellus*
	Pumpkinseed	*Lepomis gibbosus*
	Bluegill	*Lepomis macrochirus*
	Longear sunfish	*Lepomis megalotis*
	Smallmouth bass	*Micropterus dolomieu*

Table 7, continued.

Description	Common Name	Scientific Name
Sunfishes	Largemouth bass	*Micropterus salmoides*
	Black crappie	*Pomoxis nigromaculatus*
Perches	Iowa darter	*Etheostoma exile*
	Least darter	*Etheostoma microperca*
	Johnny darter	*Etheostoma nigrum*
	Yellow perch	*Perca flavescens*
	Logperch	*Percina caprodes*
	Walleye	*Sander vitreus*

Table 8. Bird species of greatest conservation need recorded during bird surveys and casual observation, 2007 – 2010.

Common Name	Scientific Name	Ada	Big Portage	Birch	Boy	Deep Portage	Lawrence	Leech	Little Boy	Long	Louise	Pine Mtn	Pleasant	Roosevelt	Steamboat	Sylvan	Ten Mile	Thunder	Wabedo	Washburn	Woman
Trumpeter Swan	*Cygnus buccinator*		x		x			x													
American Black Duck	*Anas rubripes*																x				
Northern Pintail	*Anas acuta*							x													
Common Loon	*Gavia immer*	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Horned Grebe	*Podiceps auritus*				x										x						
Red-necked Grebe	*Podiceps grisegena*	x						x				x									x
American White Pelican	*Pelecanus erythrorhynchos*		x		x			x				x	x		x	x	x		x		
American Bittern	*Botaurus lentiginosus*			x	x			x											x		
Least Bittern	*Ixobrychus exilis*							x													
Bald Eagle	*Haliaeetus leucocephalus*	x	x	x	x	x		x	x	x		x	x	x	x	x	x	x	x	x	x
Northern Harrier	*Circus cyaneus*				x			x													
Red-shouldered Hawk	*Buteo lineatus*																x				
Yellow Rail	*Coturnicops noveboracensis*				x			x													
Virginia Rail	*Rallus limicola*				x			x				x					x				
Semipalmated Sandpiper	*Calidris pusilla*							x													
Dunlin	*Calidris alpina*							x													
Franklin's Gull	*Leucophaeus pipixcan*							x													
Black Tern	*Chlidonias niger*	x	x		x			x	x			x									
Common Tern	*Sterna hirundo*	x	x	x	x			x				x	x		x		x	x			x
Forster's Tern	*Sterna forsteri*							x													
Black-billed Cuckoo	*Coccyzus erythropthalmus*		x		x			x		x										x	
Common Nighthawk	*Chordeiles minor*		x	x	x			x	x	x	x		x	x			x		x	x	
Eastern Whip-poor-will	*Caprimulgus vociferus*						x														
Yellow-bellied Sapsucker	*Sphyrapicus varius*	x		x	x	x		x		x	x	x	x	x	x	x	x	x	x	x	x

Table 8, continued.

Common Name	Scientific Name	Ada	Big Portage	Birch	Boy	Deep Portage	Lawrence	Leech	Little Boy	Long	Louise	Pine Mtn	Pleasant	Roosevelt	Steamboat	Sylvan	Ten Mile	Thunder	Wabedo	Washburn	Woman
Olive-sided Flycatcher	*Contopus cooperi*												x								
Eastern Wood-Pewee	*Contopus virens*	x	x	x	x	x		x	x	x		x	x	x	x	x		x		x	
Least Flycatcher	*Empidonax minimus*	x	x		x	x	x	x	x	x	x		x	x		x	x	x		x	x
N. Rough-winged Swallow	*Stelgidopteryx serripennis*		x		x			x	x								x				
Winter Wren	*Troglodytes hiemalis*								x			x			x				x		
Sedge Wren	*Cistothorus platensis*		x		x			x				x			x				x	x	
Marsh Wren	*Cistothorus palustris*				x			x				x				x					
Veery	*Catharus fuscescens*	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Wood Thrush	*Hylocichla mustelina*								x							x			x	x	
Brown Thrasher	*Toxostoma rufum*							x													
Golden-winged Warbler	*Vermivora chrysoptera*	x	x	x			x	x	x	x				x	x	x	x		x	x	
Cape May Warbler	*Dendroica tigrina*				x			x										x		x	
Ovenbird	*Seiurus aurocapilla*	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Connecticut Warbler	*Oporornis agilis*							x													
Canada Warbler	*Wilsonia canadensis*							x													
Le Conte's Sparrow	*Ammodramus leconteii*				x			x													
Nelson's Sparrow	*Ammodramus nelsoni*				x			x													
Swamp Sparrow	*Melospiza georgiana*		x	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
White-throated Sparrow	*Zonotrichia albicollis*			x	x		x	x		x		x	x		x		x	x	x	x	x
Rose-breasted Grosbeak	*Pheucticus ludovicianus*	x	x	x	x		x	x	x	x	x	x		x	x	x	x	x	x	x	x
Bobolink	*Dolichonyx oryzivorus*				x			x													

Table 9. Bird species list. Includes all species documented during Sensitive Lakeshore bird surveys and casual observation of lakes, 2007 – 2010.

Description	Common Name	Scientific Name
Waterfowl	Canada Goose	*Branta canadensis*
	Trumpeter Swan	*Cygnus buccinator*
	Wood Duck	*Aix sponsa*
	Gadwall	*Anas strepera*
	American Wigeon	*Anas americana*
	American Black Duck	*Anas rupripes*
	Mallard	*Anas platyrhynchos*
	Blue-winged Teal	*Anas discors*
	Northern Pintail	*Anas acuta*
	Green-winged Teal	*Anas crecca*
	Canvasback	*Aythya valisineria*
	Redhead	*Aythya americana*
	Ring-necked Duck	*Aythya collaris*
	Bufflehead	*Bucephala albeola*
	Common Goldeneye	*Bucephala clangula*
	Hooded Merganser	*Lophodytes cucullatus*
	Common Merganser	*Mergus merganser*
	Red-breasted Merganser	*Mergus serrator*
Grouse/turkeys	Ring-necked Pheasant	*Phasianus colchicus*
	Ruffed Grouse	*Bonasa umbellus*
Loons	Common Loon	*Gavia immer*
Grebes	Horned Grebe	*Podiceps auritus*
	Pied-billed Grebe	*Podilymbus podiceps*
	Red-necked Grebe	*Podiceps grisegena*
	Eared Grebe	*Podiceps nigricollis*
Cormorants	Double-crested Cormorant	*Phalacrocorax auritus*
Pelicans	American White Pelican	*Pelecanus erythrorhynchos*
Herons/bitterns	American Bittern	*Botaurus lentiginosus*
	Least Bittern	*Ixobrychus exilis*
	Great Blue Heron	*Ardea herodias*
	Green Heron	*Butorides virescens*
Vultures	Turkey Vulture	*Cathartes aura*
Hawks/eagles	Osprey	*Pandion haliaetus*
	Bald Eagle	*Haliaeetus leucocephalus*
	Northern Harrier	*Circus cyaneus*
	Sharp-shinned Hawk	*Accipiter striatus*
	Cooper’s Hawk	*Accipiter cooperii*
	Red-shouldered Hawk	*Buteo lineatus*
	Broad-winged Hawk	*Buteo platypterus*
	Red-tailed Hawk	*Buteo jamaicensis*

Table 9, continued.

Description	Common Name	Scientific Name
Falcons	Merlin	*Falco columbarius*
Rails/coots	Yellow Rail	*Coturnicops noveboracensis*
	Virginia Rail	*Rallus limicola*
	Sora	*Porzana carolina*
	American Coot	*Fulica americana*
Cranes	Sandhill Crane	*Grus canadensis*
Plovers	Killdeer	*Charadrius vociferus*
Sandpipers/allies	Spotted Sandpiper	*Actitis macularius*
	Solitary Sandpiper	*Tringa solitaria*
	Lesser Yellowlegs	*Tringa flavipes*
	Semipalmated Sandpiper	*Calidris pusilla*
	Least Sandpiper	*Calidris minutilla*
	Dunlin	*Calidris alpina*
	Wilson's Snipe	*Gallinago delicata*
Gulls/terns	Bonaparte's Gull	*Chroicocephalus philadelphia*
	Franklin's Gull	*Leucophaeus pipixcan*
	Ring-billed Gull	*Larus delawarensis*
	Herring Gull	*Larus argentatus*
	Caspian Tern	*Hydroprogne caspia*
	Black Tern	*Chlidonias niger*
	Common Tern	*Sterna hirundo*
	Forster's Tern	*Sterna forsteri*
Doves	Mourning Dove	*Zenaida macroura*
Cuckoos	Black-billed Cuckoo	*Coccyzus erythropthalmus*
Owls	Great Horned Owl	*Bubo virginianus*
	Barred Owl	*Strix varia*
Goatsuckers	Common Nighthawk	*Chordeiles minor*
	Eastern Whip-poor-will	*Caprimulgus vociferus*
Swifts	Chimney Swift	*Chaetura pelagica*
Hummingbirds	Ruby-throated Hummingbird	*Archilochus colubris*
Kingfishers	Belted Kingfisher	*Megaceryle alcyon*
Woodpeckers	Red-bellied Woodpecker	*Melanerpes carolinus*
	Yellow-bellied Sapsucker	*Sphyrapicus varius*
	Downy Woodpecker	*Picoides pubescens*
	Hairy Woodpecker	*Picoides villosus*
	Northern Flicker	*Colaptes auratus*
	Pileated Woodpecker	*Dryocopus pileatus*

Table 9, continued.

Description	Common Name	Scientific Name
Flycatchers	Olive-sided Flycatcher	*Contopus cooperi*
	Eastern Wood-Pewee	*Contopus virens*
	Alder Flycatcher	*Empidonax alnorum*
	Least Flycatcher	*Empidonax minimus*
	Eastern Phoebe	*Sayornis phoebe*
	Great Crested Flycatcher	*Myiarchus crinitus*
	Eastern Kingbird	*Tyrannus tyrannus*
Vireos	Yellow-throated Vireo	*Vireo flavifrons*
	Warbling Vireo	*Vireo gilvus*
	Red-eyed Vireo	*Vireo olivaceus*
Jays/crows	Blue Jay	*Cyanocitta cristata*
	American Crow	*Corvus brachyrhynchos*
	Common Raven	*Corvus corax*
Swallows	Purple Martin	*Progne subis*
	Tree Swallow	*Tachycineta bicolor*
	Northern Rough-winged Swallow	*Stelgidopteryx serripennis*
	Bank Swallow	*Riparia riparia*
	Cliff Swallow	*Petrochelidon pyrrhonota*
	Barn Swallow	*Hirundo rustica*
Chickadees	Black-capped Chickadee	*Poecile atricapilla*
Nuthatches	Red-breasted Nuthatch	*Sitta canadensis*
	White-breasted Nuthatch	*Sitta carolinensis*
Creepers	Brown Creeper	*Certhia americana*
Wrens	House Wren	*Troglodytes aedon*
	Winter Wren	*Troglodytes hiemalis*
	Sedge Wren	*Cistothorus platensis*
	Marsh Wren	*Cistothorus palustris*
Kinglets	Golden-crowned Kinglet	*Regulus satrapa*
	Ruby-crowned Kinglet	*Regulus calendula*
Thrushes	Eastern Bluebird	*Sialia sialis*
	Veery	*Catharus fuscescens*
	Swainson's Thrush	*Catharus ustulatus*
	Hermit Thrush	*Catharus guttatus*
	Wood Thrush	*Hylocichla mustelina*
	American Robin	*Turdus migratorius*
Mockingbirds	Gray Catbird	*Dumetella carolinensis*
	Brown Thrasher	*Toxostoma rufum*
Starlings	European Starling	*Sturnus vulgaris*
Waxwings	Bohemian Waxwing	*Bombycilla garrulus*
	Cedar Waxwing	*Bombycilla cedrorum*

Table 9, continued.

Description	Common Name	Scientific Name
Warblers	Golden-winged Warbler	*Vermivora chrysoptera*
	Nashville Warbler	*Vermivora ruficapilla*
	Northern Parula	*Parula americana*
	Yellow Warbler	*Dendroica petechia*
	Chestnut-sided Warbler	*Dendroica pensylvanica*
	Cape May Warbler	*Dendroica tigrina*
	Yellow-rumped Warbler	*Dendroica coronata*
	Black-throated Green Warbler	*Dendroica virens*
	Blackburnian Warbler	*Dendroica fusca*
	Pine Warbler	*Dendroica pinus*
	Palm Warbler	*Dendroica palmarum*
	Blackpoll Warbler	*Dendroica striata*
	Black-and-white Warbler	*Mniotilta varia*
	American Redstart	*Setophaga ruticilla*
	Ovenbird	*Seiurus aurocapilla*
	Northern Waterthrush	*Seiurus noveboracensis*
	Connecticut Warbler	*Oporornis agilis*
	Common Yellowthroat	*Geothlypis trichas*
	Wilson's Warbler	*Wilsonia pusilla*
	Canada Warbler	*Wilsonia canadensis*
Sparrows/allies	Chipping Sparrow	*Spizella passerina*
	Clay-colored Sparrow	*Spizella pallida*
	Savannah Sparrow	*Passerculus sandwichensis*
	Le Conte's Sparrow	*Ammodramus leconteii*
	Nelson's Sparrow	*Ammodramus nelsoni*
	Song Sparrow	*Melospiza melodia*
	Swamp Sparrow	*Melospiza georgiana*
	White-throated Sparrow	*Zonotrichia albicollis*
Cardinals/allies	Scarlet Tanager	*Piranga olivacea*
	Northern Cardinal	*Cardinalis cardinalis*
	Rose-breasted Grosbeak	*Pheucticus ludovicianus*
	Indigo Bunting	*Passerina cyanea*
Blackbirds	Bobolink	*Dolichonyx oryzivorus*
	Red-winged Blackbird	*Agelaius phoeniceus*
	Yellow-headed Blackbird	*Xanthocephalus xanthocephalus*
	Common Grackle	*Quiscalus quiscula*
	Brown-headed Cowbird	*Molothrus ater*
	Baltimore Oriole	*Icterus galbula*

Table 9, continued.

Description	**Common Name**	**Scientific Name**
Finches	Purple Finch	*Carpodacus purpureus*
	House Finch	*Carpodacus mexicanus*
	Red Crossbill	*Loxia curvirostra*
	Pine Siskin	*Spinus pinus*
	American Goldfinch	*Spinus tristis*
Old World Sparrows	House Sparrow	*Passer domesticus*

Table 10. Summary of sensitive lakeshore identified on Sensitive Lakeshore project study lakes, 2006 - 2010.

Lake name	Shoreline length (mi)	Sensitive shoreline (mi)	% Sensitive shoreline	Shoreland area (acres)	Sensitive shoreland (acres)	% Sensitive shoreland
Ada	7.5	3.6	48	1096	484	44
Big Portage	7.7	2.2	29	1131	310	27
Birch	15.7	5.1	32	1825	759	42
Boy	25.9	8.2	32	3412	1860	55
Deep Portage	1.9	0.2	11	416	114	27
Lawrence	4.8	0.7	14	729	204	28
Leech	229.3	107	47	25942	13693	53
Little Boy	10.0	4.1	40	1412	542	38
Long	15.6	3.6	23	1827	812	44
Louise	1.2	0.1	8	305	150	49
Pine Mountain	9.5	2.0	21	1374	422	31
Pleasant	9.0	3.3	37	1214	557	46
Roosevelt	18.4	5.5	30	2597	773	30
Steamboat	8.2	2.2	26	1401	594	42
Sylvan	11.1	4.3	39	1553	764	49
Ten Mile	25.2	11.6	46	3120	1825	58
Thunder	15.9	7.0	44	1966	802	41
Wabedo	11.3	2.9	26	1704	688	40
Washburn	19.5	4.7	24	2188	830	38
Woman	30.7	11.9	39	3980	1808	45

Figure 2. Example of sensitive lakeshore delineation (Ten Mile Lake).

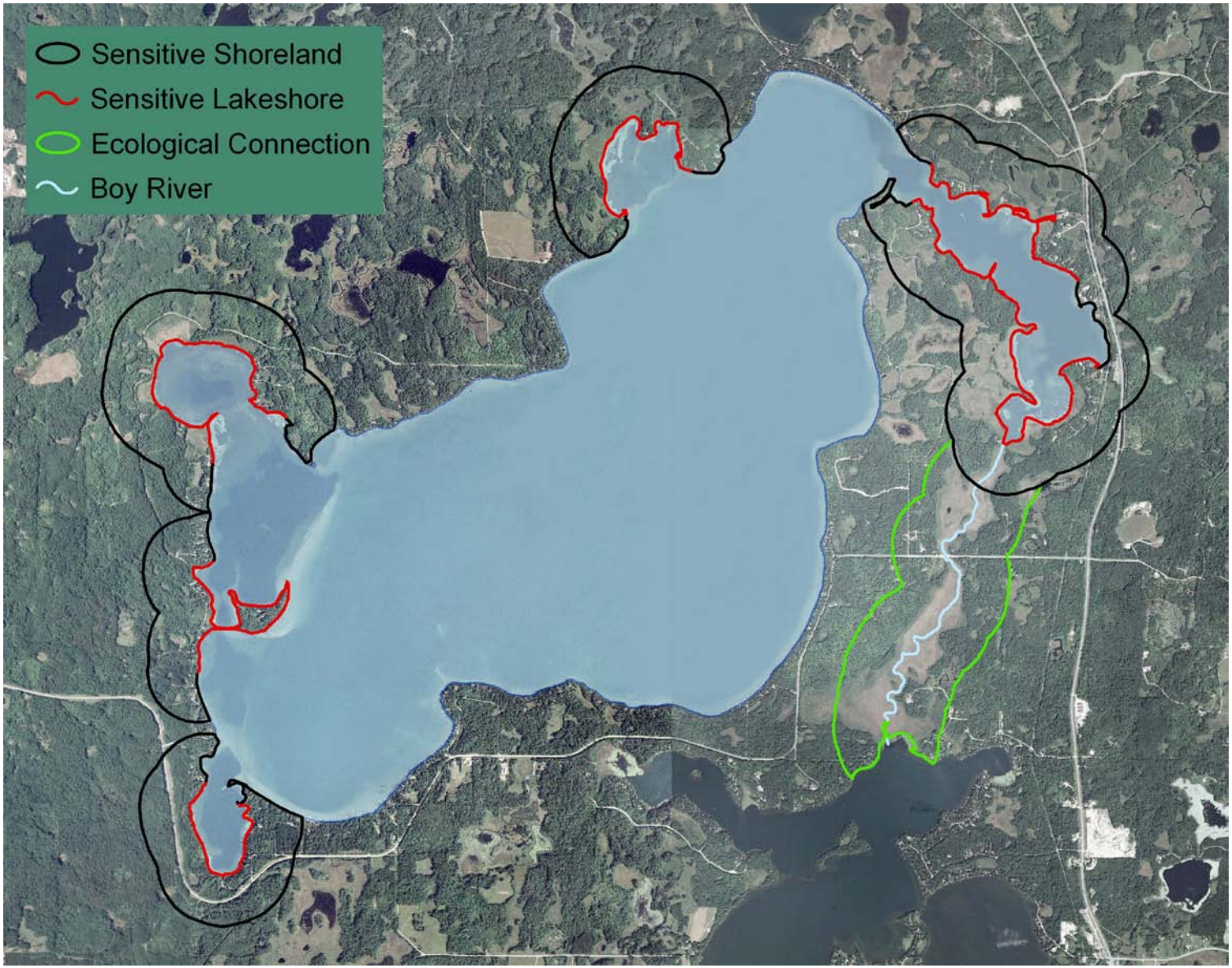


Exhibit A. Intra-lake Zoning to Protect Sensitive Lakeshore Areas. List of study lakes and completed survey work.

Lake Name	DOWLKNUM	Acres	Percent shoreline private and in large parcels	Grid aquatic plant survey	Emergent / floating-leaf beds delineated from aerial photos	Bulrush beds mapped	Shoreline habitat plots	Frog survey	Fish survey	Bird survey	Sensitive areas fowarded to County
Leech	11020300	109415		2002-05	yes	2008-10		2007-09		2010	2011
Woman	11020100	5360	16	2006	yes	AF	2006-07	2006	2006	2007	2008
Ten Mile	11041300	4640	26	2006	yes	AF	2006-07	2006	2006	2007	2008
Birch	11041200	1262		2006	yes	2006	2006-07	2007	2007	2008	2009
Long	11014200	926		2007	yes	2007	2007	2007	2007	2008	2009
Little Boy	11016700	1396	32	2007	yes	2007	2007	2007	2007	2008	2009
Louise*	11057300	22		2007	yes				2007	2008	2009
Wabedo	11017100	1272	32	2007	yes	2007	2007	2007	2007	2008	2009
Ada	11025000	1044	7	2007	yes	2007	2007	2007	2007	2008	2009
Pine Mountain	11041100	1657	41	2007	yes	2007	2008	2008	2007	2008	2009
Pleasant	11038300	1038	38	2007	yes	2008	2008	2008	2007	2008	2009
Washburn	11005900	1768		2006	yes	AF-2008	2007	2007	2007	2008-09	2010
Thunder	11006200	1316	42	2008	yes	2008	2008	2008	2008	2009	2010
Boy	11014300	3404		2008	yes	2008		2008	2008	2009	2010
Roosevelt	11004300	1561	9	2008	yes	2008	2008	2009	2008	2009	2010
Lawrence*	11005300	224		2008	yes	2008		2009	2008	2009	2010
Deep Portage*	11023700	129		2008	yes	2008	2008	2009	2008	2009	2010
Sylvan	11030400	882		2008	yes	2008		2009	2008	2009	2010
Big Portage	11030800	956		2008	yes	2008		2009	2008	2009	2010
Steamboat	11050400	1761	38	2008	yes	2008	2008	2009	2008	2009	2010

KEY

	Completed	AF	DNR Fisheries data
	In progress		Not completed or planned

* Additional lakes (connecting waterbodies)

Attachment A: Final Budget Detail for Total for 2007 & 2008 Projects

Project Title: *Intra-Lake Zoning to Protect Sensitive Lakeshore Areas, [2007: Subd. 5(h) 2008: Subd. 4(e)]*

Project Manager Name: *Paul Radomski*

Trust Fund Appropriation: $ *235,000 ($110,000 in 2007 + $125,000 in 2008)*

1) See list of non-eligible expenses, do not include any of these items in your budget sheet

2) Remove any budget item lines not applicable

2007 & 2008 Trust Fund Budget	**Revised Result 1 Budget:**	**Amount Spent** *(06/30/2011)*	**Balance** *(06/30/2011)*	**Result 2 Budget:**	**Amount Spent** *(06/30/2011)*	**Balance** *(06/30/2011)*	**Result 3 Budget:**	**Amount Spent** *(06/30/2011)*	**Balance** *(06/30/2011)*	**TOTAL BUDGET**	**TOTAL BALANCE**
	Identify and Map Sensitive Shorelands			*Cass County Ordinance Development and Adoption for Sensitive Shorelands*			*Propose and Implement Zoning Districts for Sensitive Areas*				
BUDGET ITEM						0			0	0	0
PERSONNEL: wages and benefits	193,000	200,735	-7,735			0	5,000	5,000	0	198,000	-7,735
Other direct operating costs *(fleet expenses)*	10,000	9,493	507			0			0	10,000	507
Capital Equipment (watercraft suitable for electrofishing, seining and trap deployment)	16,000	12,571	3,429			0			0	16,000	3,429
Equipment / Tools *(sampling equipment and biological supplies)*	6,000	2,037	3,963			0			0	6,000	3,963
Office equipment & computers - NOT ALLOWED unless unique to the project			0			0			0	0	0
Printing			0	2,500	2,500	0	2,500	2,500	0	5,000	0
Other Supplies *(education material and mailing)*			0			0			0	0	0
Travel expenses in Minnesota			0			0			0	0	0
Travel outside Minnesota *(where?)*			0			0			0	0	0
Other *(Describe the activity and cost)*			0			0			0	0	0
COLUMN TOTAL	**$225,000**	**$224,836**	**$164**	**$2,500**	**$2,500**	**$0**	**$7,500**	**$7,500**	**$0**	**$235,000**	**$164**

2008 Project Abstract
For the Period Ending June 30, 2012

PROJECT TITLE: **Native Shoreland Buffer Incentives (NSBI) Program**

Project Manager: Mark Hauck
Affiliation: Community Assistance, MN Dept. of Natural Resources
Mailing Address: 940 Industrial Drive So.
City / State / Zip: Sauk Rapids, MN 5639
Telephone Number: 320-255-4279 ext. 236
E-mail Address: mark.hauck@state.mn.us
Fax Number: 320-255-3999
Web Page address: http://mndnr.gov/nsbi
Location: Statewide
FUNDING SOURCE: Environment and Natural Resources Trust Fund")

LEGAL CITATION: M.L. 2008, Chap. 367, Sec. 2, Subd. 4(f)

Appropriation Language:

$225,000 is from the trust fund to the commissioner of natural resources to accelerate the native shoreland buffer incentive program through market research, technical assistance, and competitive grants to local governments for creating and implementing shoreland buffer incentive programs. Grant recipients must have current shoreline management requirements and effective enforcement. This appropriation is available until June 30, 2011, at which time the project must be completed and final products delivered, unless an earlier date is specified in the work program.

Legal Citation: M.L. 2011, Chap. 2, Art. 3, Sec. 2, Subd. 18(a)

Carryforward Language:
The availability of the appropriation for the following projects is extended to June 30, 2012:(1) Laws 2008, chapter 367, section 2, subdivision 3, paragraph (g), State Land Acquisition Consolidation;(2) Laws 2008, chapter 367, section 2, subdivision 4, paragraph (f), Native Shoreland Buffer Incentives Program;

APPROPRIATION AMOUNT: $225,000

Overall Project Outcome and Results

Through a competitive grant process, the MN DNR offered two $75,000 grants. East Ottertail SWCD and the Itasca Water Legacy Partnership (Itasca SWCD) collaborated with DNR and the Water Resources Center (WRC) at the U of M to craft shoreland restoration incentive programs for lakeshore residential properties. Unique to this project was the focus on assessing the effectiveness of applying social science methods (KAP Studies) in promoting the planting of native shoreland buffers.

Using a process that is well known but rarely used in natural resources, Dr. Karlyn Eckman (WRC) used KAP Studies to determine Knowledge, Attitudes and Practices of target audiences.

Survey landowners ⇨ Design & implement incentives. ⇨ Survey again.

The second survey determines the effectiveness of project activities in changing the knowledge, attitudes and practices of the target audience. Target audiences for East Ottertail County were lakeshore owners 50 to 70 years old owning 120 feet or more of shoreline and for Itasca County, all landowners on 5 selected lakes. Funds were utilized for designing incentives and analyzing results.

Project conclusions:

- Using a "KAP Study" contributed to more successful outcomes (more shoreland restored) by predicting better incentives and better communication methods.
- People were more knowledgeable than expected about water quality.
- People in these particular studies were not motivated to action by a financial incentive – they took it because it was offered. Therefore, funds intended for financial incentives may have greater impact if they are re-allocated to hire high-quality, knowledgeable professionals.
- Social networks were more important than previously realized. Groups like lake associations, churches, garden clubs, informal groups of neighbors helped spur interest and motivation.
- More projects should incorporate KAP methods so they are "evaluation-ready" before implementation to better utilize the use of conservation funding and document project success to funders.
- Social science practices could be used in areas such as invasive species, habitat restoration, and recreation. Practices include KAP studies, message re-framing and utilizing existing social networks in the community.

<u>Project Results Use and Dissemination</u>

The DNR project manager and partners have shared the results of the project and project components on several different occasions.
Interim results were shared at the:

1. 71st Midwest Fish and Wildlife Conference in Minneapolis December 15th, 2010. ~ 40 attendees.
2. Counties and MN Assoc. of Watershed Districts, July 12, 2010 ~ 50 attendees
3. Water Summit - MN Assoc. of Soil and Water Conservation Districts, Assoc. of MN in St. Cloud July 12th, 2011 ~ 65 attendees
4. 72nd Midwest Fish and Wildlife Conference in Des Moines, Iowa December 10, 2011 ~ 50 attendees
5. Minnesota Waters Conference in St. Cloud April 28, 2011 ~35 attendees.

Final results were shared at the:

1. Minnesota Erosion Control Association in Nisswa March 9th, 2012 ~ 75 attendees.
2. Shoreland Users Group in St. Cloud on March 15th, 2012. ~ 50 attendees.
3. MN DNR Central Region Managers meeting on July 31, 2012 - 13 attendees

Total recipients of in-person presentations = approximately 365

This project was submitted for consideration for the 2011 Environmental Initiative Awards. Now that the project is complete consideration is now being given for submission again in the spring of 2013.

In order to widen the influence of the results of the demonstrations, several actions are being considered at the present time. They include:

1) This final LCCMR report and the individual detailed survey evaluations will be entered into the DNR Documents Library for reference to others.
2) Development of a Native Shoreland Buffer Initiative web page hosted by the DNR that will provide a gateway to information on the buffer projects including survey examples, final reports from the University of Minnesota, resource products developed by the project partners.
3) Communication back to the original 'class' of buffer proposers participating in the initial workshop.
4) The DNR's Division of Ecological and Water Resources widely distributes results in order to adopt social science principles into natural resources work.

Discussions are ongoing as to the applicability of the project results to other programs within the Department of Natural Resources and elsewhere.

Environment and Natural Resources Trust Fund 2008 Work Program
Final Report

Date of Report: **July 31, 2012**
Date of Next Status Report:
Date of Work Program Approval: June 10, 2008 (Revised, 10/31/08)
Project Completion Date: June 30, 2012 (see carry forward language below)

I. PROJECT TITLE: **Native Shoreland Buffer Incentives (NSBI) Program**

Project Manager: Mark Hauck
Affiliation: Community Assistance, MN Dept. of Natural Resources
Mailing Address: 940 Industrial Drive So.
City / State / Zip: Sauk Rapids, MN 5639
Telephone Number: 320-255-4279 ext. 236
E-mail Address: mark.hauck@state.mn.us
Fax Number: 320-255-3999
Web Page address: http://mndnr.gov/nsbi
Location: Statewide

Total Trust Fund Project Budget:	**Trust Fund Appropriation:**	$	225,000.00
	Minus Amount Spent:	$	174,752.96
	Equal Balance:	$	50,247.04

Legal Citation: M.L. 2008, Chap. 367, Sec. 2, Subd. 4(f)

Appropriation Language:
$225,000 is from the trust fund to the commissioner of natural resources to accelerate the native shoreland buffer incentive program through market research, technical assistance, and competitive grants to local governments for creating and implementing shoreland buffer incentive programs. Grant recipients must have current shoreline management requirements and effective enforcement. This appropriation is available until June 30, 2011, at which time the project must be completed and final products delivered, unless an earlier date is specified in the work program.

Legal Citation: M.L. 2011, Chap. 2, Art. 3, Sec. 2, Subd. 18(a)

Carryforward Language:
The availability of the appropriation for the following projects is extended to June 30, 2012:(1) Laws 2008, chapter 367, section 2, subdivision 3, paragraph (g), State Land Acquisition Consolidation;(2) Laws 2008, chapter 367, section 2, subdivision 4, paragraph (f), Native Shoreland Buffer Incentives Program;

II. and III. FINAL PROJECT SUMMARY:

Through a competitive grant process, the MN DNR offered two $75,000 grants. East Ottertail SWCD and the Itasca Water Legacy Partnership (Itasca SWCD) collaborated with DNR and the Water Resources Center (WRC) at the U of M to craft shoreland restoration incentive programs for lakeshore residential properties. Unique to this project was the focus on assessing the effectiveness of applying social science methods (KAP Studies) in promoting the planting of native shoreland buffers.

Using a process that is well known but rarely used in natural resources, Dr. Karlyn Eckman (WRC) used KAP Studies to determine Knowledge, Attitudes and Practices of target audiences.

Survey landowners ⇨ Design & implement incentives. ⇨ Survey again.

The second survey determines the effectiveness of project activities in changing the knowledge, attitudes and practices of the target audience. Target audiences for East Ottertail County were lakeshore owners over 50 years old owning 200 feet or more of shoreline and for Itasca County, all landowners on 5 selected lakes. Funds were utilized for designing incentives and analyzing results.

Project conclusions:

- Using a “KAP Study” contributed to more successful outcomes (more shoreland restored) by predicting better incentives and better communication methods.
- People were more knowledgeable than expected about water quality.
- People in these studies are not motivated by a financial incentive. Therefore, funds intended for financial incentives will have greater impact if they are re-allocated to hire high-quality, knowledgeable professionals.
- Social networks were more important than previously realized. Groups like lake associations, churches, garden clubs, informal groups of neighbors helped spur interest and motivation.
- More projects should incorporate KAP methods so they are “evaluation-ready” before implementation to better utilize the use of conservation funding and document project success to funders.
- Social science practices could be used in areas such as invasive species, habitat restoration, and recreation. Practices include KAP studies, message re-framing and utilizing existing social networks in the community.

IV. OUTLINE OF PROJECT RESULTS

Result 1: Project Design Workshop

Description: To ensure each trial program's sustainability and effectiveness, the DNR will partner with university programs to conduct a market-research driven project design workshop for all prospective applicants.

Summary Budget Information for Result 1:

	Trust Fund
Budget:	**$6,857**
Amount Spent:	**$6,857**
Balance:	**$0**

Deliverable	Completion Date	Budget	Status
1. Program Design Workshop	October 2008	$6,870	Complete

Completion Date: October 2008

Final Report Summary:

Significance of Results:
Utilizing a program design workshop was very effective in recruiting high quality projects as well as setting the tone and expectations for successful bidders. All organizations in attendance were also able to discuss the merits of this new way of delivering incentives and hopefully this event increased the use of some very basic social science and marketing tactics to increase the effectiveness of all attendees.
Work Not Completed In This Deliverable:
None.
Match Dollars:
The Minnesota DNR contributed in-kind of approximately $10,000.
Unresolved Problems:
None.
Explanation of Unspent Balance:
None.

The funds left unspent are largely due to the difficulties of installing shoreland buffers with changing weather conditions over a short period of time. Only two growing seasons could be accommodated and the second season was truncated by the State Government Shutdown.
Of the 35 LGUs that submitted letters of interest to the NSBI Program in September 2008, 22 attended (42 people, total) the pre-application workshop on Friday, October 17, 2008 at the Initiative Foundation in Little Falls, MN. The DNR contracted with the University of Minnesota Water Resources Center (WRC) for Dr. Karlyn Eckman, a senior research fellow, to design and deliver the workshop, "Working with your Target Audience: A Workshop for Program Applicants." The workshop integrated three group exercises with presentations about audience analysis and social science research methods. Based on feedback from participant evaluations, the workshop was successful in helping applicants define information needs about their target audiences and in assisting them lay out practical strategies for planning and evaluating their proposed incentive projects. Per the amended work plan of October 31, 2008, $3,130

of unspent monies from Result 1 were shifted to Result 3 to provide grantees with additional training in shoreland restoration.

Result 2: Competitive Grant Awards for Two Trial Buffer Incentives Programs

Description: The DNR will select, through a competitive process, two trial incentive programs to fund over the course of three years. Trial programs will be selected based on the description of the proposed incentive program; a proposed implementation, research, monitoring, and assessment protocol; and any matching monies or in-kind contributions to the proposed program. The Department will fund trial incentive programs that show the most promise for success, employ a market research-driven approach, represent different local circumstances, and come from LGUs that have current shoreline management requirements and effective enforcement. Each selected LGU will be awarded up to $75,000 to implement its incentives program. It was requested that $3,500 be moved from Result #3 to Result #2. These funds slated for ongoing technical assistance from the University of Minnesota Extension for shoreland workshops and travel (budget lines 24 – 27) would be used instead for training Itasca Community College and U of M Master gardeners in developing shoreland planting plans for landowners. This was previously an activity that was to be provided in-kind by the U of M Extension. To facilitate ease of implementation, it is requested to be billed through the Itasca SWCD.

Summary Budget Information for Result 2: Trust Fund

Budget:	**$153,500.00**
Amount Spent:	**$110,667.76**
Balance:	**$42,832.24**

Deliverable	**Completion Date**	**Budget**	**Status**
1. Competitive Selection Process	December 2008	$0	Complete
2. Two Incentive Program Models	June 2012	$153,500	Complete

Completion Date: June 2012

Final Report Summary:

Significance of Results:
Very helpful to the successful outcome of this deliverable was the ability of the local units of government to be empowered to think creatively and collaboratively with project staff and the Karlyn Eckman. These high-flying programs were 'unleashed' when they had the right tools (research and funding for incentives).
Work Not Completed In This Deliverable:
None.
Match Dollars:
The Minnesota DNR contributed in-kind of approximately $38,900.
$85,461 In the form of in-kind and cash match.
Itasca = $50,492

E. Ottertail = $34,969

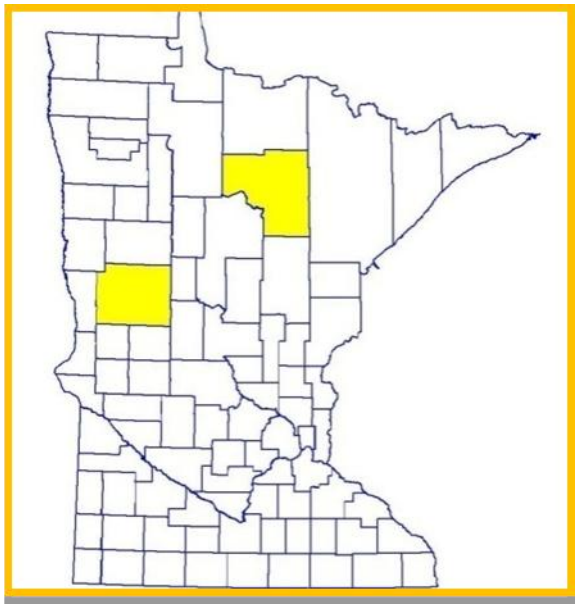
Unresolved Problems:

None.

Explanation of Unspent Balance:

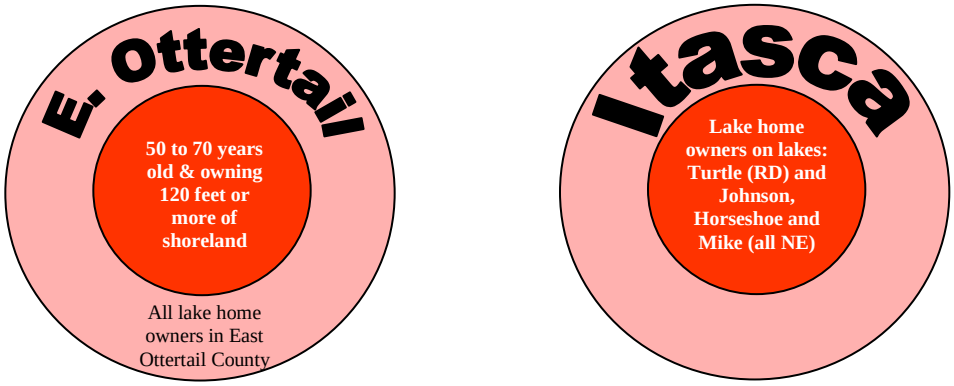
The funds left unspent are largely due to the difficulties of installing shoreland buffers with changing weather conditions over a short period of time. Only two growing seasons could be accommodated and the second season was truncated by the State Government Shutdown.

Selection phase: Ten LGUs submitted applications to the NSBI Program on or before the application deadline of December 1, 2008. A review committee of DNR, nonprofit and University of Minnesota representatives selected Itasca and Otter Tail counties as the trial projects. Reviewers felt that the Itasca County and Otter Tail County proposals presented the highest likelihood of success based on their description of local capacity to carry out the program. While on the surface, both are “lakes areas” with high projected population growth, the underlying land use types are different—Otter Tail being more ag-based and Itasca being more mining / timber-based.



NSBI KAP Project Locations

Target Audience Selection: The proposed scope of each program is different as well, with Itasca County choosing to focus its efforts on four lakes that were close in proximity but differed widely in their development patterns and classifications. East Ottertail identified the 50 to 70 year old owning more than 120 feet of lakeshore located anywhere throughout the entire county.



Target Audiences of Trial Buffer Project

First KAP Survey: Both projects administered social surveys during summer 2009 with coaching from Dr. Karlyn Eckman of the U of M Water Resources Center. Each project identified a target demographic that they had identified as critical to evaluate. Surveys included questions unique to each target demographic and locality.

Incentive Design:
Each project utilized the results of the first survey to better understand the target audience and design incentives that meet their needs.

Itasca:
The Itasca partners, led by Dr. Mary Blickenderfer of Minnesota Extension, subcontracted with Action Media to design the social marketing component of the Itasca NSBI. The Itasca NSBI team took a step-wise process, building on the initial social research findings, experimenting with different strategies, starting with small steps that might be acceptable to lakeshore property owners and adding additional options over time that emerged out of expressions of interest voiced by participants. Both the Itasca and East Otter Tail teams developed an education and outreach strategy with several options, which were tested and assessed. In Itasca County, the strategy can be summarized as:

"High-touch" (frequent and direct on-site contact by shoreland specialists, with multiple options for adoption including buffer installations with free labor; the Itasca Lakes Challenge; and other options);
"Medium-touch" (less frequent contact, but with some site visits; and
"Low-touch" (no direct contact with the property owner, who received a newsletter only).

The Itasca team selected Turtle Lake and South Johnson Lake as high-touch lakes. Medium-touch sites were limited to North Johnson Lake. The low-touch strategy was applied at smaller lakes (Mike Lake, Horseshoe Lake). These lakes varied considerably in terms of size, population density, and development patterns, from Turtle Lake (a large, developed lake with several resorts) to Mike Lake (a small lake with four cabins).

During the project period the Itasca team also designed several experimental civic engagement tools that were tested at various sites. These tools and activities were open to property owners on the five pilot lakes, as well as to the general public. These included:

1. The Itasca Lakes Challenge, whereby shoreland property owners scheduled a guided assessment with trained peers to assess the condition of their own shoreline, and to select options to improve shoreline condition;

2. Several civic engagement options accompany the Lakes Challenge, including:
   a. Citizen-based monitoring of runoff plots to compare native or new (installed) buffers with developed areas (lawns, paths, roads);
   b. Frog classes and frog monitoring;
   c. Fish identification/ecology classes; hands-on fish workshops (protocol and curriculum have recently been developed);
   d. Beachcomber program, with property owners looking for evidence of invasive plants.

The Itasca NSBI also included biophysical research components including shoreland buffer trials (runoff plots), and detailed technical support and advice on buffer installation. Those activities are described in the Itasca NSBI final report.

Ottertail: The EOT NSBI strategy can be summarized as:

"High-touch," defined as frequent and direct on-site contact by shoreland specialists, with multiple options for adoption including buffer installations with free labor and other options. Guidebooks were given at an earlier step to all participants. There were multiple messengers (e.g. Karen Terry from UM Extension who did a shoreland workshop; Steve Henry directly contacted and prepared participants for site visits; site visits were all performed with small groups; and joint installations were conducted). Participants were asked to contact their neighbors (peer to peer contact).
Sites: Lake Seven (14 adoptees of 70 parcels; 11 are awaiting cost share through Clean Water)

"Medium-touch" defined as less frequent contact, but with some site visits. There was also joint installation (do one house then do next house with owners on each site). Participants received guidebooks at site visits, and were also asked to contact neighbors (peer to peer).
Sites: Pickerel Lake (11 adoptees of 250 parcels)

"Low-touch" defined as no direct contact with the property owner, who received a newsletter only. Property owners were given guidebook and asked to contact their neighbors (peer to peer). Only two property owners participated on adjoining lots. SWCD staff swayed one owner; the respondent got a guidebook and talked to neighbor. Result was the same result (adoption).
Sites: West Battle (2 adoptees of 490)

Total: 27 adoptees (not all got NSBI cost share; two got no cost share from any source, but got labor)

Lake Seven was the High Touch implementation lake.
Project Guidebooks were distributed at Community Meetings, a Group Buffer Design Presentation was held, Neighbor to Neighor site investigation tour on two days in September.
The teired outreach structure has resulted in rapid practice adoption and installation with reductions in staff time and project costs.
Over 10% of parcels are currently pursuing a project.

Legend

Homeowners pursuing NSBI projects.

0.5 0.25 0 0.5 Miles

Result 3: Program Consultation and Assessment

Description: The DNR will partner with university programs to provide ongoing support to local government units (LGUs) in the design, implementation and assessment of each trial shoreline buffer incentives program. Support will come in the form of:

1) Ongoing program implementation and consultation support
2) Technical assistance with shoreland restoration workshops,
3) Social and economic efficacy research on each trial program, and
4) Ongoing research to evaluate buffer effectiveness to prepare final analysis and recommendations document and to utilize marketing assistance to increase adoption of buffer effectiveness recommendations.

Summary Budget Information for Result 3:	**Trust Fund**	
	Budget:	**$64,643.17**
	Amount Spent:	**$57,228.41**
	Balance:	**$7,414.76**

Deliverable	**Completion Date**	**Budget**	**Status**
1. Interim Program Report	December 2009	$0	
2. Social & Economic Efficacy Research and Final Report	June 2012	$30,000	Complete
3. Ongoing Program Consultation	June 2012	$19,630	Complete
4. Buffer Effectiveness Research and Final Report	June 2012	$15,013	Report Complete, Buffer Effectiveness Not Complete

Completion Date: June 2012

Final Report Summary:

Significance of Results:
Surprising was the result that showed how small an influence "traditional" cost share programs had on landowners decision to plant native buffers. Also, to use a KAP approach which was traditionally used in the field of community health and apply it to natural resource BMP implementation was unique and groundbreaking.

Work Not Completed In This Deliverable:
Originally envisioned was field testing to quantify the relative effectiveness of *restored* shoreland buffers to *indigenous* shoreland buffers. This water quality work was later determined to be impossible to complete in this project for two reasons:

1. The project would be too costly for the amount of funding allotted in the NSBI program
2. The complexity of such a study would not allow for reliable results to be reported within the relatively short appropriation period.

Match Dollars:
The Minnesota DNR contributed in-kind of approximately $11,000.
Unresolved Problems:
None.
Explanation of Unspent Balance:
See above – Work Not Completed In This Deliverable.

Overview of the U of M contributions:
The University of Minnesota Water Resources Center played a pivotal role in the design and evaluation of the trial buffer projects due to the comparatively limited KAP experience in the Minnesota conservation community. Dr. Eckman provided guidance to the buffer projects during the design of the survey instruments, advised projects on administration of the surveys, interpretation of the surveys, design of incentives, design and administration of second round surveys, and the development of interim and final effectiveness reports. The experience and skills that Dr. Eckman provided to the project were unique and invaluable.

Report conclusions:

1. NSBI explored a fundamental question: Do "traditional" incentives work in promoting shoreland conservation?
What we learned:

a. People are not motivated by a financial incentive. They will take the money, but will readily adopt conservation practices without the incentive. Also, people are not motivated because of lack of knowledge. Those incentive programs which assume that people first need to be informed may be wasting effort.
b. People are motivated by stewardship values and deep concern for clean water, and especially for "their" lake. They take action because of that concern. Conservation messages that build on and reward stewardship will likely have the most impact. Financial incentives are almost inconsequential for this demographic and have the least appeal of all possible offerings (labor, planting materials, technical advice, etc.).
c. People would rather have direct interaction with a trained natural resources professional than any other option (cost-share, brochure, handbook, workshop, etc.). They need and want practical, "high-touch" contact with a knowledgeable professional for guidance and specialized technical information. They also preferred a guidebook as a reference while installing their own buffers.

Take-home message: Funds intended for financial incentives will have greater impact if they are re-allocated and invested in human resources. High-quality access to knowledgeable professionals will result in greater adoption and impact.

2. NSBI also asked: How could social science research contribute to conservation efforts?
What we learned:

a. Social research (the KAP study) produced location-specific data about people's knowledge, attitudes, practices and barriers that helped staff create more effective outreach and education strategies. That is, social data from one location may not apply to other audiences.
b. People were more knowledgeable than expected about water quality, and the KAP studies identified the limits of their knowledge. Staff discovered that their messages were too "canned" and contained information that people already knew. KAP data helped staff to reframe their educational content to appropriate levels, fill in missing knowledge gaps, and create outreach/engagement opportunities based on people's expressed interests and needs.
c. We discovered the importance of social networks (lake associations, churches, garden clubs, informal groups of neighbors) in spreading conservation messages and organizing education/outreach.

Take-home message: The social research tool used in the NSBI (and other natural resources projects) has generally contributed to more successful outcomes and impacts. Without social science data, project staff are likely unaware of audience behaviors, and will be unable to determine impacts on those audiences.

3. How was social science data used for NSBI? How can it be used in a practical sense elsewhere?

a. KAP data was helpful in project planning. It identified people willing to participate; attitudes toward conservation; barriers to BMP adoption and maintenance; and collect pre-project data on knowledge and practices.
b. Data was used to re-frame core conservation messages (see images below).
c. Data identified informal social groupings that can disseminate information, and provide new venues for civic engagement.
d. The data helped to identify or create outreach and educational opportunities to engage people in new conservation activities with direct and local appeal. These had a better impact than conventional outreach methods.

Itasca examples: Frog counts for kids and their grandparents; Lake Challenge tool.

Otter Tail examples: Design new buffer packages that appeal to different tastes (cottage garden, prairie garden, natural shoreline, etc.); medium and high touch group activities.

e. Social research provided pre/post project data for evaluation, reporting and evidence of project impacts.

Take-home message: Social science data had practical value at all stages of project design and implementation. Other incentive program project budgets should allow for basic social research. Projects should be designed to be "evaluation-ready" before implementation to best evaluate impacts on intended audiences. Certain social approaches and tools (e.g. KAP study method; message re-framing; Lake Challenge tool) used in the NSBI are widely applicable to other programs (invasive species; habitat restoration; recreation; etc.).

V. TOTAL TRUST FUND PROJECT BUDGET:

Grants to LGUs:	**$153,500.00**
Contract Services for Program Support:	**$64,643.17**
Supplies	**$186.83**
TOTAL TRUST FUND PROJECT BUDGET:	**$225,000.00**

Explanation of Capital Expenditures Greater Than $3,500: Not Applicable

VI. OTHER FUNDS & PARTNERS:

A. Project Partners: The DNR will partner with university programs and two LGUs on the incentives program. The LGUs will be chosen through a competitive process in Fiscal 2009, with strong consideration given to two related 2008 LCCMR proposals (Line 54, Anhorn, Social Marketing to Develop and Implement Shoreline Buffer Incentive System; and Line 58, Riggs, Incentives for Shoreland Conservation Through Property Tax Reductions). The primary project manager will be DNR Northeast Regional Lakes Planner/Community Liaison Erika Rivers and Community Assistance Specialist Mark Hauck, who will supervise the program, with technical support from Shoreland Management Program Manager Peder Otterson and DNR Shoreland Habitat Specialist/Research Analyst Paul Radomski. University of Minnesota's Water Resources Center and Extension Service's Shoreland Education Program will also collaborate on the project.

B. Other Funds Proposed to be Spent during the Project Period: DNR staff time included Rivers, Hauck, Otterson, and Radomski and was projected to be approximately $50,000 per fiscal year. One-third match ($25,000) will be expected from each trial incentive program; the matching contribution can be a combination of direct funding and in-kind contributions to the trial program.

Final Report Summary:

The post completion estimate for DNR staff time contributions to the project is approximately $59,900 for all years of the project combined.

The East Otterail project garnered $34,969 of in-kind contributions (cash and labor) while the Itasca project brought forward $53,492 in cash contributions (cash and labor).

C. Past Spending: No money has been spent on this project to date.

D. Time: This will be a multi-year project ending in June 2012.

VII. DISSEMINATION:

The DNR project manager and partners will share results and incentive program models when possible at professional and academic conferences, and through

electronic media and professional networks. The interim and final reports will also be available through the DNR publications library and on the DNR Web site.

VIII. REPORTING REQUIREMENTS:

Periodic work program progress reports will be submitted no later than December 2008; June 2009; December 2009; June 2010; December 2010; June 2011; December 2011 and June 2012. A final work program report and associated products will be submitted between June 30 and August 1, 2012 as requested by the LCCMR.

Attachment A: Final Budget Detail for 2008 Projects

Project Title: *Native Shoreland Buffer Incentives Program*

Project Manager Name: *Mark Hauck (MN DNR)*

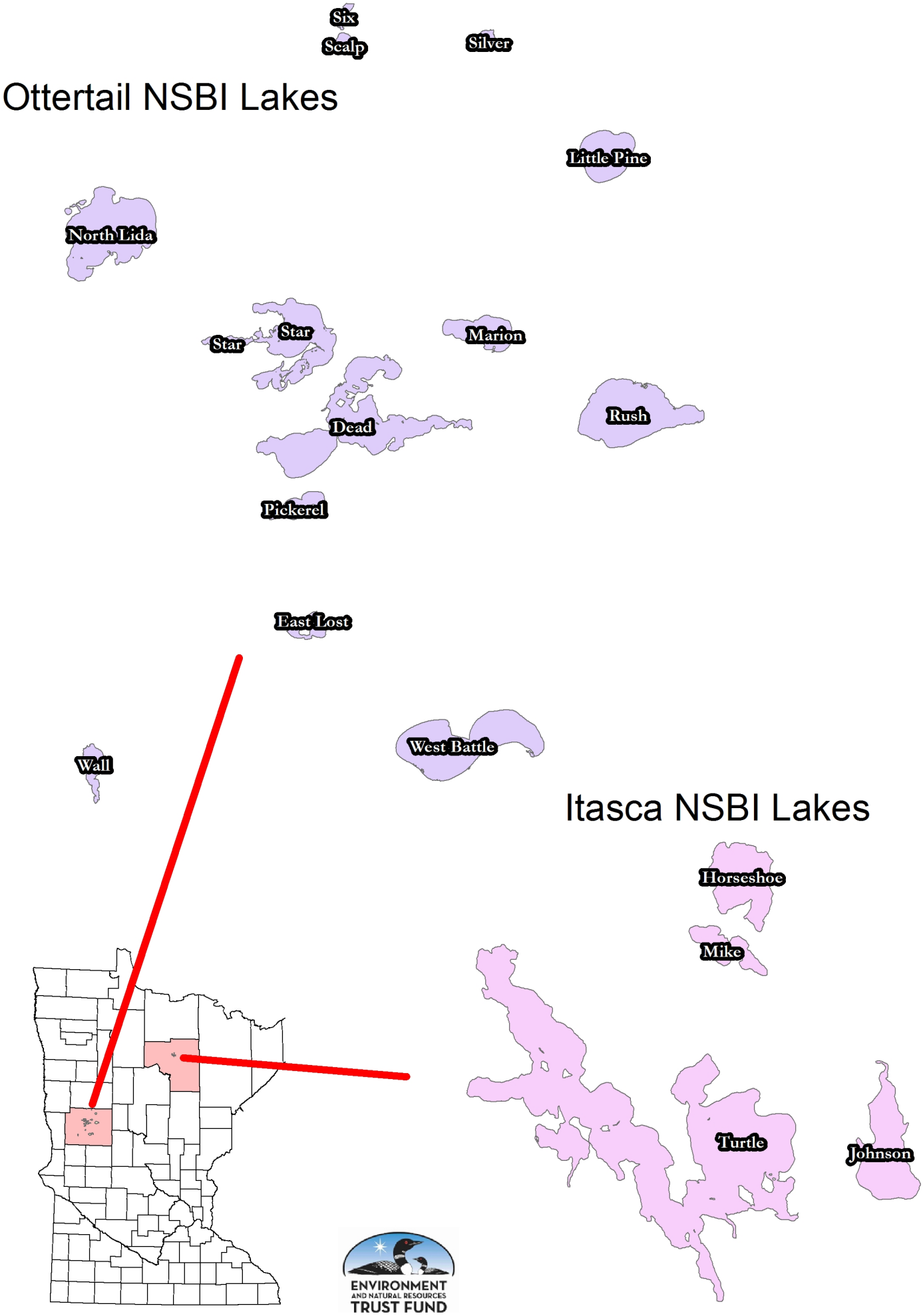
Trust Fund Appropriation: $225,000

1) See list of non-eligible expenses, do not include any of these items in your budget sheet

2) Remove any budget item lines not applicable

2008 Trust Fund Budget	**Result 1 Budget:**	**Amount Spent** *(7/31/12)*	**Balance** *(7/31/12)*	**Result 2 Budget:**	**Amount Spent** *(7/31/12)*	**Balance** *(7/31/12)*	**Result 3 Budget:**	**Amount Spent** *(7/31/12)*	**Balance** *(7/31/12)*	**TOTAL BUDGET**	**TOTAL BALANCE**
	Project Design Workshop			*Competitive Grant Awards*			*Program Consultation and Assessment*				
BUDGET ITEM											
PERSONNEL: wages and benefits											
Contracts											
University of MN--WRC Contract											
Design Project Design Workshop	$6,670.00	$6,670.00	$0.00							$6,670.00	$0.00
Socio-Econ Design/Implementation							$8,340.00	$8,340.00	$0.00	$8,340.00	$0.00
Project consultation & evaluation							$19,990.00	$19,990.00	$0.00	$19,990.00	$0.00
Outline final report/data to date							$5,000.00	$5,000.00	$0.00	$5,000.00	$0.00
Produce final assessment/report							$16,300.00	$16,300.00	$0.00	$16,300.00	$0.00
Develop Best Practices							$5,000.00	$5,000.00	$0.00	$5,000.00	$0.00
Travel - WRC							$4,000.00	$2,598.41	$1,401.59	$4,000.00	$1,401.59
University of MN--Extension Contract											
Technical assistance (16 hours @ $60)											
Travel											
Shoreland workshops (1 each LGU)											
Grants for LGUs *To create incentives programs ($75,000 for each program)*				$153,500.00	$110,667.72	$42,832.28				$153,500.00	$42,832.28
Itasca County SWCD				*$78,500.00*	*$59,691.43*	*$18,808.57*				--	--
East Otter Tail SWCD				*$75,000.00*	*$50,976.29*	*$24,023.71*				--	--
Other Supplies *workshop materials*	$186.83	$186.83	$0.00							$186.83	$0.00
Unassigned							$6,013.13		$6,013.13	$6,013.13	$6,013.13
Other - Balance Adjust							$0.04		$0.04	$0.04	$0.04
COLUMN TOTAL	**$6,856.83**	**$6,856.83**	**$0.00**	**$153,500.00**	**$110,667.72**	**$42,832.28**	**$64,643.17**	**$57,228.41**	**$7,414.76**	**$225,000.00**	**$50,247.04**

Native Shoreland Buffer Initiative (NSBI)



EAST OTTER TAIL COUNTY NSBI
Social Research Report

February 18 2012

Karlyn Eckman
Water Resources Center, University of Minnesota

ACRONYMS

BMP	Best management practice
CATA	Check-all-that-apply
COLA	Coalition of Lake Associations
COOR	Check-only-one-response
DNR	Minnesota Department of Natural Resources
EOT	East Otter Tail
EOTSWCD	East Otter Tail County Soil and Water Conservation District
KAP	Knowledge, attitudes and practices study
LGU	Local government unit
MNENRTF	Minnesota Environment and Natural Resources Trust Fund
n	number
NSBI	Native Shoreland Buffer Incentives Project
Q	Question
SWCD	Soil and Water Conservation District
TMDL	Total maximum daily load
UM	University of Minnesota
WRC	University of Minnesota Water Resources Center

Introduction

The Native Shoreland Buffer Incentives project (NSBI) was a pilot project designed to test and evaluate new approaches to engaging shoreland property owners in northern Minnesota. The project was proposed by the DNR to the Minnesota Environment and Natural Resources Trust Fund (MNENRTF) in 2008. It was accepted by the Trust Fund Commission, which recommended the proposal to the Minnesota State Legislature, and was eventually funded for $225,000. The program has run for three years (July 2008 – June 2011).[1]

The primary resource objective of the NSBI is to protect native vegetation buffers along Minnesota shorelines. The project goal is to develop, implement, and evaluate the efficacy of two substantially different models for incentivizing the maintenance of native shoreland buffers by local government units (LGUs). The project scope combines both social science and natural resources activities. Through the NSBI, the Minnesota Department of Natural Resources (DNR) offered two competitive grants to LGUs to craft shoreland protection incentive programs that encourage maintaining and restoring native shoreland buffers in areas of existing or newly proposed development. East Otter Tail County was one of the two LGUs selected to participate in the NSBI.

Intended outcomes of the NSBI program were:

1) A workshop and ongoing consultation services that educated prospective local governmental applicants about how to design incentive programs that elicit sustainable behavioral change;
2) Two trial buffer incentive programs models (one per LGU);
3) Interim and final reports on program efficacy;
4) DNR technical and assessment support on the effectiveness of trial program buffers.

Measures of success:
This project will be considered successful if:

- Two buffer incentive programs (chosen by competitive process) are developed, implemented, and evaluated by June, 2011;
- The MNENRTF is satisfied with the final efficacy reports, and the reports are helpful to others considering incentive-based approaches to shoreland stewardship;
- Involved stakeholders have increased their skills and knowledge as a result of the project;
- The DNR and other interested parties can readily benefit from the lessons learned from the trial programs.

The project was led by the DNR, and a subcontract was awarded to the University of Minnesota Water Resources Center (WRC) for the social research component. The DNR partnered with the WRC to conduct a workshop in October 2008 for prospective applicants, and to conduct social,

[1] The project was extended due to the state government shutdown as well as administrative delays in contracting.

economic and ecological efficacy research for each trial program. These project partners have provided technical assistance to LGUs in the design, administration, implementation and evaluation of the trial incentive programs.

The NSBI project commenced in October 2008 with a workshop called "Understanding your Target Audience," which was attended by approximately forty staff of two dozen local governments, mainly counties and soil and water conservation districts (SWCDs). The LGUs were invited to submit proposals to the NSBI with innovative strategies intended to foster adoption and maintenance of shoreland buffers by shoreland property owners. The proposals were submitted and reviewed by a panel with members drawn from The Initiative Foundation, DNR, WRC and others. Two proposals from the East Otter Tail (EOT) County Soil and Water Conservation District, and a coalition of partners from Itasca County (including Minnesota Extension, the Itasca Coalition of Lake Associations, or ICOLA) were selected for funding ($75,000 each). Contracts were prepared for each county, and project activities commenced in late 2008.

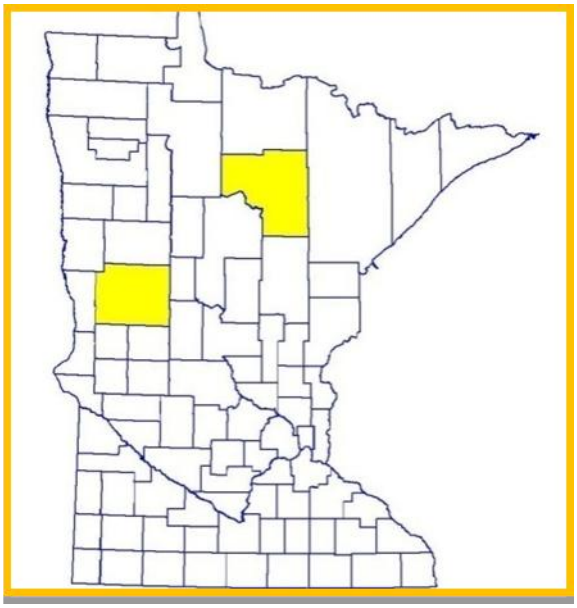


Figure 1: Location of Itasca and East Otter Tail Counties
(Itasca is in northern Minnesota; East Otter Tail is in west-central Minnesota)

Both counties committed to a social research component that investigated the awareness and behaviors of shoreland property owners. Barriers and constraints to adoption of shoreland buffers were also explored. One social research and evaluation tool employed in both Itasca and East Otter Tail counties is the *knowledge, attitudes and practices (KAP) study* described in Eckman (2010 and 2011).

This report concerns only the social research aspects and social outcomes of the East Otter Tail County NSBI project. A similar report has been prepared for Itasca County. Each county will also submit a final report detailing the deliverables in each case. In addition, the NSBI final/efficacy report gives an overview of project accomplishments and lessons, and draws conclusions about the efficacy of the different strategies tested in each county.

It should be noted that unfortunate administrative delays in processing contracts in 2008, 2009 and 2010, combined with the 2011 state government shutdown, severely handicapped the social research elements of the NSBI. The long administrative delays and work stoppages caused frequent interruptions in field work, leaving insufficient time for data analysis. There has been limited time in which to prepare this report and the NSBI final/efficacy report. Nevertheless, valuable lessons and findings have been gained, and are summarized in this and the accompanying final/efficacy report.

The East Otter Tail County NSBI Project

The purpose of the East Otter Tail County NSBI was described in the proposal submitted to the DNR in late 2008:

"This project targets owners of larger lots (greater than 120 feet of shoreline) in the 50- to 70-your old age demographic with outreach materials and incentives to restore or maintain native shoreline buffers. Targeted shoreland homeowners will be invited to attend tours, site open houses and workshops, and will be offered opportunities and incentives to establish large, attractive and sustainable shoreland buffers on their sites. The project will also document changes in public knowledge, attitudes and perceptions (KAP) through pre- and post-implementation research, evaluate established buffer quality, and disseminate all results and developed materials through the eotswcd.org website."

A customized conceptual framework guided the NSBI strategy for each county. For East Otter Tail County, the "big picture" questions were determined to be:

- Which incentives should be offered to residents?
- What is the acceptability of cost-share to residents?
- What are perceptions of property owners of a naturalized shoreline?
- How to move the "maybes" (e.g. those individuals that say they might be interested in participating)?
- Which low-touch incentives will move the "maybes?"
- What kind of information do the "maybes" need?
- Which treatments or "offerings" (incentives and otherwise) do people prefer?

The following graphic was provided by the EOTSWCD in 2010 and describes the strategy used in EOT shoreland staff:

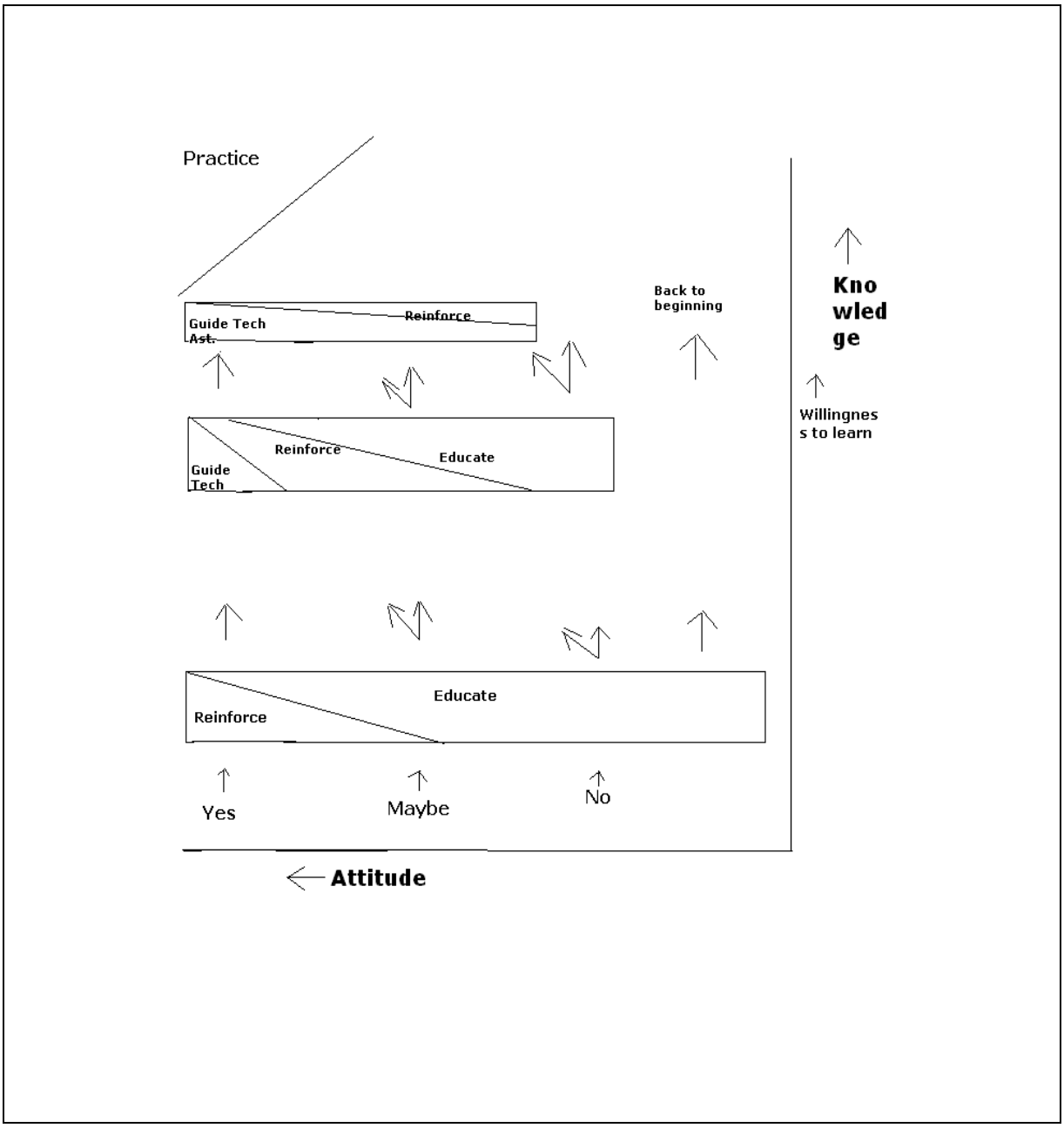


Figure 2: EOTSWCD Education and Outreach Strategy

A knowledge, attitudes and practices (KAP) study was designed to provide county staff with a baseline data set that could determine the current level of audience knowledge, which would guide the design of educational messages. KAP values would also be useful to the EOT staff in understanding respondent motivation; identifying specific constraints preventing respondents from adopting buffers; identifying gaps in knowledge and practices; and identifying individuals ready to adopt and participate. Measureable changes in KAP values (particularly knowledge) over time would provide evidence of impact over the project period. Based upon the first-round KAP data, East Otter Tail staff (Steve Henry) developed an innovative education and outreach strategy with several options, which were tested and assessed during NSBI implementation. The EOT NSBI strategy can be summarized as:

"*High-touch,*" defined as frequent and direct on-site contact by shoreland specialists, with multiple options for adoption including buffer installations with free labor and other options. Guidebooks were given at an earlier step to all participants. There were multiple messengers (e.g. Karen Terry from UM Extension who did a shoreland workshop; Steve Henry directly contacted and prepared participants for site visits; site visits were all performed with small groups; and joint installations were conducted). Participants were asked to contact their neighbors (peer to peer contact).
Sites: Lake Seven (14 adoptees of 70 parcels; 11 are awaiting cost share through Clean Water)

"*Medium-touch*" defined as less frequent contact, but with some site visits. There was also joint installation (do one house then do next house with owners on each site). Participants received guidebooks at site visits, and were also asked to contact neighbors (peer to peer).
Sites: Pickerel Lake (11 adoptees of 250 parcels)

"*Low-touch*" defined as no direct contact with the property owner, who received a newsletter only. Property owners were given guidebook and asked to contact their neighbors (peer to peer). Only two property owners participated on adjoining lots. SWCD staff swayed one owner; the respondent got a guidebook and talked to neighbor. Result was the same result (adoption).
Sites: West Battle (2 adoptees of 490)

Total: 27 adoptees (not all got NSBI cost share; two got no cost share from any source, but got labor)

The corresponding EOT treatments are summarized in the following table:

Table 1: EOT Treatment and Control Groups

Treatment Groups	Low touch Medium touch High touch	- Brochure (all) - Community meeting (West Battle Lake; Lake Seven) - Intense presence with personalization (Pickerel Lake)
Control Group: East Battle Lake	- No brochure - Monitor only - Post-KAP focus group	

Social Science Research Aspects of the EOT NSBI

The NSBI included a social research and evaluation component, in contrast to most Minnesota water quality projects (Eckman, Walker, Nuckles and Bouapao, 2008). It has been observed that, within a targeted audience, some individuals are inclined to adopt a recommended best management practice (BMP), while others are disinclined. The reasons for this are not well explained by current research and literature. A major question among natural resource professionals is how to move people from being disinclined to being more inclined to adopt a conservation practice.

It has also been observed that most natural resources professionals are trained in the biophysical sciences. They are often unfamiliar with social research and evaluation practices and methods, which limits their use at the project level. In addition, as the NSBI began, it was learned that few water quality projects in Minnesota conduct any form of project evaluation, and that the evaluation of social outcomes and impacts is very rare (Eckman, Walker, Nuckles and Bouapao, 2008). Therefore, there is limited capacity among natural resources professionals and related public agencies to investigate the underlying reasons for non-adoption of BMPs and lack of participation in conservation. The vast majority of water quality projects in Minnesota are unable to determine with certainty the impact of their projects and messages on intended target audiences. Evaluating social outcomes also relates to questions of accountability: how can the overall impact of major investments of public resources on resource users be known? The NSBI was designed in part to address these underlying questions.

Some of the underlying social research questions of the NSBI include:

- What motivates people to adopt and maintain a recommended practice? Why are some individuals inclined and others disinclined to adopt?
- Are the customary financial incentives offered by state and local agencies sustainable? Do people maintain the practice after the incentives end?
- How can education and outreach strategies be designed according to local needs for better impact?
- How can we, as natural resources professionals, foster civic engagement?
- How do we know what impact the NSBI project has on property owners? What are the social impacts, results and outcomes?

These are "big picture" questions currently being discussed by a number of natural resources professionals in Minnesota and elsewhere. While these questions may not be entirely answered by the social research in this particular project, our findings may contribute in a small way to this very active dialogue. One example comes from Lake Seven, where "high touch" social interaction provided by EOT staff encourages people to keep participating. In principle, the greater the interaction between natural resources professionals and local property owners, the better, but how can this be sustained and even expanded county-wide given limited LGU resources? How can one staff member work with an ever-expanding number of groups? How can civic engagement best be supported?

Photo 1: EOTSWCD shoreland staff checking a newly-planted buffer

The social research methods selected in this project were chosen because of their relatively low cost, relatively rapid nature, and ease of application and interpretation. A mixed-methods approach was taken in order to triangulate and verify findings, and to obtain a richer understanding of attitudes and (especially) motivation of local property owners. The pre-implementation research methods used in East Otter Tail County included:

1. A baseline KAP (knowledge, attitudes and practices) study to assist in planning, the design of education and outreach methods, and to identify possible participants in the NSBI;
2. A focus group held with lake association members to understand social networks and diffusion of information between property owners;

The end-of project research methods included:

1. A second-round KAP study to evaluate changes in knowledge, attitudes and practices, and the acceptability of recommended practices and installations. This yielded two data sets enabling comparison of pre and post KAP values;
2. Key informant interviews to gain a richer understanding of participant motivation and to better understand local social networks.

Coaching in the KAP method was provided throughout the NSBI by the University of Minnesota Water Resources Center, and a "how-to" workshop was organized on designing a focus group study.

The NSBI social research methods are characterized as purposive and exploratory in nature. Even though the baseline EOT KAP sample was intended to be a random probability sample, the response rates were not large enough to enable more sophisticated data analysis. The analysis, therefore, is based upon a comparison of descriptive statistics (frequencies/percentages) for the two data sets. These quantitative findings were contrasted with the qualitative data gained from key informant interviews.

The EOT NSBI KAP Study

As noted, a KAP study was designed specifically for property owners in East Otter Tail County. The purpose of the KAP study was to assess the views of shoreland property owners about shoreline buffers, as well as to identify potential incentives that might help to overcome barriers to installing and maintaining buffers.

The survey experimental design was guided by a "gap exercise," whereby NSBI and EOT staff considered what they needed to know about the audiences on target lakes. Of special interest was gaps in staff knowledge about those audiences ("what *don't* we know about these property owners, but *should* know, in order to design an effective education and outreach strategy). During this exercise, a list of gaps was made during a brainstorming session with EOT and NSBI staff. This preliminary list of gaps was the basis for questionnaire construction. The list of gaps and questions was refined, critiqued by the team, refined again, and finally converted into a Survey Monkey draft questionnaire. This was pretested and refined again. The two KAP questionnaires (2009 and 2011) are attached as annexes to this report.

The sampling frame was based on criteria determined by the EOT SWCD. These included:
a. Shoreland property owners with larger lots (> 120 feet of shoreline);
b. Shoreline property owners in the 50-70 years of age demographic.

Table 2: Comparison of First and Second Round EOT KAP Studies

	Dates	Sample Population	Sample size	# Respondents	Response Rate	Margin of Error
KAP 1	Summer 2009	1,500	665	383	58%	2.84
KAP 2	Summer 2011	1,500	379 (~20 returned) = 359	131	36%	4.35

For the second round KAP study, EOT staff sent a small number of surveys to three different treatment groups county-wide, drawn from the same pool as the original survey. These included:

a. Pickerel Lake residents meeting EOTSWCD's original criteria;
b. Pickerel Lake residents in general;
c. Lake Seven residents meeting EOTSWCD's original criteria;
d. Lake Seven residents in general.

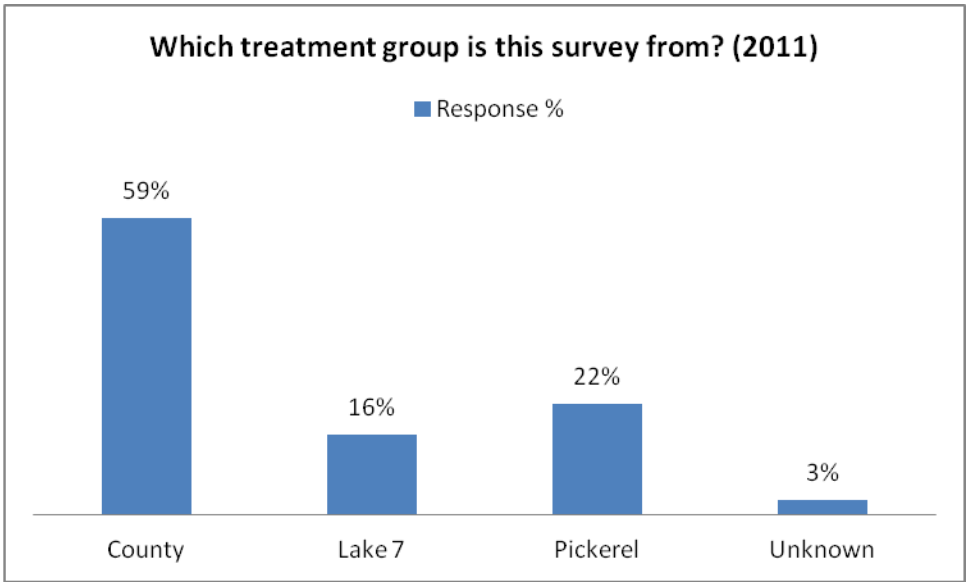
The individual respondents in the second sample were different than the first sample in most cases. EOT intended to compare targeted lakes (with the specific criteria) with the county-wide population. However, too few questionnaires were completed to enable such a comparison.

Survey administration

The EOT KAP study was administered twice: first as a baseline survey at the project outset (summer 2009); and again toward the end of the project (summer 2011). Both surveys were administered by mail, with mailing protocols based upon the Dillman Tailored Design Method (Dillman 2000). A professional company was employed by EOTSWCD to address and mail the surveys for the first-round surveys. Data entry for both surveys was done by EOT staff, except for one batch of 2011 questionnaires that was sent to WRC for data entry in December 2011. The first-round data set in the EOTSWCD Survey Monkey account was unfortunately deleted in 2010 resulting in some loss of some sampling data and respondent comments (although a partial dataset had been downloaded).

The second-round stratified sample is summarized in the following table:

Table 3: EOT Treatment Groups



Second-round survey administration was managed by EOTSWCD staff, with coaching provided by the WRC. EOTSWCD mailed less than one hundred questionnaires in the fall of 2011, of which about thirty were returned. EOT was encouraged by WRC to significantly increase the number of questionnaires in the sample to reach a minimum sample size. The second tranche of questionnaires was therefore sent in late October 2011 resulting in a total of 131 for the second-round data set. While this number is unfortunately low (*e.g*. 36% response rate and 4.35 margin of error), it is a basis for the comparison of pre and post project data. EOTSWCD provided the following possible explanations for the low response rates:

- The state government shutdown (July 2011) meant that the second-round KAP study was delayed for about two months, leaving only a small window of time for EOT staff to send out the introductory letter, a second-tranche survey, and reminder notices;

- Both verbal and written comments suggested that property owners were frustrated about the state government shutdown, which may have affected respondents' willingness to participate in the survey.

Data analysis was done by WRC with Survey Monkey and Excel software using basic descriptive statistics. Data from the pre and post surveys were compared to give longitudinal results. Given the small sample sizes, especially for the second-round survey, it was not possible to do more sophisticated data analysis.

Data application. The first-round data was used to inform the education and outreach aspects of the EOT NSBI, and to help identify property owners expressing an interest in participating.[2] The second-round survey differed somewhat from the first-round survey, although many questions were retained in order to give a basis for comparison and evaluation. The second-round study repeated many (but not all) of the questions in order to gauge changes in key KAP values. A few first-round questions needed for planning were dropped (e.g. Q8, 13 and 18). A set of efficacy questions were added to the second-round questionnaire (Q18-26) in order to assess acceptability and utility of the NSBI approach. These new questions were posed to assess the acceptability of the strategies and interventions that were introduced in the interim. This produced two data sets (pre and post implementation), enabling direct comparison of values. Specific details are provided in the Discussion section below.

The results and comparison of the first and second round surveys are presented below. Knowledge questions are presented first, followed by attitudes and practices questions. In the ranked scale data sets, the values with highest frequencies are highlighted in bold font. Where appropriate, the symbol 💧 is used to signify an interpretive comment or note of the results for specific survey questions.

Knowledge Questions

In 2009, a sequence of statements was posed in a scale question to respondents to explore their **knowledge about water quality**. 2009 results are summarized below in Table 4. Highest ranked results are in bold font.

Table 4: How much do you agree with the following statements? Please check the box that best indicates how much you agree (2009 Results).

	Agree	Neutral	Disagree	I don't know	Response count
"How the land around my lake is managed has an impact on the water quality in my lake."	**92.3% (348)**	4.8% (18)	0.8% (3)	2.1% (8)	377
"Pollution that gets into my lake slowly builds up over time."	**81.3% (304)**	9.9% (37)	2.7% (10)	6.1% (23)	374
"My lake's water quality will get worse in the future."	27.5% (103)	**38.2% (143)**	17.1% (64)	17.1% (64)	374
"The water clarity (how deep you can see) in my	**75.8% (285)**	16.0% (60)	2.7% (10)	5.6% (21)	376

[2] Details about how the KAP data was used in preparing the education/outreach strategy and materials are described in the NSBI final/efficacy report.

lake has an effect on the value of my property."					
"My actions impact the water quality experienced by future generations."	Data unavailable	Data unavailable	Data unavailable	Data unavailable	Data unavailable
Answered question					377
Skipped question					12

This question was repeated in 2011, and results are presented below.

Table 5: How much do you agree with the following statements? Please check the box that best indicates how much you agree (2011 Results).

	Agree	**Neutral**	**Disagree**	**I don't know**	**Response count**
"How the land around my lake is managed has an impact on the water quality in my lake."	**94.5% (121)**	3.1% (4)	0.8% (1)	1.6% (2)	128
"Pollution that gets into my lake slowly builds up over time."	**89.2% (116)**	6.9% (9)	0.8% (1)	3.1% (4)	130
"My lake's water quality will get worse in the future."	**37.2% (48)**	29.5% (38)	20.2% (26)	13.2% (17)	129
"The water clarity (how deep you can see) in my lake has an effect on the value of my property."	**79.1% (102)**	17.8% (23)	0.8% (1)	2.3% (3)	129
"My actions impact the water quality experienced by future generations."	**89.9% (116)**	8.5% (11)	0.8% (1)	0.8% (1)	129
Answered question					131

Skipped question					0

Results are notable in that respondent knowledge and awareness of key water quality constructs is very high. However, there seems to be a lack of awareness of the possibility of change in water quality. In 2009, the majority did not appear to perceive that water quality might worsen over time. However, by 2011 there was a ten percent increase in the number of respondents who expressed awareness that water quality could decline. There is also an increased belief in 2011 that water quality affects property values.

Both data sets suggest that knowledge about water quality is already relatively high, and that responses across the board shifted in a positive direction from 2009 to 2011. Since awareness of the importance of water quality is already high, outreach and educational messages should build upon what people already know and are concerned about.

A second knowledge question explored respondent **knowledge about the environmental benefits of native shoreland buffers**, as well as preconceptions and attitudes toward buffers. Results are summarized in the table below.

Table 6: How much do you agree with the following statements? Please check the box that corresponds with how much you agree. "Natural shoreland areas…." (2009).

	Agree	Neutral	Disagree	I don't know	Rating averages	Response count
Prevent erosion	**76.2% (276)**	14.9% (54)	4.4% (16)	4.4% (16)	2.63	362
Protect water quality	**75.8% (275)**	14.6% (53)	3.6% (13)	6.1% (22)	2.60	363
Improves property appearance	22.5% (82)	**46.3% (168)**	26.2% (95)	5.0% (18)	1.87	363
Provide wildlife habitat	**79.7% (291)**	14.2% (52)	3.6% (13)	2.5% (9)	2.71	365
Provide fish habitat	**72.1% (259)**	17.8% (64)	5.6% (20)	4.5% (16)	2.58	369
Reduce shoreline maintenance	**52.5% (188)**	26.3% (94)	14.5% (52)	6.7% (24)	2.25	358
Obstruct lake views	30.6%	**35.8%**	27.5%	6.1%	1.91	360

	(110)	**(129)**	(99)	(22)		
Are a safety hazard	5.6% (20)	34.8% (125)	**52.9% (190)**	6.7% (24)	1.39	359
Increase nuisance bug and pest activity	**40.9% (147)**	31.5% (113)	18.4% (66)	8.2% (33)	2.04	359
Interfere with dock and lift removal/storage	**39.6% (143)**	31.6% (114)	22.7% (82)	6.1% (22)	2.05	361
Eliminate sandy beaches	32.3% (116)	**33.1% (119)**	25.3% (91)	9.2% (33)	1.89	359
Interfere with lake access	29.2% (105)	36.9% (133)	28.1% (101)	5.8% (21)	1.89	360
Answered question						367
Skipped question						16

This question was repeated in 2011, although EOTSWCD shortened the number of possible responses. Results are presented in the table below.

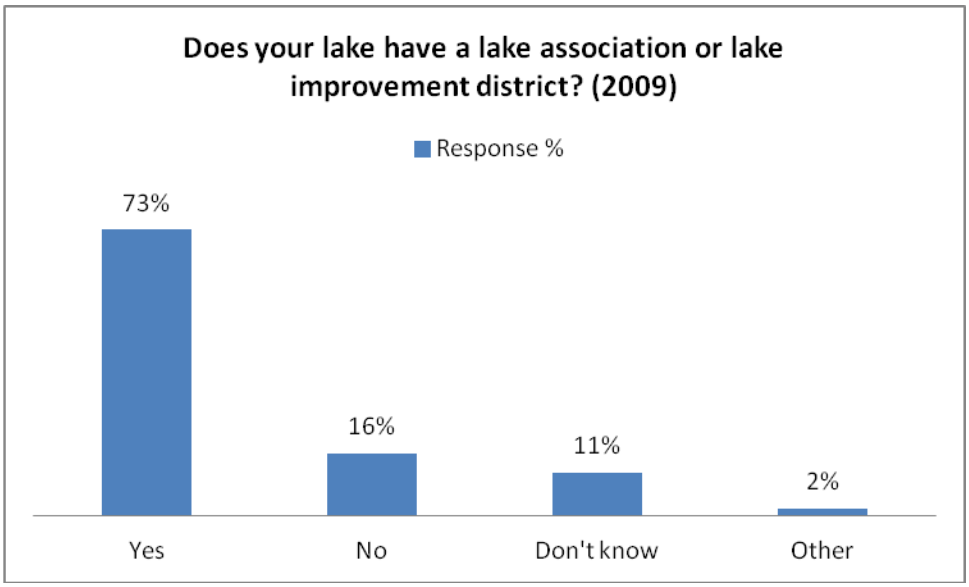
Table 7: How much do you agree with the following statements? Please check the box that corresponds with how much you agree. "Natural shoreland areas…." (2011).

	Agree	Neutral	Disagree	I don't know	Rating averages	Response count
Prevent erosion	**83.2% (104)**	8.8% (11)	4.8% (6)	3.2% (4)	2.72	125
Protect water quality	**84.1% (106)**	11.1% (14)	2.4% (3)	2.4% (3)	2.77	126
Provide wildlife habitat	**72.0% (90)**	23.2% (29)	2.4% (3)	2.4% (3)	2.65	125
Obstruct lake views	27.6% (34)	**47.2% (58)**	20.3% (25)	4.9% (6)	1.98	123
Interfere with dock and lift removal/storage	**41.6% (52)**	32.0% (40)	19.2% (24)	7.2%% (9)	2.08	125
Eliminate sandy beaches	29.0% (36)	**34.7% (43)**	29.0% (36)	7.3% (9)	1.85	124
Interfere with lake access	30.9% (38)	**39.8% (49)**	22.8% (28)	6.5% (8)	1.95	123
Answered question						127
Skipped question						4

Responses suggest that the majority of respondents are at least somewhat aware of the functions and benefits of natural shoreland areas. The majority of respondents know that natural shorelines prevent erosion, protect water quality, provide wildlife and fish habitat, and reduce shoreline maintenance. However, many also believe that natural shorelines have negative characteristics (obstruct lake views, interfere with docks and boat lifts, eliminate sandy beaches and interfere with lake access, etc.). This suggests that education and outreach should build upon the positive impressions of buffers, and focus on reducing concerns about perceived negative aspects.

Awareness of lake associations was fairly high in 2009. Seventy-three percent knew that there was a lake association for their lake, while sixteen percent said that there was not a lake association for their lake. Eleven percent responded "I don't know," and 2% replied "Other." Results are summarized in the following table:

Table 8: Awareness of Lake Association



The significance of this question is that lake associations are already familiar local organizations to shoreland property owners, and that most lakes do have an association or lake improvement district. This question was not repeated in 2011.

Attitudes Questions

Questions were posed exploring respondents' links with Otter Tail lakes, and their **perceptions of water quality**. A ranking/scale question was "*Which of the following factors make Otter Tail County lake property particularly valuable to you*? Choose one answer for each of the following factors." Results for this question are summarized in Table 9 (2009) and Table 10 (2011) below. Highest response rates are in bold font.

Table 9: Attitudes about the Value of Lakeshore Property in Otter Tail County (2009)

	Very Important	Important	Somewhat Important	Not Important	Response Count
Scenic Environment	**55.3% (202)**	38.4% (140)	5.5% (20)	1.1% (4)	365
Clean Water	**76.4% (281)**	21.5% (79)	2.4% (9)	0.0% (0)	368
Affordability	39.1% (127)	**41.8% (136)**	12.9% (42)	6.2% (20)	325
Good Fishing	35.3% (126)	**37.3% (133)**	16.8% (60)	10.9% (39)	357
Convenience (close by)	26.1% (86)	**30.9% (102)**	21.5% (71)	21.8% (72)	330
Investment Potential	26.9% (106)	**39.0% (138)**	21.5% (76)	9.9% (35)	354
Family Ties	**39.5% (135)**	20.8% (71)	14.6% (50)	25.1% (86)	342
Answered question					378
Skipped question					11

Table 10: Attitudes about the Value of Lakeshore Property in Otter Tail County (2011)

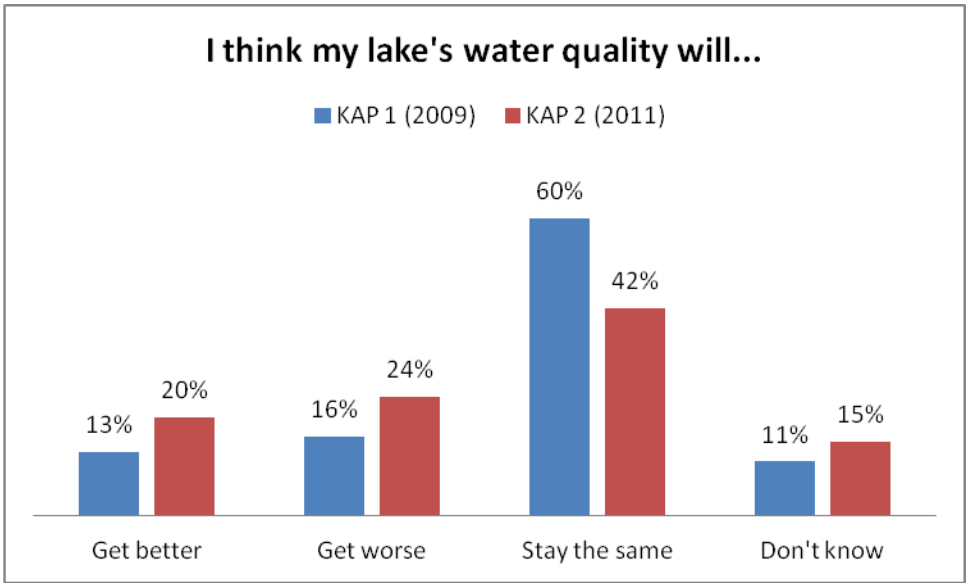
	Very Important	Important	Somewhat Important	Not Important	Response Count
Scenic Environment	**69.3% (88)**	24.4% (31)	5.5% (7)	0.8% (1)	127

Clean Water	**89.1% (115)**	10.1% (13)	0% (0)	0.8% (1)	129
Affordability	**45.7% (53)**	37.1% (43)	12.9% (15)	4.3% (5)	116
Good Fishing	40.5% (51)	**28.6% (36)**	22.2% (28)	8.7% (11)	126
Convenience (close by)	29.7% (35)	**36.4% (43)**	21.2% (25)	12.7% (15)	118
Investment Potential	29.2% (33)	**33.6% (38)**	25.7% (29)	11.5% (13)	113
Family Ties	**39.3% (46)**	23.1% (27)	16.2% (19)	21.4% (25)	117
Answered question					129
Skipped question					2

Clean water received the highest value of all possible responses in both surveys, and suggests a very high level of concern for the majority of property owners. Of note, the importance of clean water increased by thirteen percent (from 76 to 89%) in the two year period. This was followed by scenic environment, which placed second at 55% in 2009 and 69% in 2011, a similar 13% increase in value. Affordability increased in 2011 by about 6%. This suggests that current and future education/outreach efforts emphasize the themes of highest importance to property owners (clean water, environment and family times/legacy), possibly with a focus on environmental stewardship.

Respondents were asked in both surveys about their **perception about the condition of their lake's water quality**. In 2009, 13% thought that it was getting better, while 16% thought that it was getting worse. The majority (60%) felt that it was staying the same. Eleven percent didn't know. Respondents showed somewhat more uncertainty in the 2011 survey, with 20% responding that water quality would improve; 24% responding that it would get worse; 42% responding that it would stay the same; and 15% didn't know.

Table 11: Perceptions of Changes to Water Quality



In the second round survey, those who answered "Yes" were identified by EOTSWCD as respondents on lakes with positive biological trends (as measured by Secchi and chemistries, and the Douglas County Trophic State Index). There were also higher correlations for respondents on smaller lakes (where you can see across) and lower correlations with big lakes (*e.g.*West Battle).

A large majority in both surveys, however, did not perceive that a change would occur to water quality in their lake, although this proportion dropped by 18% by 2011. This presents an opportunity for appropriate educational messages of trends in water quality, e.g. that water quality can and does change as a function of land use and how people use their shoreland areas.

A ranking/scale question was asked about factors that **determine the appearance of their shoreland area**. Respondents were asked to choose one answer for each of the following factors.

Table 12: How Important are the Following Factors in Determining the Appearance of your Shoreline? (2009)

	Important	Neutral	Not Important	I don't know	Rating Average	Response Count
Fish and Wildlife Habitat	**70.8 % (254)**	22.8 % (82)	5.8 % (21)	0.6 % (2)	2.64	359
Neighbor's Opinion/Appearance	31.1% (111)	**38.4% (137)**	30.0% (107)	0.6% (2)	2.0	357
Annual	**56.5% (201)**	34.0% (121)	8.7% (31)	0.8% (3)	2.46	356

Maintenance						
View of the Lake	**84.4% (309)**	12.8% (47)	2.2% (8)	0.5% (2)	2.81	366
Impact on Water Quality	**87% (314)**	11.6% (42)	0.8% (3)	0.6% (2)	2.85	361
Cost	**47.9% (172)**	42.9% (154)	7.8% (28)	1.4% (5)	2.37	359
Shoreline Erosion	**83.6% (301)**	12.5% (45)	2.8% (10)	1.1% (4)	2.79	360
Open Space for Access	**55.7% (187)**	31.8% (187)	11.9% (40)	0.6% (2)	2.43	336
Answered question						370
Skipped question						13

Table 13: How Important are the Following Factors in Determining the Appearance of your Shoreline? (2011)

	Important	Neutral	Not Important	I don't know	Rating Average	Response Count
Fish and Wildlife Habitat	**56.7 % (72)**	34.6 % (44)	5.5 % (7)	3.1% (4)	2.45	127
Neighbor's Opinion/Appearance	**38.0% (49)**	38.0% (49)	23.3% (30)	0.8% (1)	2.13	129
Annual Maintenance	**62% (80)**	34.1% (44)	3.1% (4)	0.8% (1)	2.57	129
View of the Lake	**90.0% (117)**	8.5% (11)	0.8% (1)	0.8% (1)	2.88	130
Impact on Water Quality	**85.4% (111)**	13.8% (18)	0.0% (0)	0.8% (1)	2.84	130
Cost	**52.4% (66)**	42.9% (54)	2.4% (3)	2.4% (3)	2.45	126
Shoreline Erosion	**88.3% (113)**	9.4% (12)	1.6% (2)	0.8% (1)	2.85	128
Open Space for Access	**54.0% (67)**	37.9% (47)	7.3% (9)	0.8% (1)	2.45	124
Steep slope limits access	24.0 (29)	**38.0 (46)**	28.9 % (35)	9.1% (11)	1.77	121
Answered question						131
Skipped question						0

In 2009 the highest ranked response concerning appearance of your shoreland area was *impact on water quality (87%)*, followed closely by *shoreline erosion* (83%) and *fish and wildlife habitat (71%).* These highest-ranked choices all relate to environmental quality, with personal choice responses lagging behind respondents' concern for environmental quality. The personal choice responses were ranked as *view of the lake (84%), annual maintenance (56%), open space for access (56%),* and *neighbor's opinion/appearance (31%).*

By 2011, there were interesting changes in the highest values for these attitudinal responses. View of the lake was the highest ranked factor, and increased in importance from 84% in 2009 to 90% in 2011. The importance of shoreline erosion followed very closely, and increased from

84% in 2009 to 88% in 2011. The importance of fish and wildlife habitat as a factor in determining the appearance of respondent shorelines declined from 71% to 57%. Annual maintenance increased somewhat from 57% to 62%. Open space for access declined slightly from 56% to 54%. Cost increased slightly from 48% in 2009 to 52% in 2011. The importance of neighbor's opinions increased from 31% to 38%. In 2011, EOTSWCD added a question variable about the steep banks on some lakes, which ranked as an important factor for 24% of respondents.

For both surveys, water quality remains a very high concern for most respondents, as does habitat and erosion control. However, these attitudes appear to be changing with time. Also, several questionnaires contained written comments in 2011 about steeply sloped lots on bluffs, or shallow lots. EOTSWCD should consider developing specialized shoreland messages for owners of bluff and sloped properties.

Next, an attitudinal scale question was posed that explored the **willingness and motivation of respondents to alter their shorelines**. Respondents were asked to choose one answer for each of the following factors. The results are summarized in Tables 14 and 15 below.

Table 14: "I would be willing to make changes to my shoreline area to…" (2009)

	Yes	Maybe	No	I don't know	Response count
Improve water quality	**69.7% (251)**	24.4% (88)	3.3% (12)	2.8% (10)	360
Protect water quality	**67.2% (242)**	25.0% (90)	5.3% (19)	2.5% (9)	360
Provide fish habitat	**48.2% (171)**	35.5% (126)	12.1% (43)	4.5% (16)	355
Provide wildlife habitat	**46.6% (165)**	35.0% (124)	14.1% (50)	4.2% (15)	354
Reduce maintenance	**48.3% (171)**	33.9% (120)	13.6% (48)	4.2% (15)	354

Improve lake views	**42.5% (15)**	32.3% (114)	21.5% (76)	3.7% (13)	353
Reduce erosion	**69.5% (251)**	21.90% (79)	5.8% (21)	2.8% (10)	361
Protect my investment	**69.1% (250)**	24.0% (87)	4.1% (15)	2.8% (10)	362
Reduce maintenance costs	**51.6% (182)**	32.0% (113)	12.2% (43)	4.2% (15)	353
Answered question					368
Skipped question					15

This question was repeated in 2011, with responses summarized in Table 15 below:

Table 15: "I would be willing to make changes to my shoreline area to…" (2011)

	Yes	Maybe	No	I don't know	Response count
Improve water quality	**55.9% (71)**	33.9% (43)	7.1% (9)	3.1% (4)	127
Protect water quality	**68.2% (88)**	24.0% (31)	6.2% (8)	1.6% (2)	129
Provide fish habitat	35.4% (45)	**43.3% (55)**	18.1% (23)	3.1% (4)	127
Provide wildlife habitat	27.0% (34)	**44.4% (56)**	26.2% (33)	2.4% (3)	126

Reduce maintenance	**46.9 (60)**	37.5% (48)	10.2% (13)	5.5% (7)	128
Improve lake views	**45.3% (58)**	35.9% (46)	16.4% (21)	2.3% (3)	128
Reduce erosion	**73.2% (93)**	20.50% (26)	3.9% (5)	2.4% (3)	127
Protect my investment	**77.3% (99)**	19.5% (25)	3.1% (4)	0.0% (0)	128
Reduce maintenance costs	**49.6% (63)**	40.20% (51)	6.3% (8)	3.9% (5)	127
Answered question					131
Skipped question					0

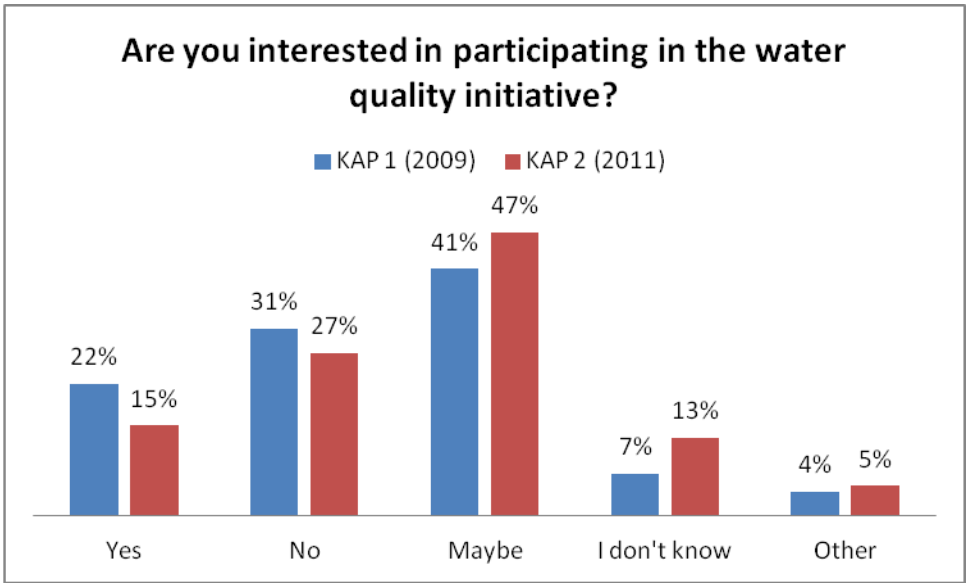
In 2009, four factors ranked almost identically: improve water quality (69.7%); reduce erosion (69.5); protect my investment (69.1%); and protect water quality (67.2%). These were followed by a second cluster of factors that ranked as second in importance: reduce maintenance costs (51.6%); reduce maintenance (48.3%); provide fish habitant (48.2%); provide wildlife habitat (46.6%); and improve lake views (42.5%).

In 2011, the top four factors split as follows: protect my investment (77.3%); reduce erosion (73.2%); protect water quality (68.2%); and improve water quality (55.9%). This later factor declined by fourteen percentage points. The secondary highest-ranked factors realigned to: reduce maintenance costs (49.6%); reduce maintenance (46.9%); improve lake views (45.3%); provide wildlife habitat (44.4%); and provide fish habitat (43.3%).

💧 The 2011 factors suggest a decline in the importance of water quality in the two-year period, and an increased sensitivity to cost and protection of investments in lakeshore property, possibly reflective of macro-economic trends.

A question was posed about respondent **willingness to participate in a water quality initiative** (the NSBI). In 2009 22% responded "Yes;" 31% replied "No;" 41% replied "Maybe, I need more information;" and 7% said "I don't know."

Table 16: Willingness to Participate in the NSBI

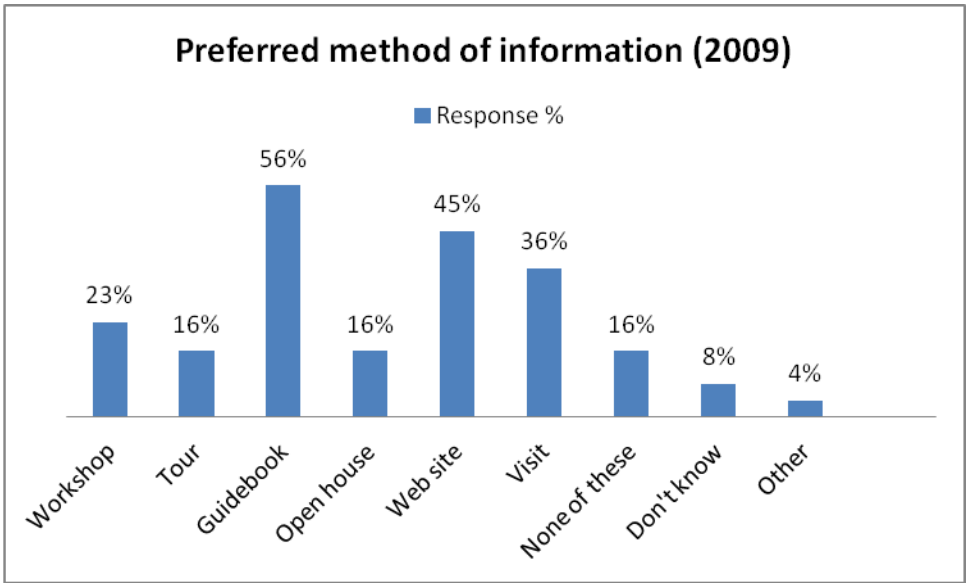


EOTSWCD observed that there was more adoption on headwater lakes than on flowage and pass-through lakes. Pickerel is almost a headwater lake. At Lake Seven, thirty percent of population now expressing interest in participating. Although NSBI is ending EOTSWCD staff are submitting proposals to continue the education and outreach aspects of buffer installation. EOTSWCD staff are no longer designing buffers because there are too many requests and no funding for implementation. Demand is increasing by word of mouth.

In 2011, willingness to participate seemed to decline, with somewhat more uncertainly expressed by the "Maybes" and "I don't know." In 2011, 15% replied affirmatively; 26% replied "No;" 47% responded "Maybe, I need more information;" and 13% replied "I don't know." The reason for this trend is unclear at this time, and may warrant further investigation either in focus groups or a discussion with local lake associations.

Next, a key check-all-that-apply question examined respondent **preferences for obtaining shoreland buffer information** in the first-round survey. Responses are summarized in the following table:

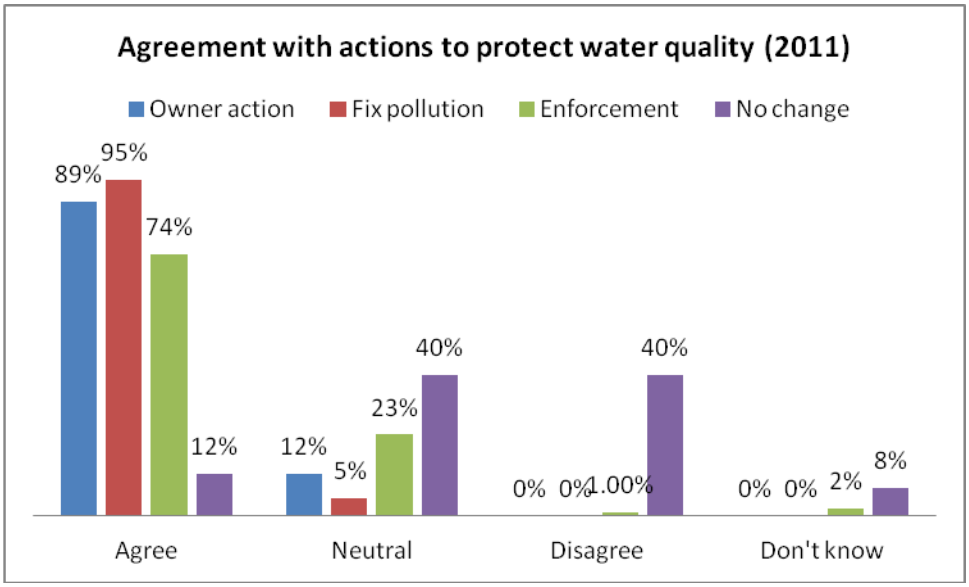
Table 17: Preferred Method of Information about Shoreland Buffers (2009)



The highest expressed preference was for a shoreland buffer guidebook. Based upon this data, EOTSWCD developed a shoreland guidebook in 2010 which was tested in a focus group setting, then distributed to NSBI participants in the high and medium touch groups. This question was not repeated in 2011.

An attitudinal question was posed about **actions needed to protect water quality** was added to the 2011 survey by the EOTSWCD. Results are shown in the following table:

Table 18: Agreement with Actions to Protect Water Quality



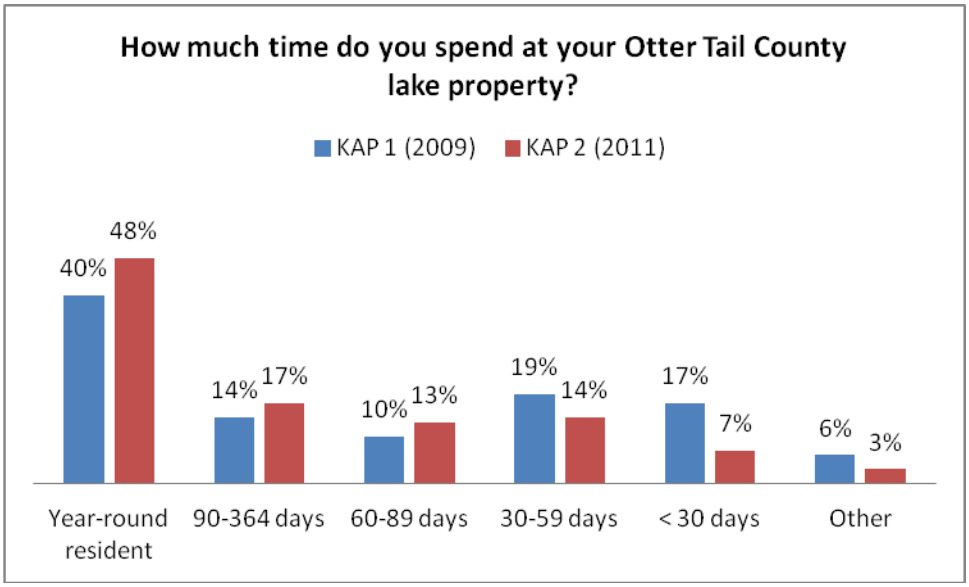
The question posed was "*To protect our lakes' current water quality…Please check a box for each statement that indicates how much you agree."* Options were "Each owner needs to act on their own land"; "The most polluting sources need to be fixed"; "Current regulations need to be enforced"; and "No changes need to be made." This question was not asked in 2009.

Responses suggest a strongly active rather than passive attitudinal stance with regard to protecting water quality in lakes. There was strong agreement and no disagreement that owners need to take action, that pollution needs to be fixed, and little disagreement that regulations should be enforced. Less than 12% of respondents felt that no changes need to be made.

Practices Questions

A screening question was posed in 2009 to determine the **length of time spent at respondents' lakeshore property**. Forty percent of respondents were year-round residents, while fourteen percent were at their property between 90-364 days/year. Ten percent were at their property between 60 and 89 days/year. Nineteen percent were at their property between 30 and 59 days/year. Seventeen percent were there less than thirty days/year. This question was repeated in 2011. Results are seen in Table 19 below:

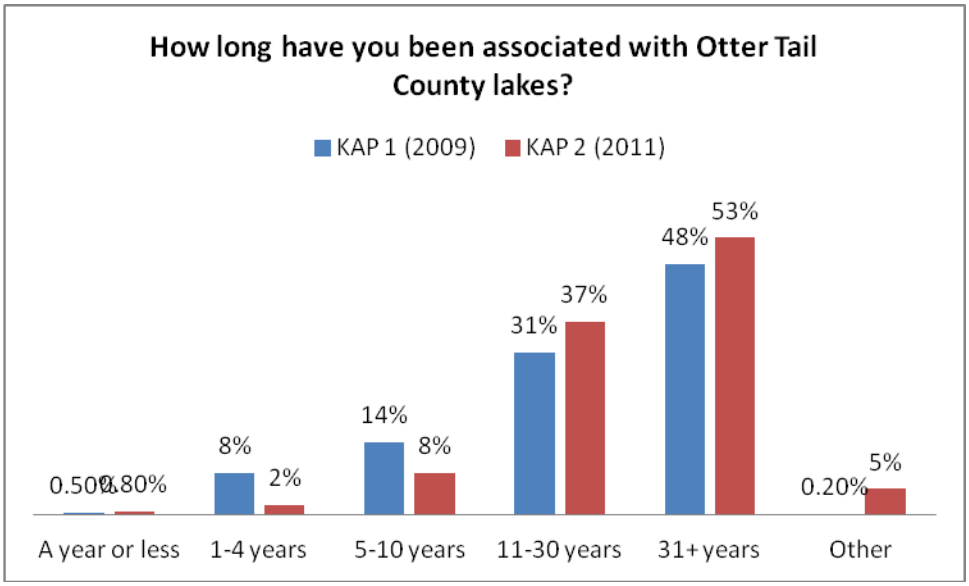
Table 19: Breakdown of Full-time and Seasonal Property Owners



This indicates that there are more seasonal than full-time residents in the survey sample. However, the two-year trend is that more property owners have become full-time residents, possibly reflecting the older demographic of the survey sample. In addition, longer-term seasonal respondents (90-364 days) and between 30-89 days are staying longer than two years ago. Seasonal property owners may have different priorities and preferences than full-time residents although this will require further investigation (it was not possible to stratify the KAP study samples due to loss of the first-round database). EOTSWCD may determine that two different education and outreach strategies are needed.

A **legacy question** was posed of the survey sample: "How long have you been associated with Otter Tail County lakes (ex: visited, owned or been in family)?" In 2009, forty-eight percent replied that they have been associated with EOT lakes for 31 or more years. Another thirty-one percent have been associated with EOT between eleven and thirty years; and fourteen percent between five and ten years. Eight percent replied one to four years; and 0.5% a year or less.

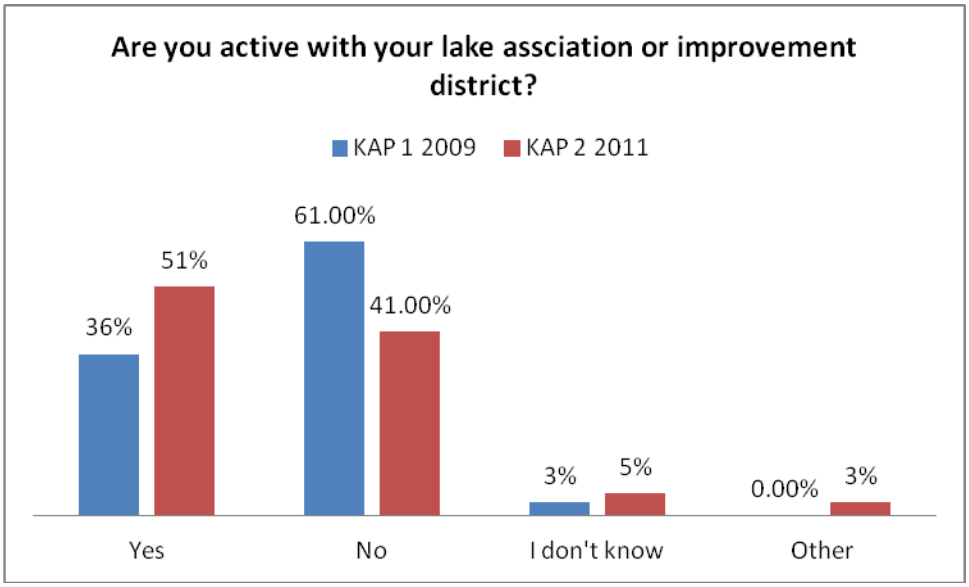
Table 20: Length of Association with Otter Tail County Lakes



In 2011, those associated with EOT lakes 5-10 years declined somewhat, but the percent for those over eleven years increased. This may possibly be the result of a generational shift in property ownership, although the real cause is unknown. Nevertheless, it is clear that the majority of respondents have family ties to their lake properties that are probably multi-generational. When combined with expressed concern for water quality, there is possibly a very strong environmental stewardship ethic existing in the sample. Current and future educational and outreach messages should build upon these points.

A question was posed in both 2009 and 2011 asking respondents if they were active in their lake association or improvement district. In 2009, 35.5% replied affirmatively, and in 2011 that number climbed to 51%. In 2009, 61% replied "No," but the "No's" declined to 41% in 2011.

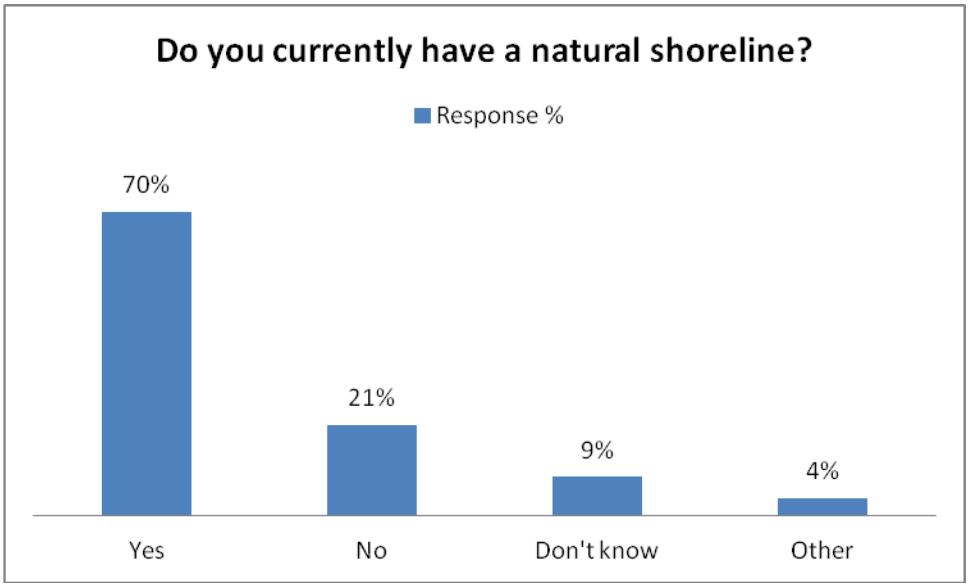
Table 21: Participation with Lake Association



There is a trend toward increased participation in lake associations. When combined with the question about sources of information, lake associations are clearly important loci of activities and information for lakeshore property owners. This presents an opportunity for EOTSWCD to collaborate with local lakeshore associations on education, outreach and other water quality initiatives.

In 2009, respondents were asked if they currently had a **natural shoreland area** on part or all of their shoreline. The results were as follows:

Table 22: Do You Currently Have a Natural Shoreline?

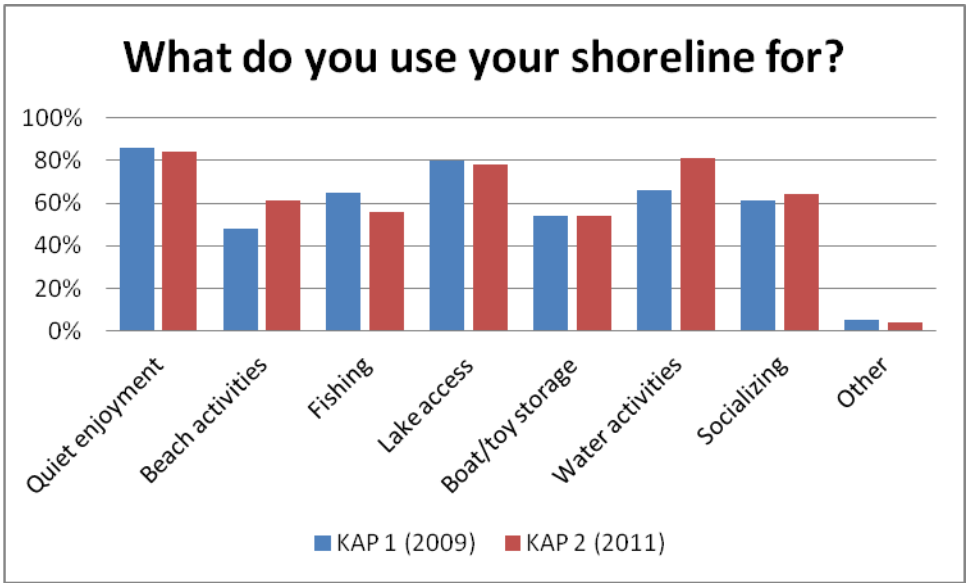


Seventy percent (*n* =263) reported in 2009 that they currently have a natural shoreline on part or all of their shoreline. Twenty-one percent (*n* = 77) reported that they do not have a natural shoreline. Nine percent (*n* = 34) were not sure. Seventy-four percent (*n* = 274) are not planning on adding or enhancing a natural shoreland area on their shoreline; while nine percent (*n* = 35) responded affirmatively. Seventeen percent (*n* = 62) were not sure.

There were a number of comments written on the questionnaires that suggested uncertainty about what constitutes a "natural" shoreline. Respondent perceptions about natural shorelines were not explored in this KAP study, but may warrant further exploration in the future. This question was not repeated in 2011.

A check-all-that-apply question was posed about **how respondents used their shoreline**. 2009 responses included quiet enjoyment (86%); beach activities (48%); fishing (65%); lake access (80%); boat/toy storage (54%); water activities such as swimming (66%); and socializing with friends and neighbors (61%). These figures were fairly stable in the 2011 survey, as can be seen in Table 23.

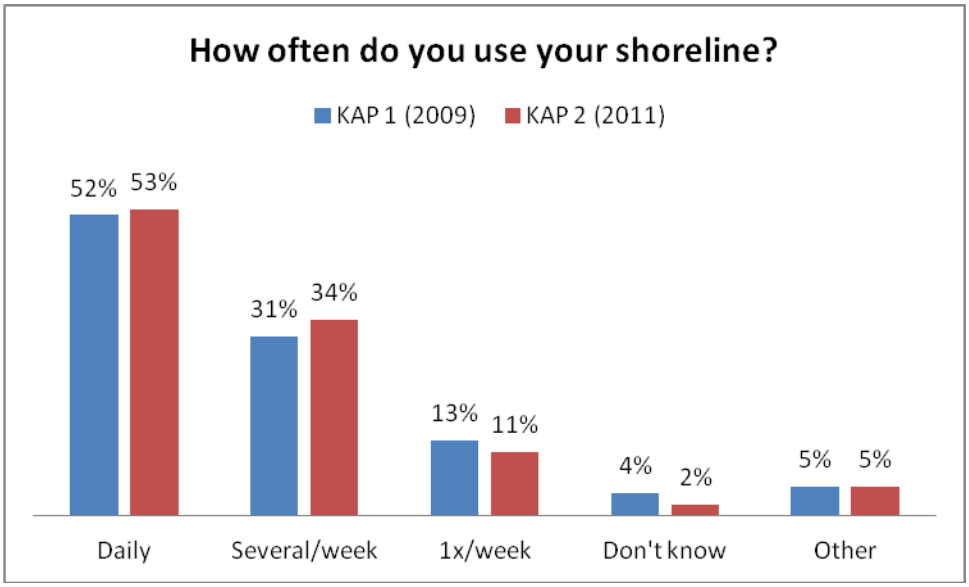
Table 23: Uses of Shoreland Property



Shoreline usage appears to be relatively stable, with slight increases in 2011 for "beach activities" and "water activities." Use of the shoreline for fishing declined somewhat. These factors might influence acceptance of shoreland buffers for some property owners. EOTSWCD might consider promoting shoreland buffer projects in a manner that the project does not interfere with preferred uses.

The KAP study explored **frequency of shoreline use**. In 2009, half (52%) of all respondents reported using their shoreline area daily. Thirty-one percent use the shore several times/week, and thirteen percent once a week or less. Four percent responded "I don't know," and five percent listed "Other." These numbers were relatively stable in 2011, as seen in Table 24 below:

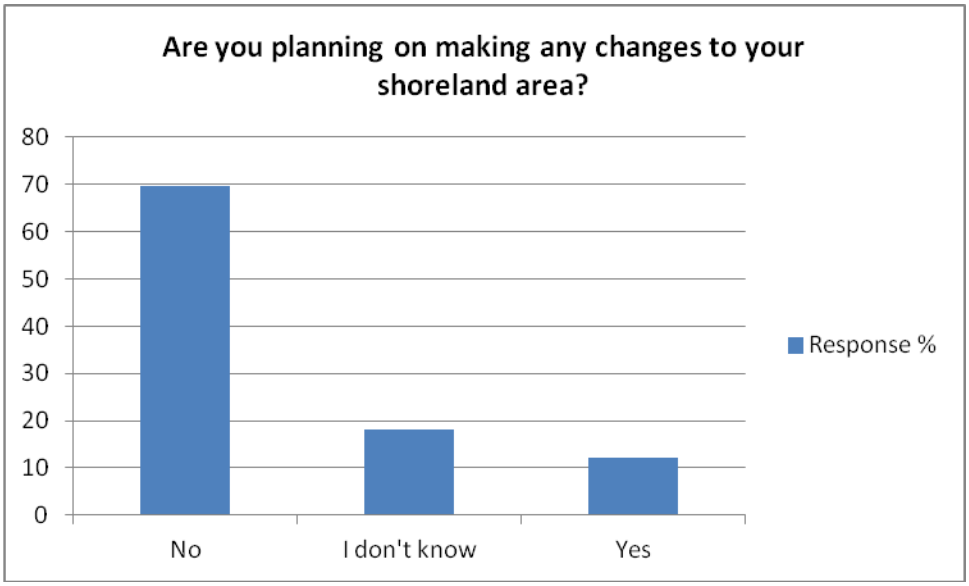
Table 24: Frequency of Shoreline Use



- The majority of property owners use their shoreland areas on a daily basis.

Respondents were asked in 2009 whether they were planning on **making any changes to their shoreland area**. The following results were obtained:

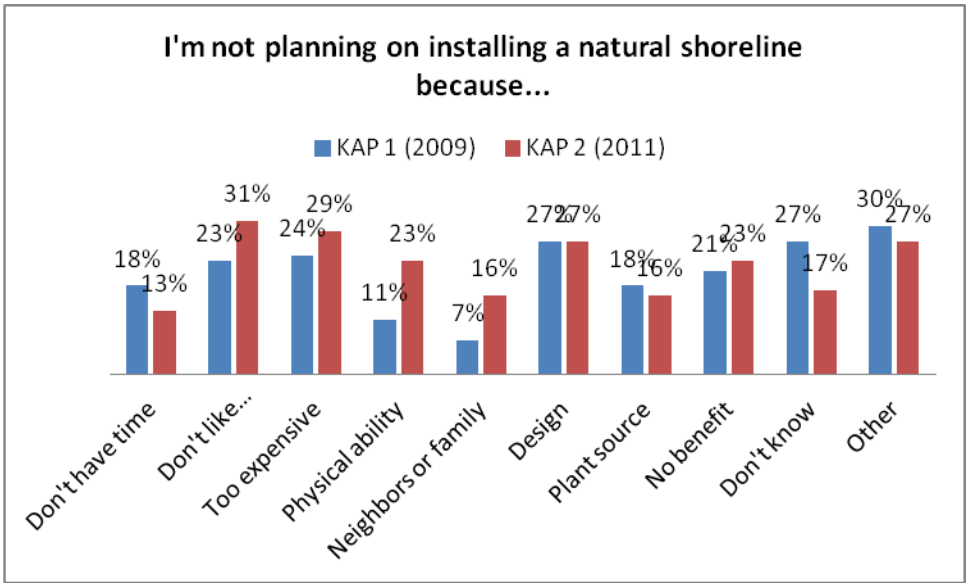
Table 25: Propensity to Change Shoreland Areas



Sixty-nine percent responded "No;" eighteen percent replied "I don't know," and twelve percent responded "Yes." This question was not repeated in 2011. About one-third are considering changes, and may be receptive to shoreland conservation messages. Nearly 20% are uncertain, and their reasons may warrant further exploration.

A follow-up **constraints question** was posed of those responding "No" to the question "I'm not currently planning on adding or enhancing a natural shoreline on my property because…" The results were very mixed in 2009. Eighteen percent said that they didn't have the time; twenty-three percent didn't like the appearance of a natural shoreline; twenty-four percent thought it would be too expensive; eleven percent reported having physical limitations; seven percent thought that their neighbors or family might disagree; twenty-six percent said that they were not sure how to design a shoreline buffer; and eighteen percent did not know where to get plants and materials. Twenty-two percent said that "there is no benefit to me." However, the most frequently checked responses to this constraints question was "I don't know" or "Other." There is no opportunity to explore the "Other" responses because the 2009 survey data is no longer available.

Table 26: Reasons for Not Installing a Shoreland Buffer

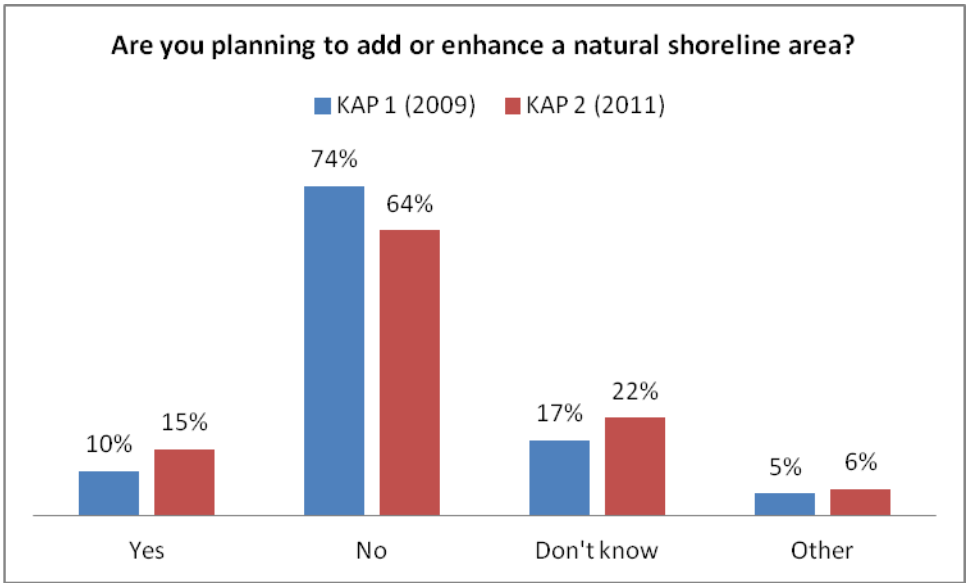


In 2011, the most frequently reported barrier reported was "I don't like the appearance" (31%); followed by expense (29%); not sure how to design a shoreland buffer (27%); my physical ability limits me (23%); there is no benefit to me (23%); my neighbors or family may disagree (16%); I don't know (17%); I'm not sure where to get plants or materials (16%); and lack of time (13%). 27% responded "Other."

💧 In general, the "reasons not to install" increased. It would be very useful to further examine these responses by checking respondent understanding of what constitutes a natural shoreline, as well as cross-checking the actual condition of respondent shorelines. There were very many comments written provided by respondents. In 2011 nineteen respondents (15%) added a comment that they already have a natural shoreline. Three respondents noted that they have added riprap. One person noted that they purchased their property for its sandy beach and they don't want to change. Four people noted that their lot dimensions are too shallow for a buffer, and one has property on a bluff with little runoff. A few others mentioned that their property is for sale, or that there is an issue with the township board.

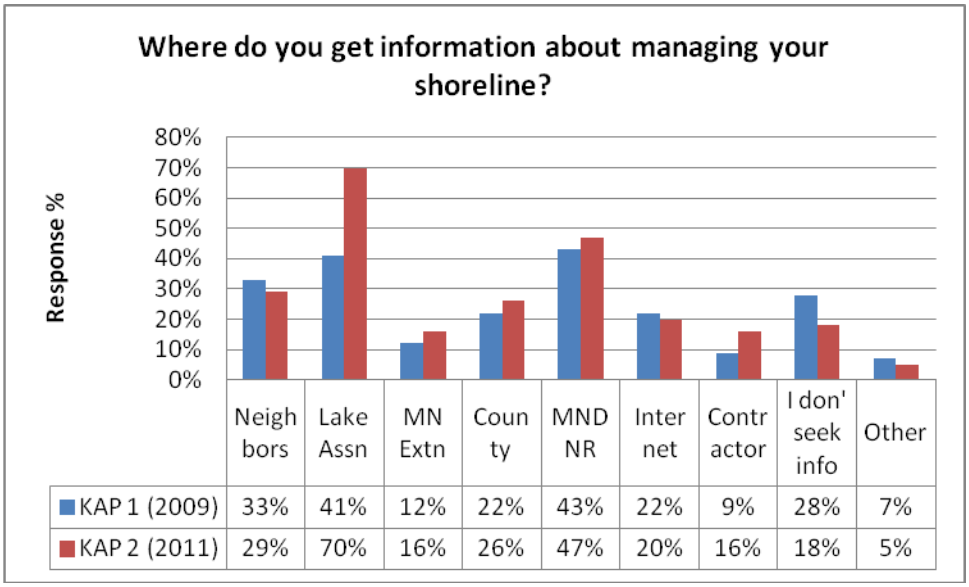
A similar question was posed in both surveys asking whether respondents were planning on **adding or enhancing a natural shoreline area** on their shoreline (check-all-that-apply). The following results were obtained:

Table 27: Propensity to Add or Enhance a Natural Shoreland



Residents were asked where they **obtain information about shoreline management** in both pre and post surveys. The following results were given (this was a check-all-that-apply question):

Table 28: Preferences for Obtaining Shoreland Information



	Neighbors	Lake Assn	MN Extn	County	MNDNR	Internet	Contractor	I don' seek info	Other
KAP 1 (2009)	33%	41%	12%	22%	43%	22%	9%	28%	7%
KAP 2 (2011)	29%	70%	16%	26%	47%	20%	16%	18%	5%

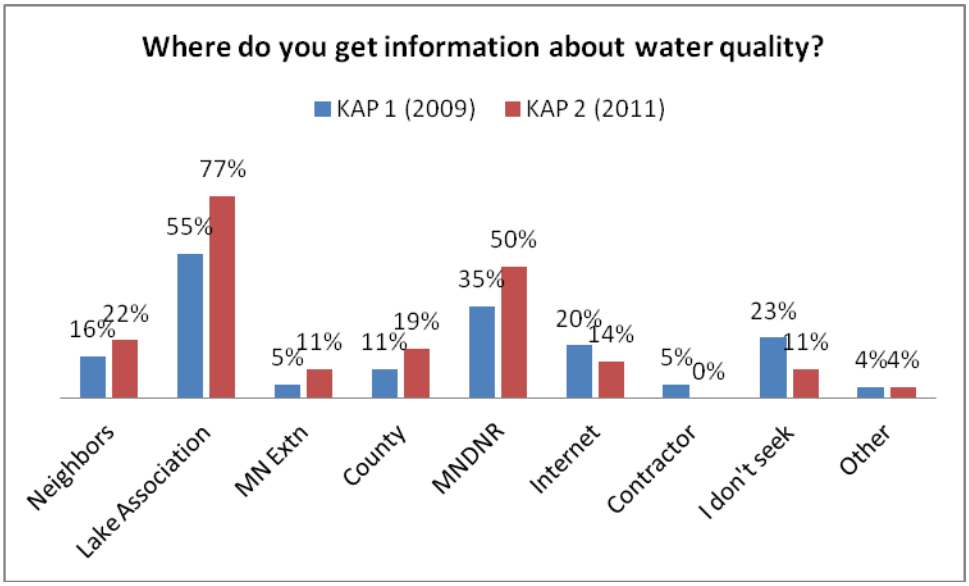
In 2009, respondents in Otter Tail sought shoreline management information most often from the DNR (43%), followed closely by their lake association (41%). They also sought information from their neighbors (33%); MN Extension (12%); county government (22%), the Internet (22%); or a rip rap contractor (9%). Twenty-eight percent did not seek shoreland management information. In 2011, lake associations were the most frequently mentioned source of

information at 70%, followed by MNDNR 47%), neighbors (29%), the Internet (20%), MN Extension and riprap contractors (both at 16%). Eighteen percent did not seek information. This was a check-all-that-apply question.

💧 These findings reinforce the growing importance of lake associations as sources of information for property owners.

Respondents were then asked about **sources of information about water quality**, also in a check-all-that-apply question. The following results were obtained:

Table 29: Sources of Information about Water Quality

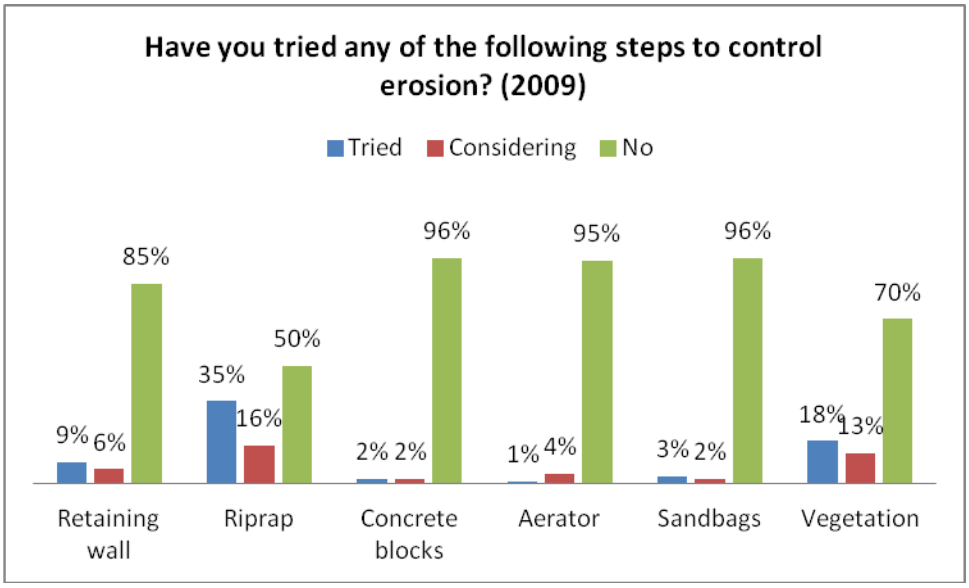


In 2009, respondents most often sought information from their lake association (55%), followed by MNDNR (35%), the Internet (20%), neighbors (16%), county government (11%), MN Extension (5%) and contractors (5%). 23% did not seek water quality information, and 4% responded ("Other). In 2011, respondents most often sought information from their lake associations (77%), MNDNR (50%), neighbors (22%), county government (19%), the Internet (14%) and MN Extension (11%). 11% did not seek information, none sought information from contractors, and 4% responded "Other."

💧 The results of these two questions (Tables 28 and 29) on sources of information show clearly that they are increasingly the "go to" resource on both water quality and shoreline management information. Would a promotional piece be designed or delivered differently if there is a purposeful partnership with lake associations?

In the first-round survey, respondents were asked whether they had already tried to **control erosion** on their property, or whether they had considered doing so. This was posed as a check-all-that-apply question. The results are summarized in the table below.

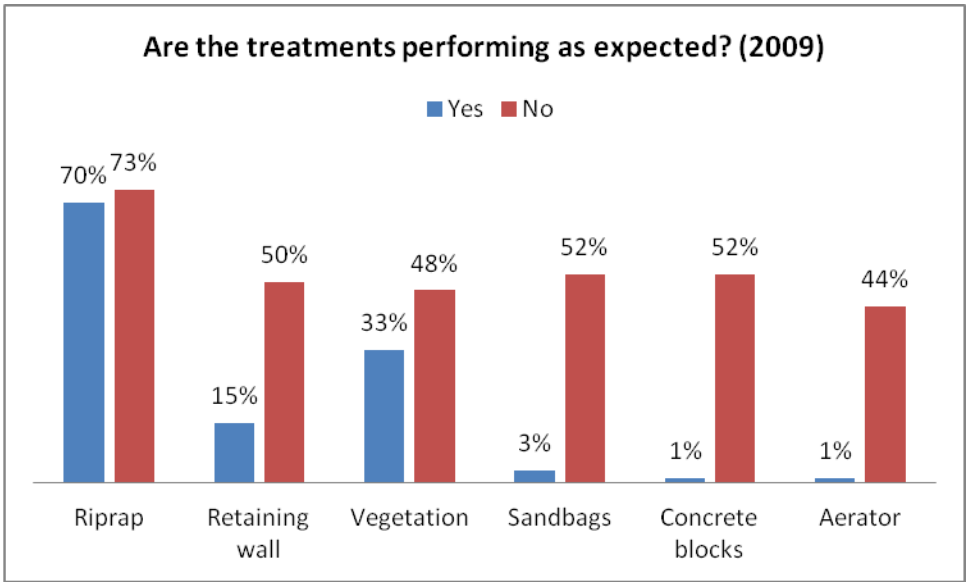
Table 30: Erosion Control



A total of 227 various treatments had been tried by respondents in 2009. Of the treatments listed rip rap was the most common, followed by adding vegetation/plants and retaining walls. This question was not repeated in the 2011 survey.

A follow-up question was then posed of respondents who had already attempted some type of **shoreland erosion control**, asking whether they were satisfied with the treatment. This was posed as a check-all-that-apply question. Results are summarized in the table below.

Table 31: Performance of Erosion Control Treatments



The majority of respondents are not satisfied with their erosion control treatments. None of the treatments are performing better than respondent expectations. Riprap is the only treatment that approaches a positive performance, followed by vegetation and retaining walls. This presents an opportunity for the EOT SWCD to demonstrate the erosion control potential of shoreland installations.

Interim Implementation Activities

EOT staff conducted a number of implementation, education and outreach activities in the interim period between the two KAP studies. EOT implemented a high/medium/low incentives structure on the target lakes and for county-wide treatment. A partial listing includes:

- Developed incentives models;
- Prepared workbooks and guidesheets for property owners;
- Prepared shoreline restoration worksheets and guidebook to bridge the knowledge gaps identified during the first-round KAP study;
- Presentations and workshops to civic groups and lakeshore associations;
- Developed news articles for various media and websites;
- Contracted with shoreland property owners to install and maintain buffers;
- Implemented twenty-four buffer installations;
- Developed lines of inquiry for focus groups;
- Visited high touch sites and provided direct technical advice to property owners, including site plans and planting designs;
- Hosted shoreline stabilization open houses.

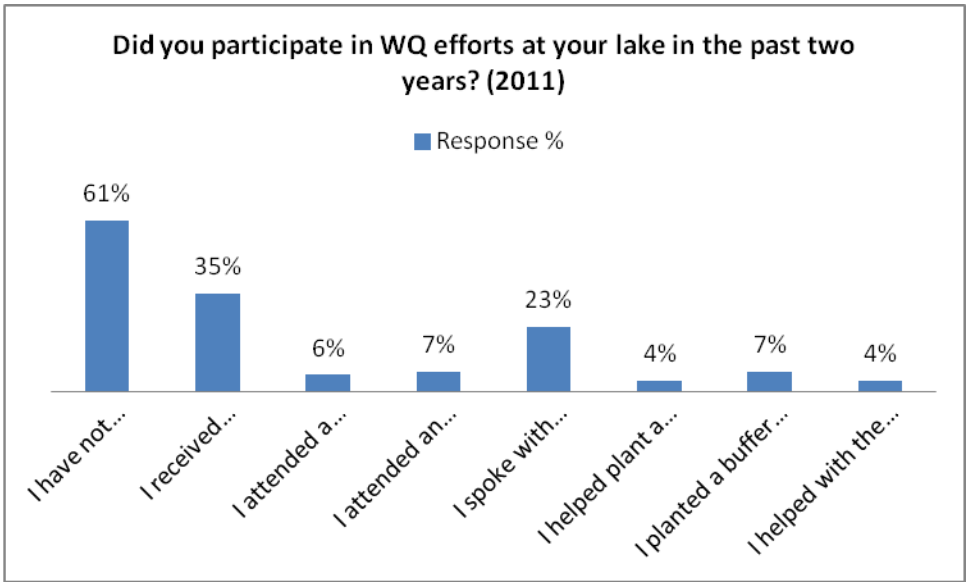
Details on these and other activities can be found in the final report prepared by the EOT SWCD, and are not summarized here.

Efficacy Questions

A series of efficacy questions were designed by EOT staff and posed in the second-round survey (2011) to better understand respondents' receptivity to the incentives offered by EOTSWCD. The responses to these questions are summarized below.

The first efficacy question asked whether the respondent had **participated in water quality efforts** around their lake in the past two years (check all that apply). Responses are tabulated in Table 32 below.

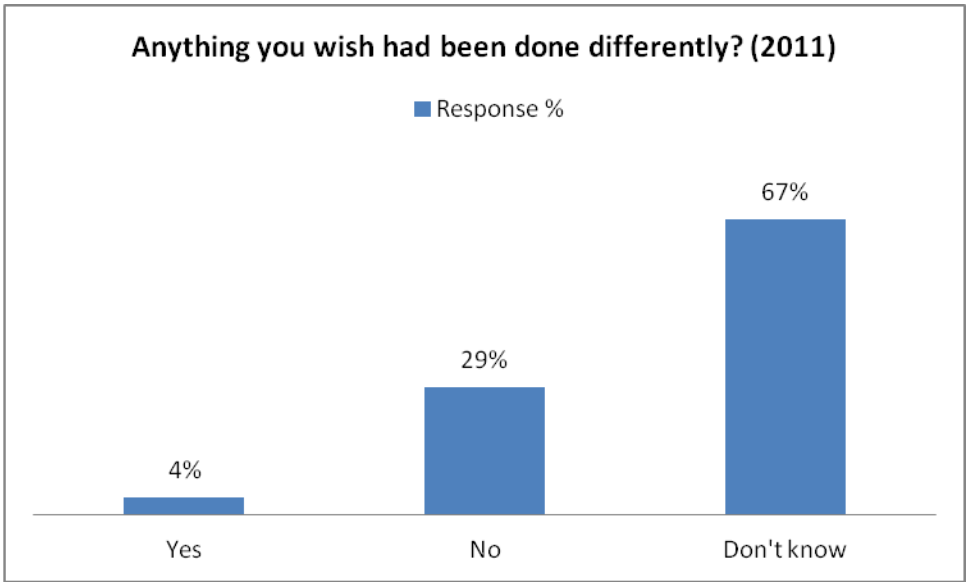
Table 32: Participation in Water Quality Activities



Most people (61%) had not participated. Of those that did, the most common response was "I received information about shoreline buffers and water quality," followed by "I spoke with friends and neighbors about water quality." Seven percent reported attending and open house, and installing a buffer on their own shoreline. Six percent attended a workshop on buffers. Four percent reported helping to install a buffer elsewhere, and another four percent reported having helped with the initiative. The most frequently reported "effort" was passive receipt of information, consistent with the "low touch" strategy. The second most frequently-reported "effort" was to speak with friends and neighbors about water quality. This may reflect the suspected importance of neighbor networking or peer-to-peer influence, although this needs further investigation.

Another efficacy question was a check-only-one-response asking whether **something should be done differently in the initiative**. Results are summarized below:

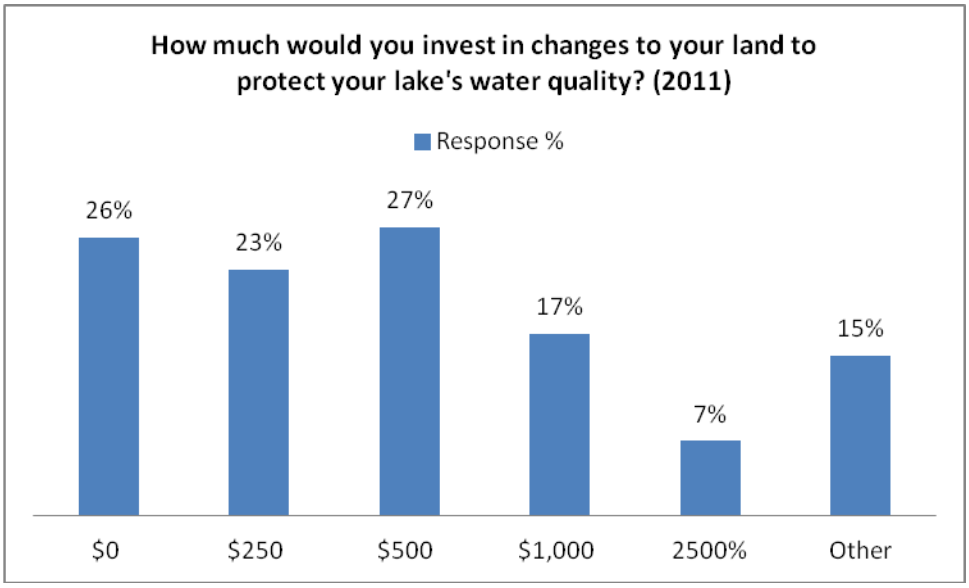
Table 33: What Should be Done Differently?



Twenty-nine percent (*n* = 35) seemed satisfied with their experience. However, the majority (67%, *n* = 81) were uncertain, but the reasons are not clear and there were no comments available to provide insights. Of the four percent (*n* = 5) responding that they wish things had been done differently, three people commented on the reasons. One respondent replied "Inform owners;" another replied "Not finished yet; and the third replied "Began contact with SWCD but did not hear back after I reworked plans (January 2011)."

Efficacy question #20 was a check-only-one-response question that asked "How much would you invest in changes to your land to protect your lake's water quality? (Check only one response)." Results are given below.

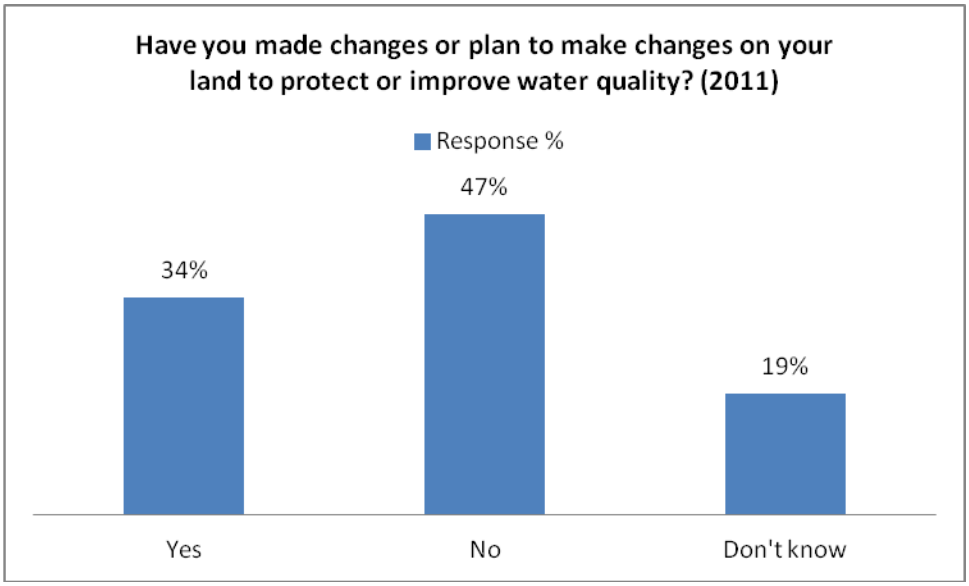
Table 34: Willingness to Pay for Water Quality Protection



The median value was $500 (27%), followed closely by $0 (26%). Twenty-three percent were willing to pay $250, and seventeen percent willing to pay $1,000. Seven percent were willing to pay $2,500. This suggests that the most acceptable amount would be under $500. Although 48% of respondents said that cost was an important factor in determining the appearance of their shoreline (this increased to 52% in 2011), not one property owner adopted a buffer because of a cost share.

EOTSWCD staff also posed a question in the 2011 survey asking "Have you made or plan to make changes on your land to protect or improve water quality? Check only one response." Results are summarized in the table below:

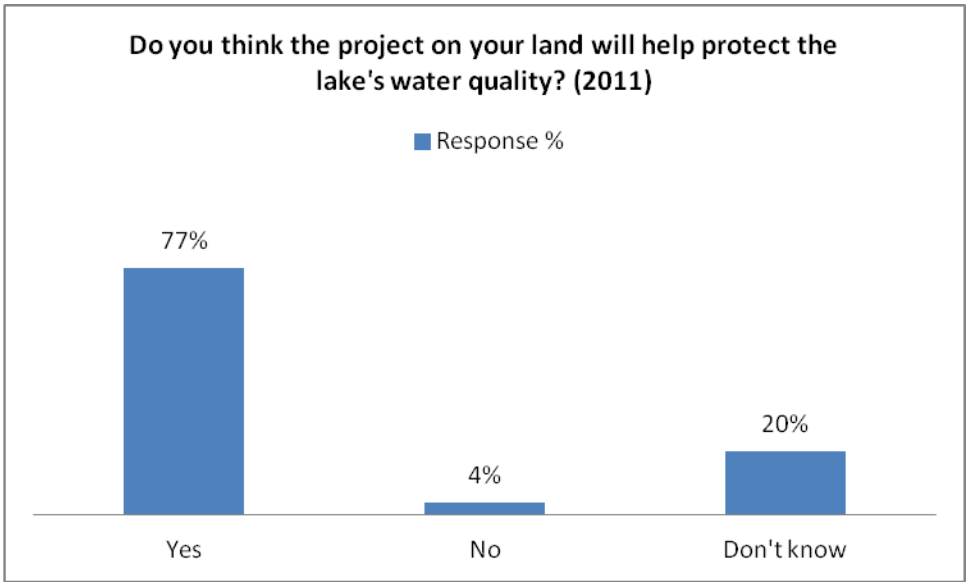
Table 35: Propensity to Change to Improve Water Quality



Almost half (*n* = 61) were not inclined to make changes, and about a third (*n* = 44) were positively inclined. That almost one-fifth (*n* = 24) of the respondents were uncertain warrants further investigation, because questions remain about "*how to move the 'maybes.*" There was not enough information gleaned from the responses to this question to understand the reasons for continued uncertainty on the part of many respondents.

A follow-up question asked: "Do you think that the project on your land will help protect the lake's water quality? Check only one response." Results are summarized in the table below:

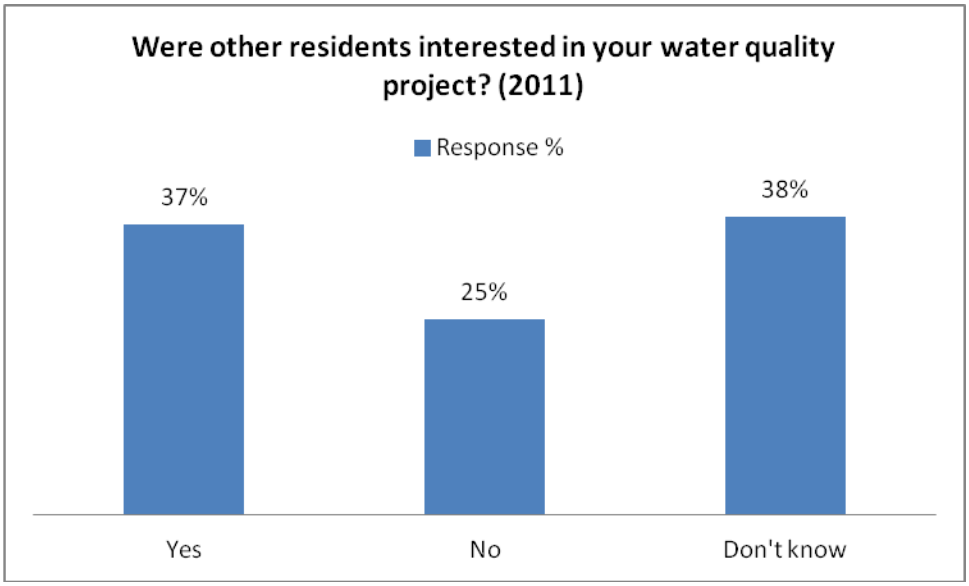
Table 36: Perceptions of Project Effectiveness



A clear majority of NSBI project participants (*n* = 39*)* felt that their project would help to protect water quality. Only 4% (two individuals) responded negatively, and provided no comments as to the reason. Twenty percent (*n* = 10) were not sure, possibly because their projects were recently installed.

EOTSWCD then posed a question asking whether respondents noticed that other residents were interested in their water quality project. Results are summarized in Table 37 below:

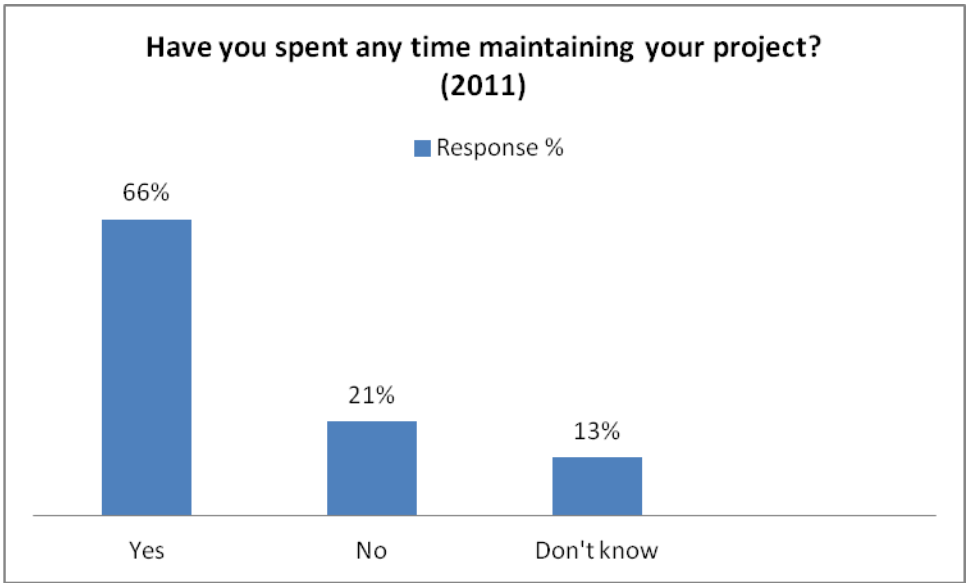
Table 37: Interest in Respondents' Projects



Thirty-seven percent (*n* = 19) responded positively, twenty-five percent said "No," (n = 13), and 39% (*n* = 20) did not know. Further exploration into how neighbor-to-neighbor contact and communication about shorelines and water quality takes place, so that the SWCD can foster this process.

Next, respondents were asked whether they spent any time maintaining their project. Results are as follows:

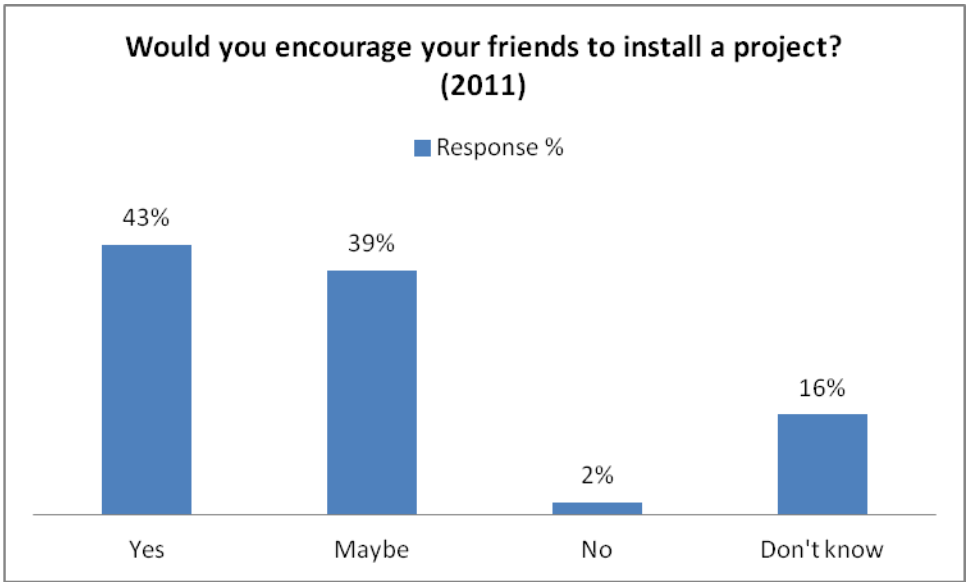
Table 38: Project Maintenance



One-third of respondents (*n* = 31) have maintained their project. There were few details provided by respondents, but this would be a fruitful area of future investigation. Adoption and maintenance of a recommended practice is a critical measure of project success, and identifying the factors that promote adoption and maintenance from each "touch" group would be useful.

Finally, respondents were asked if they would encourage their friends to install a project. Results are summarized below.

Table 39: Recommendations for Buffer Installation



Forty-three percent (*n* = 22) responded positively, and thirty-nine percent (*n* = 20) responded "Maybe." Sixteen percent (*n* = 8) were unsure. Only two percent (one individual) responded "No." Again, the newness of the installations may be a factor in these responses.

Discussion and Conclusions

The research results summarized in this report have been drawn from the following sources:
a. Pre and post-KAP study data sets;
b. Informal interviews with key informants;
c. Analysis of written comments made by respondents on the survey questionnaires;
d. Unobtrusive observation of shorelines; and
e. Verbal information provided by the EOTSWCD shoreland staff.

We believe that the social research in this project helped to answer the questions posed earlier on pages 5 and 9 of this report. First, we address the "big picture" questions posed on page 9.

● <u>What motivates people to adopt and maintain a recommended practice? Why are some individuals inclined and others disinclined to adopt?</u>
Some natural resources professionals are currently exploring these questions, often using various theories of adoption, behavioral change, innovation and diffusion, or social marketing. In the case of the East Otter Tail County NSBI project, we have found that public concern for water resources and knowledge about water quality is very high. Our research in Minnesota suggests that among individuals with some association with a specific water body (e.g. EOT lakes, Itasca lakes, Lake Superior and the Lester River, Como Lake in Saint Paul and elsewhere) express very strong affinity and concern for those water bodies. We understand from qualitative research and the KAP studies that local lakes are special to people, and property owners frequently have multi-generational association and deep affection for "our" lake. These values and expressed concern for lakes and water quality appears to motivate many to take action. There is also a sense of stewardship and a conservation ethic for many that may be reinforced by long-term family "legacy" of the majority of shoreland property owners in the EOT sample.

The social research uncovered negative impressions about shoreland buffers often held by property owners, in that buffers might affect lake access and view, followed by a number of lesser concerns (buffers might harbor mosquitoes and ticks, etc.). This information enabled EOT staff to customize and tailor its marketing about buffers to address those concerns of property owners. This "customization" of information to address concerns, coupled with positive water quality messages, helped property owners to overcome their disinclination to adopt. The data identified those property owners who were willing to adopt (e.g. interested in installing a buffer), and identify the variance between the two groups (e.g. inclined v. disinclined).

For example, KAP data and key informant interviews highlighted that the photographic images on educational materials were not appealing to property owners. EOT staff realized that the photos used to illustrate buffers ignored concerns for access and view, and caused staff to take new photos of shoreland installations. There was an unexpected negative reaction to the images

of restored buffers that were presented to respondents that showed a “wall of vegetation” accompanied by a discussion that described the wonderful wildlife habitat and water quality benefits that it created. From their perspective, however, a tangled weed patch blocking the view of the lake that was full of bugs, bees and maybe skunks is not something that helped to sell a shoreline restoration.

KAP data revealed the need to change the promotional materials and formats, including the photos used to illustrate shorelands, lakes and buffers. EOT staff replaced vegetation-centered photos with broad views of the lake (e.g. sky, lake and horizon in 60% of the frame). The old photos had no variation in plant height, and were focused entirely on a “wall of vegetation” with no image of water or shore. The new photos show docks, shoreline, wave height, sky, etc.

EOT staff also began offering different types of buffer options (e.g. cottage garden, prairie style, natural shoreline). The change in image style and content also gave property owners a choice in the buffer style, height of vegetation, degree of lake access and other aspects. When presented with images showing a lower profile, and a colorful “tamed” native buffer restoration, that they could imagine more like a garden (78% of Itasca respondents enjoyed gardening), there was a much more eager response -- or at least a less negative one!

Photo X: Garden-style buffer

The social research on preferred sources of information clearly showed a strong preference for a shoreland buffer guidebook, website and personal contact with a shoreland professional. EOT responded to these preferences by preparing a new guidebook, posting the new educational materials on the EOT website, and by creating a new engagement structure to facilitate direct contact with property owners.

● How do we know what impact the NSBI project had on property owners? What are the social impacts, results and outcomes?

Summarizing the outcomes of the high, medium and low touch strategies, the following patterns of adoption and maintenance took place:

> **"*High-touch*"** (frequent and direct on-site contact by shoreland specialists, with multiple options for adoption including buffer installations, free labor and other options, guidebooks, multiple messengers, site visits, joint installations, and peer to peer contact).
> **Sites:** Lake Seven (14 adoptees of 70 parcels; 11 are awaiting cost share through Clean Water).
> Adoption rate (percentage that adopted the BMP): 20%
>
> **"*Medium-touch*"** (less frequent contact, but with some site visits, joint installation, guidebooks at site visits, and peer to peer contact).
> **Sites:** Pickerel Lake (11 adoptees of 250 parcels)
> Adoption rate (percentage that adopted the BMP): 4%
>
> **"*Low-touch*"** (no direct contact with the property owner, who received a newsletter only. Property owners were given guidebook and asked to contact their neighbors (peer to peer).
> **Sites:** West Battle (2 adoptees of 490)
> Adoption rate (percentage that adopted the BMP): .004%

The "high touch" strategy clearly demands more time and resources on the part of County staff. The high-touch strategy was most effective, with a 20% adoption rate. The medium-touch approach was more effective than the low-touch approach, but had a considerably lower adoption rate (4%) than the high-touch strategy. We conclude that the low-touch approach was least effective, with an adoption rate of less than 1%. While all property owners were offered cost shares, not one property owner adopted a treatment solely on the basis of being offered a financial incentive. Of those that did not adopt, many reported already having a natural shoreline, or cited other reasons as noted in the results section above.

Photo X: EOTSWCD staff with a "high-touch"NSBI participant

● <u>Are the customary financial incentives offered by state and local agencies sustainable? Do people maintain the practice after the incentives end?</u>

The KAP research illuminated many issues and opportunities that prompted EOT staff to elaborate a response structure that met respondent needs. However, the County had a capacity gap in that there are hundreds of shoreland property owners in the defined demographic and only one full-time shoreland professional to meet their needs. It was necessary to strike a balance between staff capacity and the need to provide outreach and education to a large number of dispersed clients on multiple lakes. In addition, the same staff member was responsible for several other grants and projects taking place simultaneously. The NSBI tested the resource limits of the EOT staff, which responded by:

1. Adopting the Itasca County community model (described in the Itasca County NSBI report) based on peer-to-peer communication to spread shoreland conservation messages; and
2. Maximizing personal contact per technical service hour on the ground by:
    b. Working with groups in workshops, and mall group site visits. This also builds community connections;
    a. The initial property owner contacted was asked to convey message among groups of neighbors.

There are many other Minnesota counties with similarly limited resources. Given the adoption rates noted above, the customary model of offering financial incentives to foster adoption should be questioned. Property owners will almost always accept a financial incentive, but they will readily adopt without it. We see financial incentives as an unnecessary and ineffective opportunity cost that could be used in a more efficacious way if invested in the mechanism shown to be most effective (direct contact with a natural resources professional).

The higher-touch models tested in the NSBI have been shown to be more effective in terms of improving respondent knowledge, and in terms of adoption of recommended practices and treatments. In this light, resources dedicated to cost-shares might be better utilized if invested in trained natural resources professionals who can interact directly with property owners. The opportunity costs and overall cost-effectiveness of this recommendation should be further explored.

● How can education and outreach strategies be designed according to local needs for better impact?

The question has been raised about "what does a healthy shoreline give back to landowners?" Focusing on what 'services' and benefits a healthy shoreland area provides can significantly change the traditional education piece. EOT landowners reported that their property was particularly valuable to them because of its clean water (98%) and scenic nature (94%). Of somewhat lesser importance was affordability (81%), good fishing (73%), and family ties to the area (40%).

The most valuable part of the social research for EOT staff was uncovering dimensions that shoreland property owners would respond to, and that shoreland staff had previously not known. Previously, there was a tendency to "tell everyone everything about buffers" and that staff would give a lot of extraneous information without knowing what those concerns were. For example, previously educational messages might state "buffers will attract bees and butterflies," but the owner might be allergic to bees or dislike bugs. Staff was repeating the same information and presentation with every encounter, without customizing the content to meet the interests and needs of the property owner.

Since doing the social research, staff now approach such encounters differently. First, staff ask about concerns, then provide appropriate information. Staff have the ability to tailor content and messages to address concerns. Staff now refine how they work with people on site, and tailor the message according to expressed concerns and interests. Before, the SWCD was not

> "Don't just drum everything out, but rather customize the message. This results in a greater rate of adoption."
>
> Steve Henry, EOT Shoreland Specialist

addressing expressed concerns. “Our outreach was not designed to reach respondents; it was built around OUR values and perceptions of plants.” This new approach puts the property owner and his/her perspective at the forefront of the encounter, and centers on a listening-responding form of communication.

● How can we, as natural resources professionals, foster civic engagement?
This is an area of active discussion among many state and local agencies, and several are making strides with new models and approaches. This is especially the case for watershed planning and the TMDL process.

The NSBI project has shown that the use of basic social science research tools, and application of resulting data, can contribute to the understanding of public preferences, concerns and needs. The KAP study data provided the NSBI team with social information that was useful in identifying constraints, motivating property owners, highlighting preferences (especially for treatments that people are likely to dislike), and selecting likely options and venues for public participation. The data helped to define the appearance and content of educational materials, and provided staff with insights into what property owners would most likely respond to.

With a better understanding of the priorities and concerns of property owners, the EOT SWCD staff were able to change their engagement approach from a top-down conventional delivery system to be much more responsive, people-centered model. Engaging property owners and lake associations in peer-to-peer knowledge dissemination was also an important step that helped to maximize scarce County resources while fostering civic engagement.

Social Research Applied to the NSBI

On page 5 of this report, a series of questions were posed specifically for the EOT NSBI project. We now answer each of those questions in turn.

● Which incentives should be offered to residents?
THE EOT SWCD staff determined that a “suite” of incentives should be offered to participants through the high, medium and low touch strategies. Different incentives packages were offered depending upon the lake, as outlined in Table 1 (page 8).

● What is the acceptability of cost-share to residents?
While most residents took the cost-share, this was not the reason that people adopted and maintained a new practice. Not one person installed a buffer on the basis of being offered a cost-share or financial incentive, according to EOT SWCD staff. Concern for water quality and clean water were the more motivating factors.

● What are perceptions of property owners of a naturalized shoreline?

The KAP study raised the possibility that property owners do not share a common understanding or perception of a natural shoreline. It is likely that this situation is widespread, and we recommend that further exploration be done on people's perceptions about natural shorelines.

Photo X: Sand blanket (rear) and shoreland restoration (foreground)

● <u>How to move the "maybes" (e.g. those individuals that say they might be interested in participating)</u>?

The EOT NSBI experience suggests that the best way to move the "maybes" is a combination of the following:

a. Medium to high-touch presence and contact with shoreland professionals, who first listen and then respond after hearing the concerns of property owners;

b. Redesign of education and outreach materials that presents a variety of appealing treatment options and choices, and that allays concerns about the negative aspects of buffers (insects, view, lake access);

c. Social reinforcement and networking that is lake-focused (e.g "our" lake), and that features neighbor-to-neighbor activities and lake associations.

●Which low-touch incentives will move the "maybes?"
The low-touch incentives resulted in a very low adoption rate (< 1%). The incentives included only a newsletter and (for some) a guidebook. The medium touch approach resulted in a 4% adoption rate, and the high touch approach resulted in a 20% adoption rate. We conclude that neither low-touch incentives nor financial incentives (cost shares) are effective in moving the "maybes." County resources invested in these low-touch incentives would be better utilized if invested instead in the engagement effort (e.g. trained staff and outreach/education).

● What kind of information do the "maybes" need?
The EOT NSBI educational materials and content were designed based upon KAP data (*e.g.* common concerns, view, cost, appearance, access, etc.). The new buffer guidebook was designed with phased information and timelines, as well as the adage "read it, write it, say it." The guidebook cover featured images of clean water and scenic environment, corresponding to values of legacy, stewardship and future generations. The educational information in itself may not be sufficient; it needs to be delivered by a respected professional, and reinforced with peer-to-peer messaging.

● Which treatments or "offerings" (incentives and otherwise) do people prefer?
The social research provided new information that enabled EOT staff to design a range of offerings that fit well with the high, medium and low touch approach. The research results also aided staff to define outreach strategies so as to maximize personal contact with natural resources professionals (a key preference). A combination of customized "offerings," along with a high degree of "touch" and social interaction, is likely to be most acceptable to lakeshore property owners.

Recommendations

The following recommendations are offered based upon the experience of the NSBI in East Otter Tail County.

1. Consider the timing and frequency of meetings for project participants. EOT staff recommend spacing out meetings to give people something to look forward to, to get feedback and fresh information, to share experiences, and to provide continued opportunities for interaction.

2. On messaging: package messages with a view to shifting perceptions from "I don't need to act because my actions will have no impact" or "I don't need to act because I don't need to act." Residents on Otter Tail Lake with several rivers do not perceive that their actions have any

impact. Property owners need to understand that water quality can change, and that their actions can make a difference.

3. Training. In the case of East Otter Tail County, the most difficult part of doing social research was to set aside the conventional model for shoreland buffer projects, and to interpret results without the tendency to interpret from one's own "silo." The research data challenges ideas and "buzz" from key informants, and also challenges long-standing ideas and opinions of shoreland professionals. EOT staff were able to make quantitative changes to the program that were *not* based on preconceived notions. They were able to adopt and utilize the social research tools with some training and coaching, with very good results. We recommend that training and coaching in basic social science research (especially the KAP study method) be provided to any new EOT staff working with water quality projects, and to other Minnesota counties interested in shoreland conservation. WRC staff are currently working on training materials, which should become available in 2012.

4. Further research. There are a number of areas outlined in this report where further research would be useful. Much of this can be accomplished by key informant interviews or focus groups. Some of the areas where further research would be useful include perceptions of what constitutes a natural shoreline; whether full-time owners have different priorities than seasonal residents; and further work on how to foster neighbor-to-neighbor or peer-to-peer networking about buffer adoption.

In addition, the majority of respondents with prior shoreland erosion control projects (*e.g*. riprap, retaining walls, aerators, sandbags, etc.) state that their treatments are not performing as expected. This may present an opportunity for future buffer installation, and may warrant further investigation and possible new opportunities for shoreland naturalization.

5. Invest in staffing. We conclude that property owners are more receptive to adoption and maintenance of shoreland buffers when they have direct access to a natural resources professional. Clearly, county staff must organize their time and resources to reach the maximum number of people, and collaborating with lakeshore associations, volunteers and peer-to-peer networks are important means of doing so. Budgetary resources that currently are dedicated to financial incentives (such as cost-shares) should be reconsidered because cost-shares were shown in this case to be ineffective. We recommend that those budgetary resources instead be invested in shoreland professionals using a medium to high touch civic engagement strategy, as efficacy will be maximized.

Contact Information

Karlyn Eckman
Senior Research Associate
University of Minnesota Water Resources Center
173 McNeal Hall
1985 Buford Avenue
Saint Paul, MN 55108
612-625-6781
eckma001@umn.edu

Steve Henry
Shoreland Specialist

East Otter Tail Soil and Water Conservation District
801 Jenny Ave. SW
Suite #2
Perham, MN 56573
218/346-4260
Steve.Henry@mn.nacdnet.net

Mark Hauck, DNR
Community Assistance Specialist
Minnesota Department of Natural Resources Regional Operations
940 Industrial Dr. So. #103
Sauk Rapids, MN 56379
320-255-4279 Ext. 236
mark.hauck@state.mn.us

Acknowledgements

- Minnesota Environment & Natural Resources Trust Fund (LCCMR)
- Erika Rivers, DNR
- MN Department of Natural Resources
- Minnesota Pollution Control Agency
- Water Resources Center, University of MN
- University of Minnesota Extension Service
- Itasca Water Legacy Partnership / Itasca SWCD

References

Dillman, Don A. 2000. *Mail and Internet Surveys: The Tailored Design Method*. New York: J. Wiley.

Eckman, Karlyn. February 2012. *Native Shoreland Buffer Incentives (NSBI) Project Final Report – Social Research and Efficacy Outcomes*. Saint Paul: University of Minnesota Water Resources Center.

Eckman, Karlyn. August 2011. Literature Review Report: Adapting the Knowledge, Attitudes and Practices (KAP) Study Method for Natural Resources Projects in Minnesota. WRC Working paper. Saint Paul: University of Minnesota Water Resources Center.

Eckman, Karlyn. In preparation for submission to the *American Journal of Evaluation*. "Crossing Disciplinary Boundaries: Adapting the KAP Study Method to Evaluate Environmental Programs."

Eckman, Karlyn. *Evaluating Outcomes of Water Resources Projects on Target Audiences.* Presentation given at the Watershed Partners Meeting, October 13 2010, at the Capitol Region Watershed District.

Eckman, Karlyn. *Evaluating Social Outcomes in Water Resources Projects: Lessons from Minnesota.* Presented at the 2010 UCOWR/NIWR Conference July 13 2010, Seattle.

Karlyn Eckman, Kimberly Nuckles, Erika Rivers and Valerie Were. *Adapting Interdisciplinary Methods to Evaluate Social Outcomes of Environmental Programs: Five Lessons From Minnesota.* Paper presented November 10 2010 at the American Evaluation Association 2010 Annual Conference, San Antonio, Texas.

Erika Rivers and Karlyn Eckman. *What Will It Take to Get You to Conserve? Lessons from the Native Shoreland Buffer Incentives Program Surveys*. Minnesota Waters Conference, October 2009.

Eckman, Karlyn and Rachel Walker, with Kimberly Nuckles and Lilao Bouapao. 2008. *Minnesota Non-point Source Pollution (NPS) Project Evaluation Practices: Survey Report.* Saint Paul: University of Minnesota Water Resources Center.

ITASCA COUNTY NSBI
Social Research Report

February 20 2012

Karlyn Eckman
Water Resources Center, University of Minnesota
with
Mary Blickenderfer
University of Minnesota Extension

ACRONYMS

CATA	Check-all-that-apply
COOR	Check only one response
DNR	Minnesota Department of Natural Resources
GD	General Development (lake class)
ICC	Itasca Community College
ICOLA	Itasca Coalition of Lake Associations
KAP	Knowledge, attitudes and practices study
KAXE	Grand Rapids-based public radio station
LGU	Local government unit
MNENRTF	Minnesota Environment and Natural Resources Trust Fund
OHWL	Ordinary high water line
n	number
NE	Natural Environment (lake class)
NSBI	Native Shoreland Buffer Incentives Project
Q	Question
RD	Recreational Development (lake class)
SWCD	Soil and Water Conservation District
UM	University of Minnesota
WRC	University of Minnesota Water Resources Center

Introduction

The primary resource objective of the Native Shoreland Buffer Incentives project (NSBI) is to protect native vegetation buffers along Minnesota shorelines. The project goal is to develop, implement, and evaluate the efficacy of two substantially different models for incentivizing the maintenance of native shoreland buffers promoted by local government units (LGUs). The NSBI project was proposed by the Minnesota Department of Natural Resources (DNR) to the Minnesota Environment and Natural Resources Trust Fund (MNENRTF) in 2008. It was accepted by the Trust Fund Commission, which recommended the proposal to the Minnesota State Legislature, and eventually funded for $225,000.

The primary resource objective of the NSBI is to protect native vegetative buffers along Minnesota shorelines. The project goal is to develop, implement and evaluate the efficacy of two substantially different models for incentivizing the maintenance of native shoreland buffers by local government units (LGUs). The project scope combines both social science and natural resources activities. Through the NSBI, the DNR offered two competitive grants to LGUs to craft shoreland protection incentive programs that encourage maintaining and restoring native shoreland buffers in areas of existing or newly proposed development. Itasca County was one of the two LGUs to participate in the NSBI.

Intended outcomes of the NSBI program were:

1) A workshop and ongoing consultation services that educate prospective local governmental applicants about how to design incentive programs that elicit sustainable behavioral change;
2) Two trial buffer incentive programs models;
3) Interim and final reports on program efficacy;
4) DNR technical and assessment support on the effectiveness of trial program buffers.

Measures of success:
This project will be considered successful if:

- Two buffer incentive programs (chosen by competitive process) are developed, implemented, and evaluated by June, 2011.
- The MNENRTF is satisfied with the final efficacy reports, and the reports are helpful to others considering incentive-based approaches to shoreland stewardship.
- Involved stakeholders have increased their skills and knowledge as a result of the project.
- The DNR and other interested parties can readily benefit from the lessons learned from the trial programs.

The project was led by the DNR, and a subcontract was awarded to the University of Minnesota Water Resources Center for the social research component. The NSBI project commenced with a workshop in October 2008 called “Understanding your Target Audience,” which was attended by approximately forty staff of two dozen local governments, mainly counties and soil and water conservation districts (SWCDs). The LGUs were invited to submit proposals to the NSBI with innovative strategies intended to foster adoption and maintenance of shoreland buffers by

shoreland property owners. The proposals were submitted and reviewed by a panel with members drawn from The Initiative Foundation, DNR, WRC and others. Two proposals from the East Otter Tail (EOT) County Soil and Water Conservation District, and a coalition of partners from Itasca County (including University of Minnesota Extension, Itasca Water Legacy Partnership, the Itasca County Soil and Water Conservation District, and Action Media) were selected for funding ($75,000 each). Contracts were prepared for each county, and project activities commenced in late 2008.

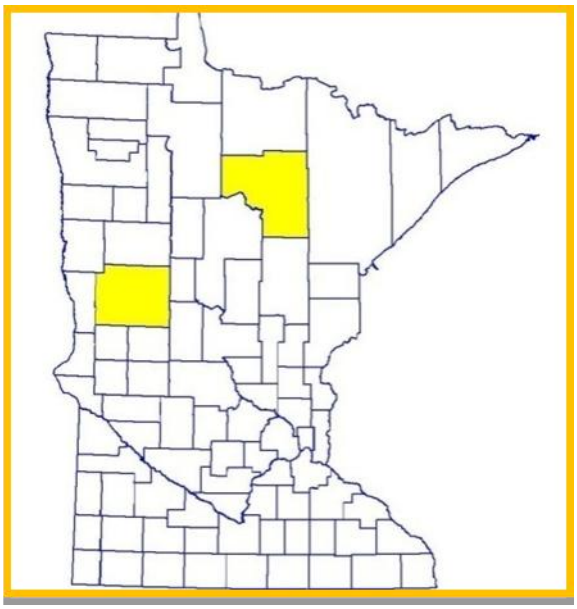


Figure 1: Location of Itasca and East Otter Tail Counties
(Itasca is in north central Minnesota; East Otter Tail is in west-central Minnesota)

Both counties committed to a social research component that investigated the awareness and behaviors of shoreland property owners. Barriers and constraints to adoption of shoreland buffers were also explored. One social research tool employed in both Itasca and East Otter Tail counties is the *knowledge, attitudes and practices (KAP) study* described in Eckman (2010 and 2011*).*

This report concerns only the social research aspects and social outcomes of the Itasca County NSBI project. A similar KAP study report has been prepared for East Otter Tail County. Each county will also submit a final report detailing the deliverables in each case. In addition, the NSBI final report gives an overview of project accomplishments and lessons, and draws conclusions about the efficacy of the different strategies tested in each county.

It should be noted that unfortunate administrative delays in processing contracts in 2008, 2009 and 2010, combined with the 2011 state government shutdown, severely handicapped the social research elements of the NSBI. The administrative delays and work stoppages caused frequent interruptions in field work, leaving insufficient time for data analysis. There has been very

limited time in which to prepare this report and the NSBI final/efficacy report. Nevertheless, valuable lessons and findings have been gained, and are summarized in this report and in the accompanying final/efficacy report.

The Itasca County NSBI

The purpose of the Itasca County NSBI was described in the proposal submitted to the DNR in late 2008:

> *This project will compare the effectiveness of both 1) standard strategies (local media/direct mailing) vs. trained peer-messengers and 2) lake association vs. non-lake association influence for recruiting property owners to install/maintain buffers on 4 lakes: Turtle (RD) and Johnson, Horseshoe and Mike (all NE). Owners will select from tiered buffer strategies (natural, no-mow, hybrid, planted) and incentive options. Train-the-trainer workshops for Master Gardeners and ICC students will increase local capacity to assist shoreland owners with buffer design, installation and maintenance. Buffer research will evaluate efficacy of county shoreland buffer standards to reduce run-off (and pollutants) and increase biodiversity of shorelines. Project effectiveness will be measured by pre-and post-project knowledge, attitudes and practices (KAP) surveys and whole-lake shoreline assessments.*

The Itasca partners, led by Dr. Mary Blickenderfer of Minnesota Extension, subcontracted with Action Media to design the social marketing component of the Itasca NSBI. The Itasca NSBI team took a step-wise process, building on the initial social research findings, experimenting with different strategies, starting with small steps that might be acceptable to lakeshore property owners and adding additional options over time that emerged out of expressions of interest voiced by participants.[1] Both the Itasca and East Otter Tail teams developed an education and outreach strategy with several options, which were tested and assessed. In Itasca County, the strategy can be summarized as:

"*High-touch*" (frequent and direct on-site contact by shoreland specialists, with multiple options for adoption including buffer installations with free labor; the Itasca Lakes Challenge; and other options);
"*Medium-touch*" (less frequent contact, but with some site visits; and
"*Low-touch*" (no direct contact with the property owner, who received a newsletter only).

The Itasca team selected Turtle Lake and South Johnson Lake as high-touch lakes. Medium-touch sites were limited to North Johnson Lake. The low-touch strategy was applied at smaller lakes (Mike Lake, Horseshoe Lake). These lakes varied considerably in terms of size, population

[1] A full description of the Itsaca NSBI strategy and approach is contained in the end-of-project report prepared by the Itasca County project lead (Mary Blickenderfer).

density, and development patterns, from Turtle Lake (a large, developed lake with several resorts) to Mike Lake (a small lake with four cabins).

During the project period the Itasca team also designed several experimental civic engagement tools that were tested at various sites. These tools and activities were open to property owners on the five pilot lakes, as well as to the general public. These included:

1. The Itasca Lakes Challenge, whereby shoreland property owners scheduled a guided assessment with trained peers to assess the condition of their own shoreline, and to select options to improve shoreline condition;

2. Several civic engagement options accompany the Lakes Challenge, including:
    a. Citizen-based monitoring of runoff plots to compare native or new (installed) buffers with developed areas (lawns, paths, roads);
    b. Frog classes and frog monitoring;
    c. Fish identification/ecology classes; hands-on fish workshops (protocol and curriculum have recently been developed);
    d. Beachcomber program, with property owners looking for evidence of invasive plants.

The Itasca NSBI also included biophysical research components including shoreland buffer trials (runoff plots), and detailed technical support and advice on buffer installation. Those activities are described in the Itasca NSBI final report.

Social Science Research Aspects of Itasca NSBI

The Itasca NSBI included a strong social research component, in contrast to most natural resources projects which omit such research. Team members wished to examine a number of questions that might assist them in designing effective civic engagement, education and outreach strategies, and to better evaluate project outcomes on intended audiences. The team had observed that many natural resources professionals are trained in the biophysical sciences and are sometimes unfamiliar with social research tools, which limits their use at the project level. In addition, it was known that few water quality projects in Minnesota conduct any form of project evaluation, and that the evaluation of social outcomes and impacts is rare (Eckman et al 2008).

Some of the underlying social research questions included:

- What motivates people to adopt and maintain a recommended practice? Why are some individuals inclined and others disinclined to adopt?
- Are the customary financial incentives offered by state and local agencies sustainable? Do people maintain the practice after the incentives end?
- How can education and outreach strategies be designed according to local needs for better impact?

- How can we, as natural resources professionals, foster civic engagement?
- How do we know what impact the NSBI project has on property owners? What are the social outcomes?

These "big picture" questions are currently being discussed by a number of natural resources professionals in Minnesota and elsewhere. While these questions may not be entirely answered by the social research in this particular project, our findings may contribute in a small way to this very active dialogue.

The social research methods selected in the Itasca project were chosen because of their relatively low cost, relatively rapid nature, and ease of application and interpretation. A mixed-methods approach was taken in order to triangulate and verify findings, and to obtain a richer understanding of attitudes and (especially) motivation of local property owners. The pre-implementation research methods included:

1. A baseline KAP study to assist in planning, the design of education and outreach methods, and to identify possible participants in the NSBI;
2. An experimental "boat-by" to visually confirm the condition of respondents' shorelines, when compared with their self-reported practices;
3. A focus group held with lake association members to understand social networks and diffusion of information between property owners;
4. Social marketing, consisting of the interpretation of KAP data by Action Media for the purpose of designing marketing messages to property owners.

The end-of project research methods included:

1. A second-round KAP study to evaluate changes in knowledge, attitudes and practices, and the acceptability of recommended practices and installations. This yielded two data sets enabling comparison of pre and post KAP values;
2. Key informant interviews to gain a richer understanding of participant motivation and to better understand local social networks.

The "boat-by," focus group and social marketing were conducted by Itasca County local partners and are not included in this report (see the Itasca NSBI Final Report for details). This report includes results of social science research conducted by the University of Minnesota Water Resources Center (*e.g.* the first and second-round KAP studies, as well as key informant interviews).

The Itasca NSBI KAP Study

As noted, a KAP study was prepared for property owners on five selected lakes to assess their views about shoreline buffers, as well to identify potential incentives that might help to overcome barriers to installing/maintaining buffers. The Itasca shoreline team decided to administer the survey at a sample of lakes representing various DNR-designated lake classes, of different sizes, and with varying degrees of development. Five lakes were selected in an area north of Grand Rapids that were in relatively close proximity in order to facilitate field work. These respondents had properties with $10,000 or greater of structural improvements to their property on five Itasca County lakes. The lakes included:

Johnson North (ID = 31068700, Natural Environment Classification)
Johnson South (ID=31058600, Natural Environment Classification)
Turtle (ID = 31072500, Recreational Development Classification)
Horseshoe (ID = 31069600, Natural Environment Classification)
Mike (ID = 31070600, Natural Environment Classification)

The questionnaire design was based upon a brainstorming "gap exercise" that identified gaps in the NSBI team's understanding about the property owners on the five selected lakes. A list of gaps was prepared, and questions drafted accordingly. The preliminary list of questions was refined, critiqued by the team, refined again, and finally converted into a draft questionnaire. This was pretested and refined again. The first-round KAP questionnaire is attached as an appendix to this report.

The KAP study was administered twice: first as a baseline survey at the project onset (June 2009); and again at the end of the project during the summer of 2011. The first-round baseline study data was used to inform the education and outreach aspects of the Itasca NSBI, and to identify property owners expressing an interest in participating. The second-round study repeated many (but not all) of the questions in order to gauge changes in key KAP values. Several new questions were posed in 2011 to assess the efficacy of the strategies and interventions that were introduced in the interim period.

The first-round survey was administered to property owners by trained college students and/or ICOLA members in person or by mail for those not present during the in-person survey. A WRC researcher (Eckman) trained the survey enumerators, and guided the field portions of the study. Care was taken to reconcile the property lists provided by the county with aerial photos, so that the survey sample was as accurate as possible.

Photo 1: Comparing aerial photos with county property lists to correct the sampling frame (2009).

Photo 2: Data entry during the first-round KAP study (2009)

First-Round Survey (2009)

Questionnaires were completed by roughly two-thirds (*n* = 224) of 331 shoreland property owners in 2009. The questionnaires were completed either during a door-to-door field survey during the week of June 22-29 2009 (*n* = 109), or later during a mailed survey to tax record addresses in July and October 2009 (*n* = 115). Of the total population of $10,000 parcels, some were eliminated from the study due to impending sales, duplicate ownership (one person owning multiple parcels on the lake) or tax forfeiture. The total of shoreline property owners by lake were:

Mike Lake total property owners: 5
Horseshoe Lake: 26
Johnson (north): 33
Johnson (south): 63
Turtle Lake: 204

Thus, the effective population size of the 2009 five-lake study was 331. To facilitate analysis and ensure accuracy, surveys were entered into Survey Monkey software by a paired data entry method or by a single person entry method with an accuracy check.

Sampling

The main difference between the pre and post KAP surveys was the sample size. The corresponding population for the five lakes was large, but many properties were owned by seasonal residents and a large number of property owners were not present during the field survey. Moreover, the sample was restricted to property owners with $10,000 or more of structural improvements.

The second-round sample was less than half of the first round, down from 225 to 104. This was attributable to the manner by which the two surveys were administered. In 2009, considerable effort was spent in a week-long door-knocking survey, which yielded 109 respondents. The 2009 door-to-door effort found that a large number of property owners were not present on their properties. It was followed by a mailed survey (particularly to seasonal owners), resulting in additional questionnaires returned for a total of 225.

For the second-round survey, conducted during the summer of 2011, it was decided to conduct only a mailed survey (although a few respondents were contacted directly).

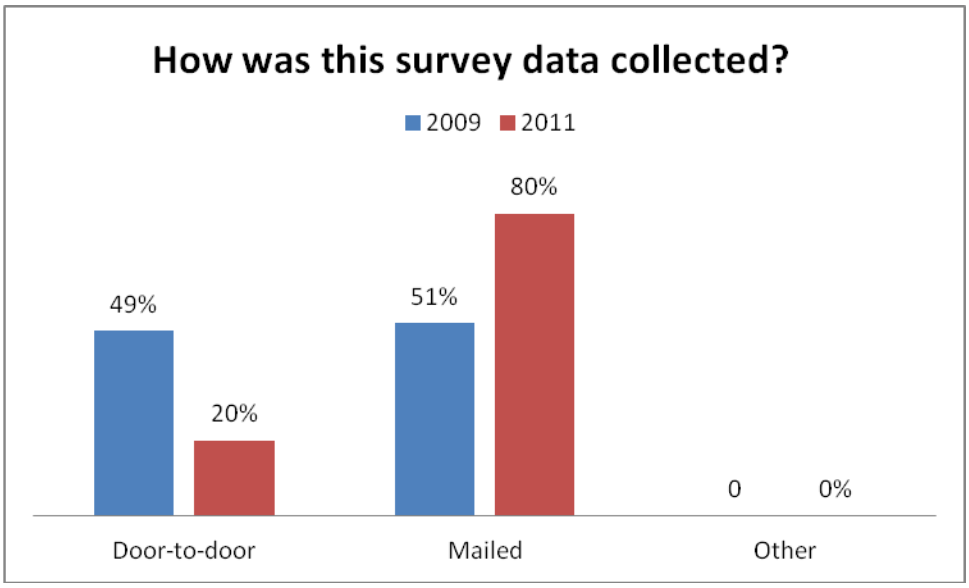
Table 1: Comparison of First and Second Round EOT KAP Studies

	Dates	Sample Population	Sample size	Response Rate	Margin of Error
KAP 1	June 2009	340	225	66%	3.73
KAP 2	Summer 2011	331	104	31%	7.97

Given the small sample sizes this survey cannot be considered a representative sample. Rather, this survey should be considered to be purposive and exploratory in nature.

A summary of pre/post survey administration is found in Table 2 below:

Table 2: Survey Administration



<u>Second-Round (2011) Survey</u>

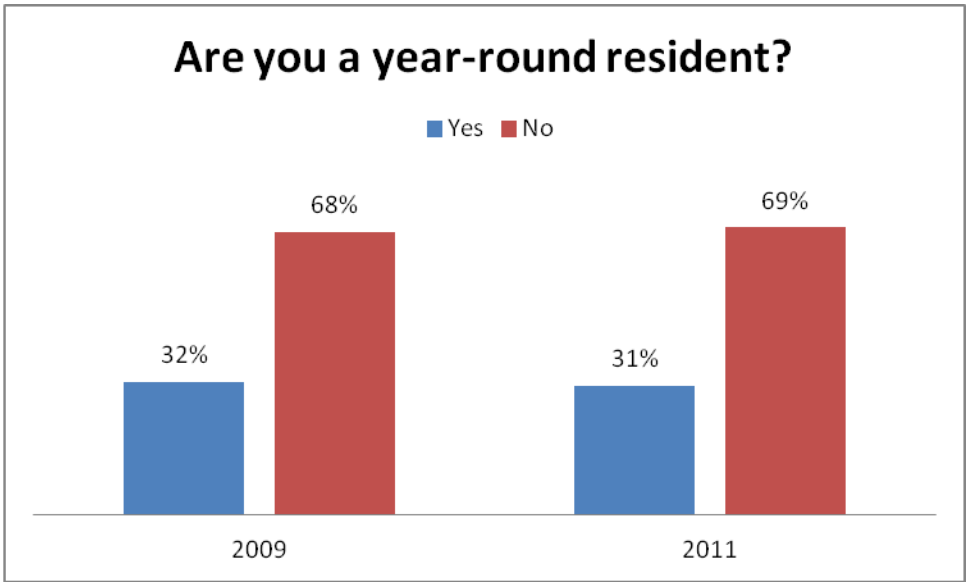
The Itasca KAP study featured two separate surveys: a first-round (baseline) survey, and a second-round follow-up survey two years later.

<u>Questionnaire content</u>

In the second-round survey, some questions were eliminated because they were originally intended for planning purposes. Other questions were added in order to assess impact and efficacy following the two-year project implementation period. The second-round mail-in only survey was conducted two years later and the data compared.

Two general demographic questions were included in both surveys. The first demographic question asked whether respondents were year-round residents. Results of both surveys are summarized below:

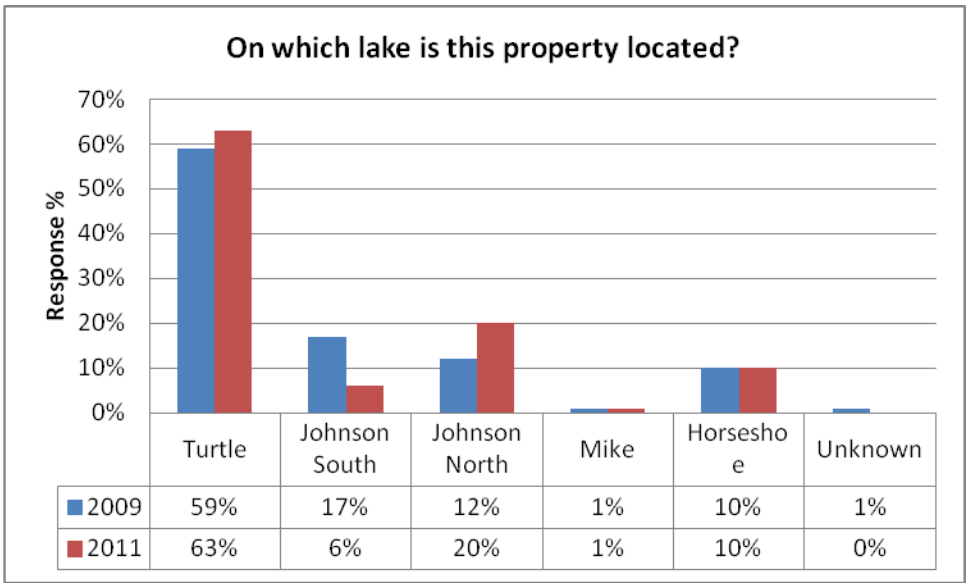
Table 3: Seasonal v. Full-time Respondents



The proportion of seasonal and full-time respondents in the two surveys was nearly identical.

The second demographic question concerned where the respondent's property is located. Results from both surveys are summarized in the table below:

Table 4: Location of Property



	Turtle	Johnson South	Johnson North	Mike	Horseshoe	Unknown
2009	59%	17%	12%	1%	10%	1%
2011	63%	6%	20%	1%	10%	0%

The great majority of properties were located on Turtle Lake, a large RD lake with numerous cabins and two resorts. The remaining lakes were smaller and were classified as NE lakes.

Interim Implementation Activities

In the interim period between the two KAP studies, a large number of project implementation activities took place, including buffer installations, civic engagement activities, training and education/outreach. These are described in more detail in the Itasca County NSBI final report. Only the audience-oriented activities are summarized here (this list is a partial summary of project activities derived from annual NSBI reports):

- Implemented "Lake Challenge" resulting in 16 site assessments and 14 project participants on three research lakes.
- Delivered Master Gardener training. Training efforts were redirected to prepare to conduct "Lake Challenge" site visits.
- Run-off research was tested with shoreland property owners. Final protocol revisions were made.
- Student/landscaper was selected and prepared site plans for five property owners requesting buffers.
- Master Gardener Shoreland Design Training was developed.
- Peer-to-peer training was developed and delivered to college students, ICOLA members and Master Gardeners.
- "Lake Challenge" shoreland assessment tool/incentive options was developed. Site visit workbook to assist peers during site visits was created.
- The tiered incentive "Lake Challenge" worksheet was field tested for use as a more detailed on-land and boat-by assessment tool.
- New rapid boat-by shore assessment was field tested.
- Survey Review and Communications Plan developed by Action Media.
- Collaboration with MN DNR on Citizen Shoreline Assessment protocol and field testing.
- Follow-up community meeting in Marcell on 12-2-09.
- Assessment tool was revised (shortened) and field tested. Further revisions based upon individual lake buffer incentives/goals will be necessary to create a more efficient and effective, citizen-friendly tool.
- Hybrid MN DNR/Itasca Co shoreline assessment tool developed and field tested
- Six trained peers contacted 59 shoreland residents inquiring about the Lake Challenge site visits. Fourteen of these contacts and two resident responses to newsletter announcement resulted in 16 site visits. Fourteen of the residents agreed to participate in one or more (up to 14) of the Lake Challenges, including buffers, program promotion and/or shoreland scientist Challenges.
- One peer developed a web forum to facilitate peer communication and entry of Lake Challenge site visit data.
- A graphic designer created a unique design and presentation options (other than the standard sign) for project participant incentive.

Photo 3: Dock sign given to NSBI participants that had installed or enhanced a native shoreland buffer, and to promote the Itasca County Lake Challenge.

• The NSBI team indicated that an online version of the Lake Challenge should be developed for a broader audience (i.e. outside the two research counties) – to include tracking options.
A field book of relevant images and information was created to assist peers during their site visits.
• Action Media reviewed survey results for marketing plan development
• Conducted Part 1 of Master Gardener training.
• A Bemidji State University student (formerly a local landscaper with shoreland restoration education and experience) agreed to design and install the shoreland projects identified in 2010.
• Master Gardener training developed (for June 7 2010 training); Master gardeners recruited.

These many public activities were expected to impact the KAP values in the second round. However, ***because knowledge and attitudes values were so high in the first-round KAP study, we did not expect to see a major increase in these values in KAP #2. In fact, these values did not change significantly in the interim two-year period.*** Assessing the second-round KAP values is based, therefore, on a more nuanced interpretation.

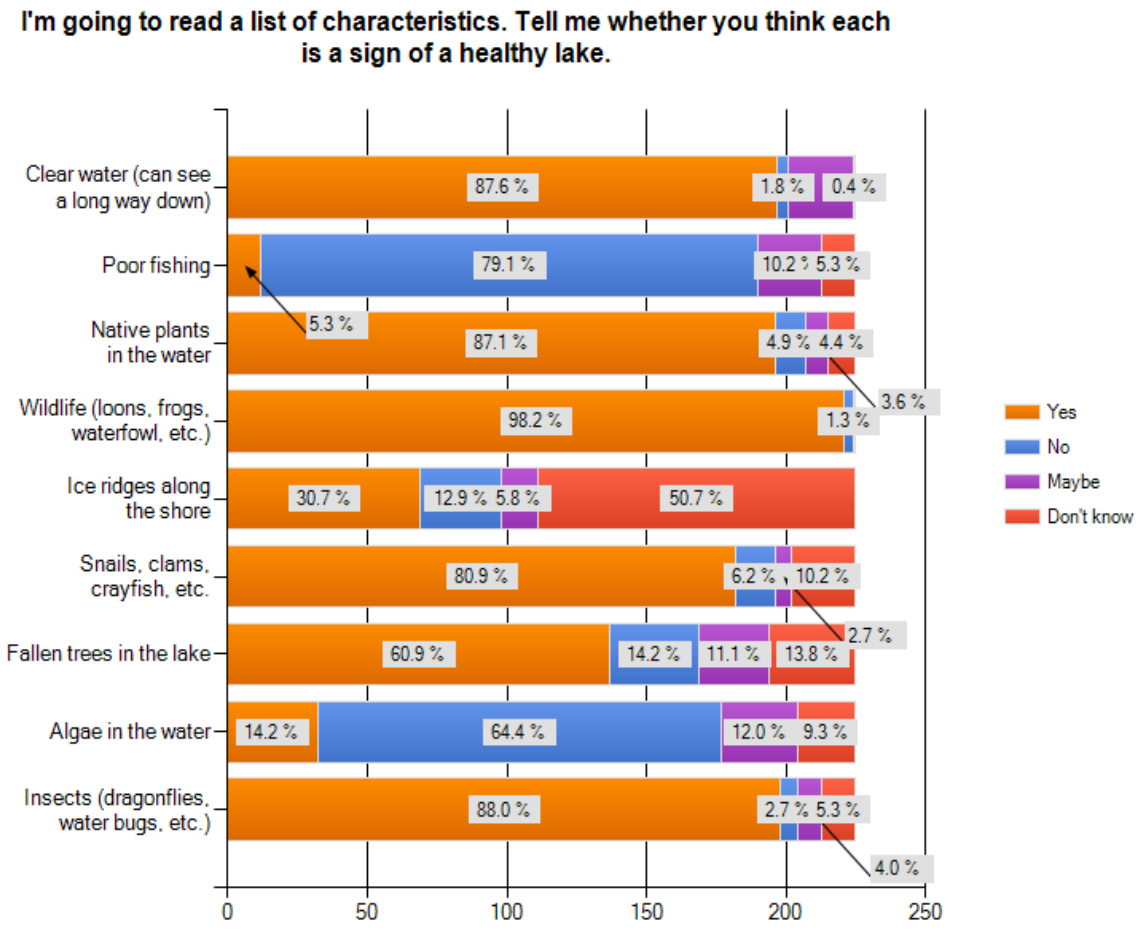
KAP Study Results

The following sections present and compare the pre and post KAP study findings. Knowledge questions are presented first, followed by attitudes and practices questions. In the ranked scale data tables (for example, Tables 5-8), the values with highest frequencies are highlighted in bold font. Where appropriate, the symbol 💧 is used to signify an interpretive comment or note significant results for specific survey questions.

Knowledge findings

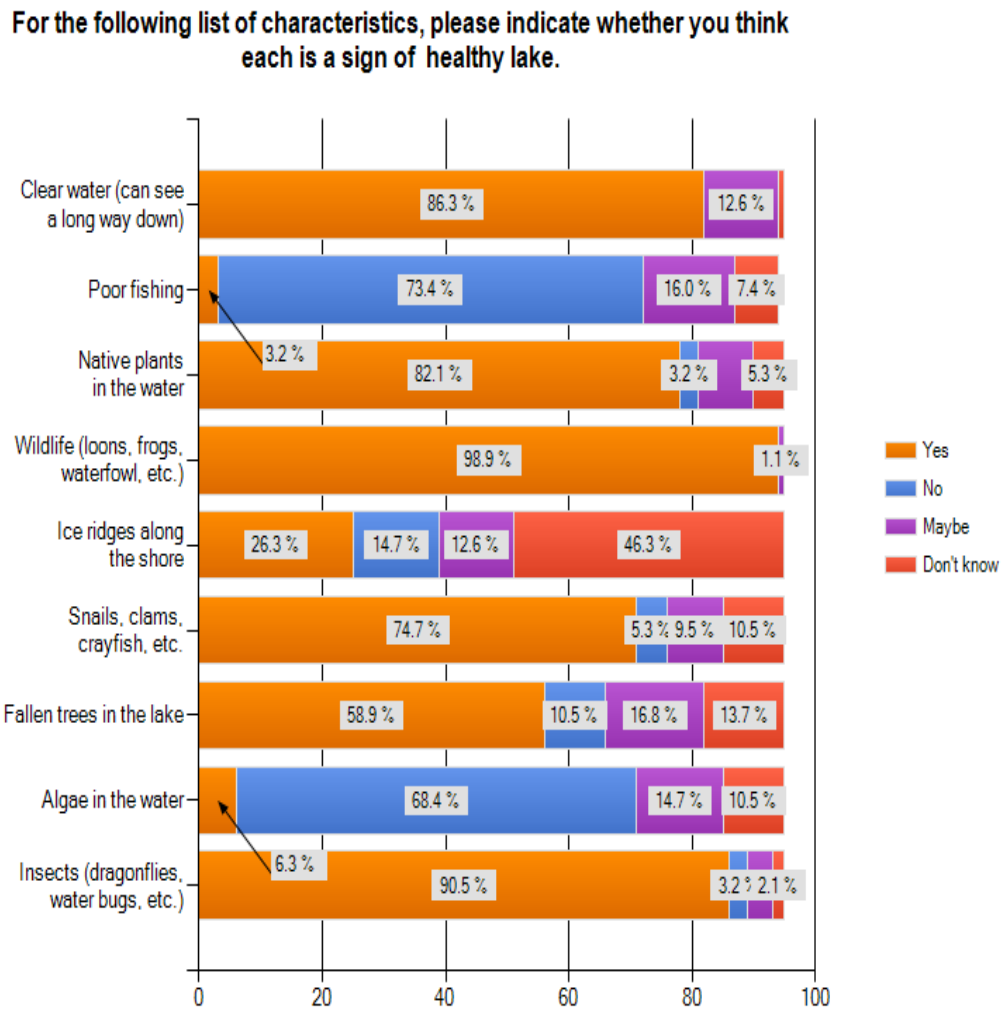
First-round responses (2009) for **knowledge of lake health** are presented in the table below.

Table 5 (2009):



This question was repeated in the second-round survey (2011), and results are presented in the following table:

Table 6 (2011):



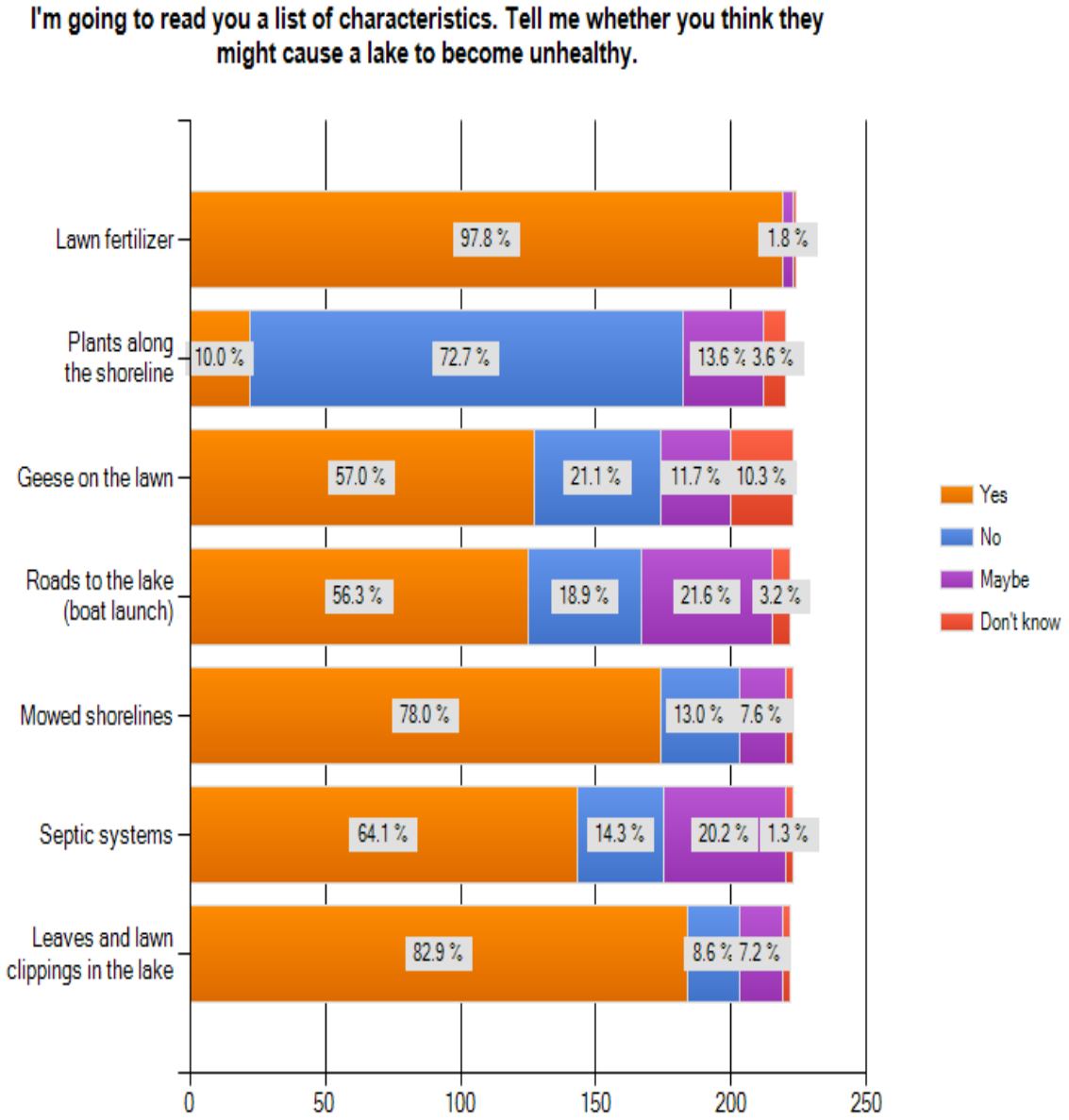
Comparing the two data sets, the highest-frequency responses did not shift significantly (more than a few percentage points in any direction). Five of the knowledge values declined slightly, and three values increased. “Clear water” declined by 1.3%; “Poor fishing” declined by 5%; “Native plants in the water” declined by 5%; “Ice ridges along the shore” declined by 4.4%; and “Fallen trees in the lake” declined by 2%. Knowledge values for “Wildlife” increased by .08%; “Algae in the water” increased by 4%; and “Insects” increased by 2.5%. Comparing the results for this question do not show a significant or clear trend in knowledge about characteristics of a healthy lake.

Overall, data from both KAP studies show that there is already a high level understanding about signs of lake health. More than 85% understood that clear water, native aquatic vegetation,

abundant wildlife and invertebrates are signs of a healthy lake ecosystem. A slightly lower percentage (61%) understood that too much algae can diminish lake health; that fallen trees along the shoreline can benefit fisheries (61%); or that poor fishing is a possible sign of an unhealthy lake (79%). About half (51%) did not understand how ice ridges may act to protect the lake by creating a barrier to sediments and pollutants in runoff. Across the board, respondents were unsure of how ice ridges could help maintain lake health by capturing runoff. Seasonal residents were somewhat less likely to make the connection about ice ridges preventing erosion (44%) than year-round residents (54%).

Conversely, respondents were asked a **knowledge question about what might cause a lake to become unhealthy**. The following data summarizes results in the 2009 survey:

Table 7 (2009):



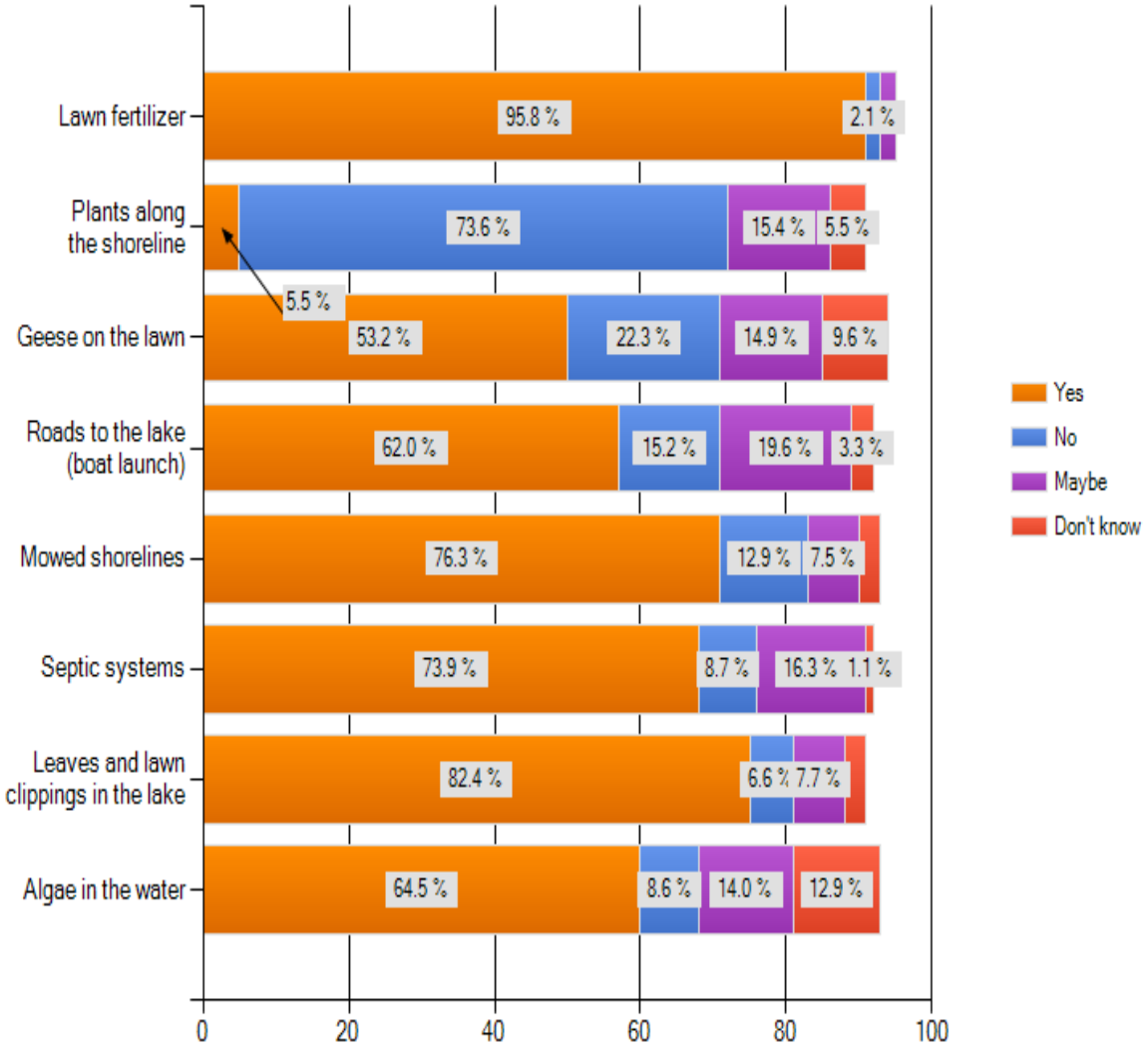
Results show that there was very good understanding of the causes of lake degradation in 2009. Ninety-eight percent of respondents showed a high level of understanding that lawn fertilizers and improper disposal of lawn clippings (83%) adversely impact the lake. However, there was a more moderate connection between lake degradation and practices such as mowing shorelines (78%) or improper septic maintenance (64%). There appeared to be a poor connection made between lake degradation and boat launches (56%) and lawns that attract geese (57%). Year-round residents (86%) appeared to have higher recognition than seasonal residents (74%) that mowing lawns may decrease lake health. Moreover, a higher percentage of seasonal owners

reported that they don't think mowed shorelines can cause a lake to become unhealthy (16% v. 7% of year-round homeowners).

The following table summarizes results from the second-round 2011 survey.

Table 8 (2011):

For the following list of characteristics, please indicate whether you think they may cause a lake to become unhealthy.



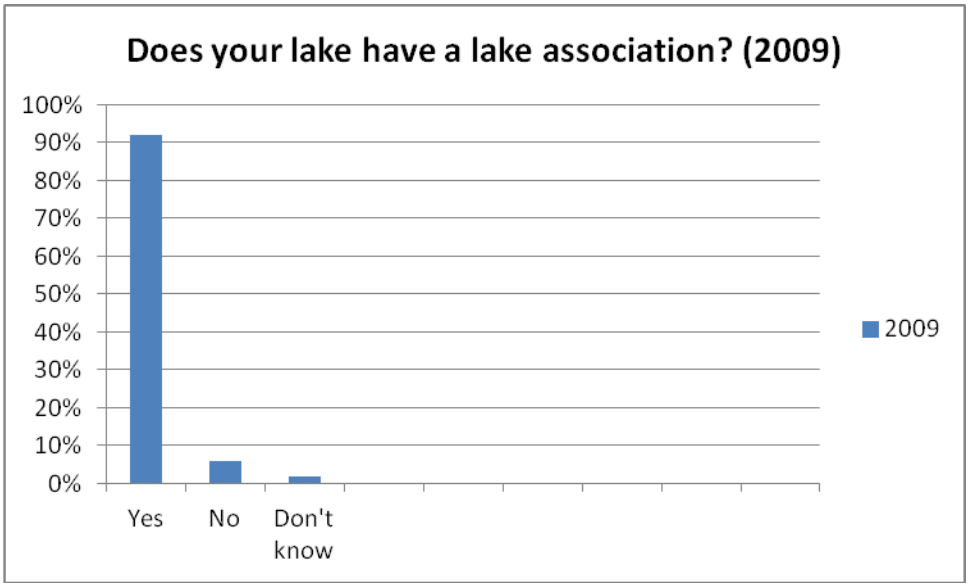
In 2011, four of the knowledge values declined slightly, and three values increased. Of these, "Lawn fertilizer" declined by 2%; "Plants along the shoreline" declined by 4.5%; "Mowed shorelines" declined by 1.7%; and "Leaves and lawn clippings in the lake" declined by .5%.

Knowledge values for “Geese on the lawn” increased by 3.6%; “Roads to the lake” by 5.7%; and “Septic systems” by 9.9%.

- Comparing the two data sets results for this question do not reveal a significant or clear trend in knowledge about what might contribute to an unhealthy lake. The highest-frequency responses did not shift significantly (*e.g*. more than a few percentage points in any direction).

Respondents were asked in 2009 whether their lake had a **lake association**. Results are as follows:

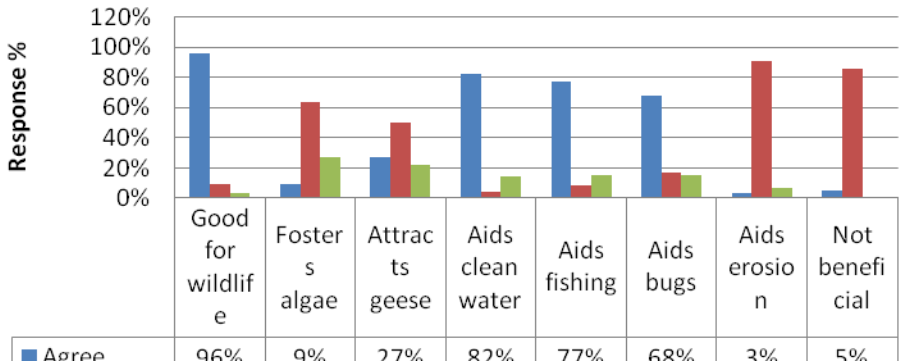
Table 9: Awareness of Lake Association



- Concerning knowledge of their lake association, ***almost all of the shoreline property owners (92%) knew about the lake association*** on their lake in 2009 (all of the lakes in the study have a lake association except Johnson Lake - north). This question was not repeated in 2011.

Knowledge about the benefits of natural shoreline buffers was relatively high in 2009, with more than 90% recognizing that they are beneficial to wildlife (96%) and help to prevent shoreline erosion (91%). There was a slightly more moderate understanding that buffers also contribute to clean water (77%). However, less well understood were connections to reduced algae (64%) and discouraging of geese (50%). Results for both 2009 are summarized in the table below.

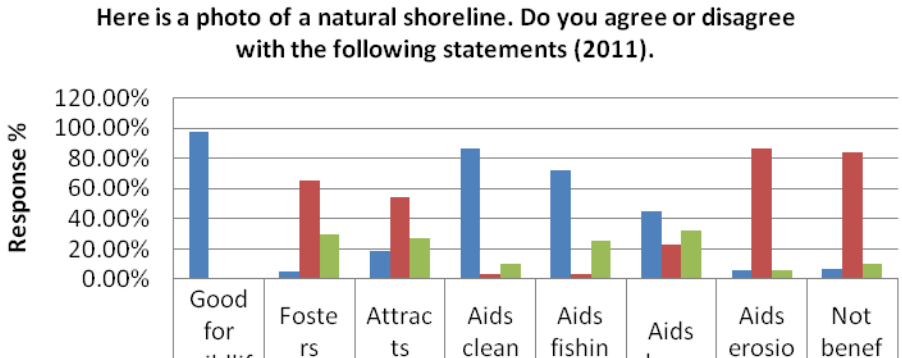
Table 10: Benefits of Shoreland Buffers (2009)



	Good for wildlife	Fosters algae	Attracts geese	Aids clean water	Aids fishing	Aids bugs	Aids erosion	Not beneficial
Agree	96%	9%	27%	82%	77%	68%	3%	5%
Disagree	9%	64%	50%	4%	8%	17%	91%	86%
Don't know	3%	27%	22%	14%	15%	15%	7%	

The 2001 results are summarized in the table below.

Table 11: Benefits of Shoreland Buffers (2011)

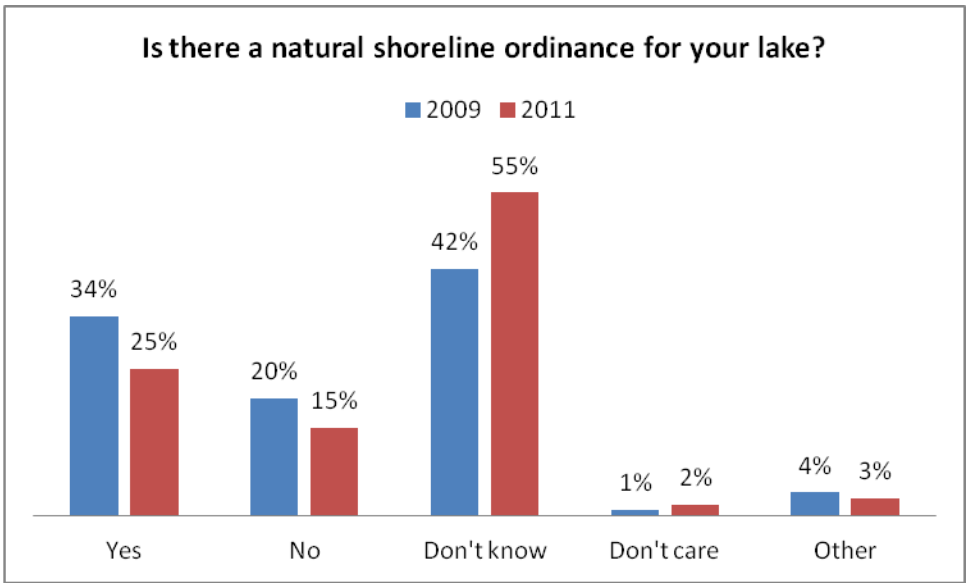


	Good for wildlife	Fosters algae	Attracts geese	Aids clean water	Aids fishing	Aids bugs	Aids erosion	Not beneficial
Agree	98.00%	5%	19%	87%	72%	45%	6%	7%
Disagree	1%	65%	54%	3%	3%	23%	87%	84%
Don't know	1%	30%	27%	10%	25%	32%	6%	10%

Comparing these first and second-round data sets shows modest gains in knowledge between 2009 and 2011 about the characteristics and functions of natural shoreland buffers. Of the highest-frequency responses, there was a 1.8% increase for "Good for wildlife;" "Contributes to clean water" (+5.5%); and "Harbors ticks and mosquitoes" (-22.7%). There was a 3% decline in those disagreeing with the option "Contributes to shoreline erosion;" and a 3% decline in those disagreeing with the statement "It is not beneficial." The only variable that moved slightly in the wrong direction was "Contributes to algae in the water" (+.6%).

Most respondents were unclear about **shoreline ordinances** in 2009 and 2011, and did not know that Itasca County requires that shorelines be left in a largely natural state. Forty-two percent of shoreland owners were unaware of the shoreline buffer ordinance, while thirty-four percent responded that they were aware of an ordinance. Of those that did know of the existence of an ordinance, none could correctly identify the requirements for Natural Environment (NE), General Development (GD) or Recreational Development (RD) lakes.

Table 12: Knowledge of Itasca County Shoreland Buffer Ordinance



In 2009, thirty-four percent said that a shoreline ordinance existed for their lake; while in 2011 this number declined somewhat to thirty percent. In 2009 forty-two percent responded "didn't know," and this number increased in 2011 to fifty-two percent. About thirty-five respondents provided vague statements concerning setbacks or minimal cutting. Year-round residents had slightly higher awareness of the ordinance than non-residents (40% v. 31%). The question asked respondents to describe the ordinance, and in 2009 there were 79 comments recorded. Of these, fifteen respondents noted either a 50 foot setback or 50 percent of shoreline; although others referred to various restrictions (no tree cutting; no vegetation removal; docks, etc.) at 20' (seven people); 250' (two people); 100'; 75 feet (1 respondent); 30'; 15'; or 10'.

By 2011, there was much greater uncertainty expressed by respondents, and the percentage replying affirmatively had declined from 34% to 25%. Only twenty-four comments were recorded, and these referred to a 300' setback (one respondent); 150' setback (1 respondent); 100' setback (5 respondents).

When asked what the Itasca County shoreline ordinance is, very few could accurately describe the ordinance in either 2009 or 2011. Respondents continue to express considerable uncertainty about the existence of shoreland ordinances, and their content. This suggests that the Itasca County shoreland ordinance is not familiar or understood by many people and that future educational and outreach efforts should focus on this point. There is clearly significant potential for Itasca County to improve public awareness and understanding of its shoreland ordinances, especially for property owners. Itasca County shoreland ordinances are described in the Itasca County Zoning Ordinance (http://www.co.itasca.mn.us/Home/Departments/Environmental%20Services/Documents/Zoning%20Ordinance.pdf). While the ordinance has a number of restrictions on shoreland use and development, the basic setbacks are summarized in the following table (IBID p.32):

Table 13: Itasca County Buffer Ordinance

Lake class	Buffer (distance from OHWL landward in feet)
General development	10
Recreational Development	15
Natural environment	50
Phosphorus-sensitive	50

During the course of project implementation the Itasca NSBI project lead (Blickenderfer) developed a civic engagement and education tool called "The Itasca County Lake Challenge." The tool was designed in 2010 and introduced in the ICOLA newsletter sent to all lake associations, and via email list-serves. It was piloted in 2010 and continued in 2011 during the final months of the NSBI with a small number of participants. Although it has not yet been widely disseminated, the second-round KAP study posed a series of questions asking respondents about the Itasca Lakes Challenge.

Of the 104 respondents in 2011, one quarter (25%) had heard of the Itasca Lakes Challenge, and sixty-six had not. Nine percent were unsure. Of those that had heard of the Challenge, fifteen (65%) had learned about it from their lake association; three (13%) had heard about it from a neighbor; one person had heard about it on the radio, and five individuals had read about it in the

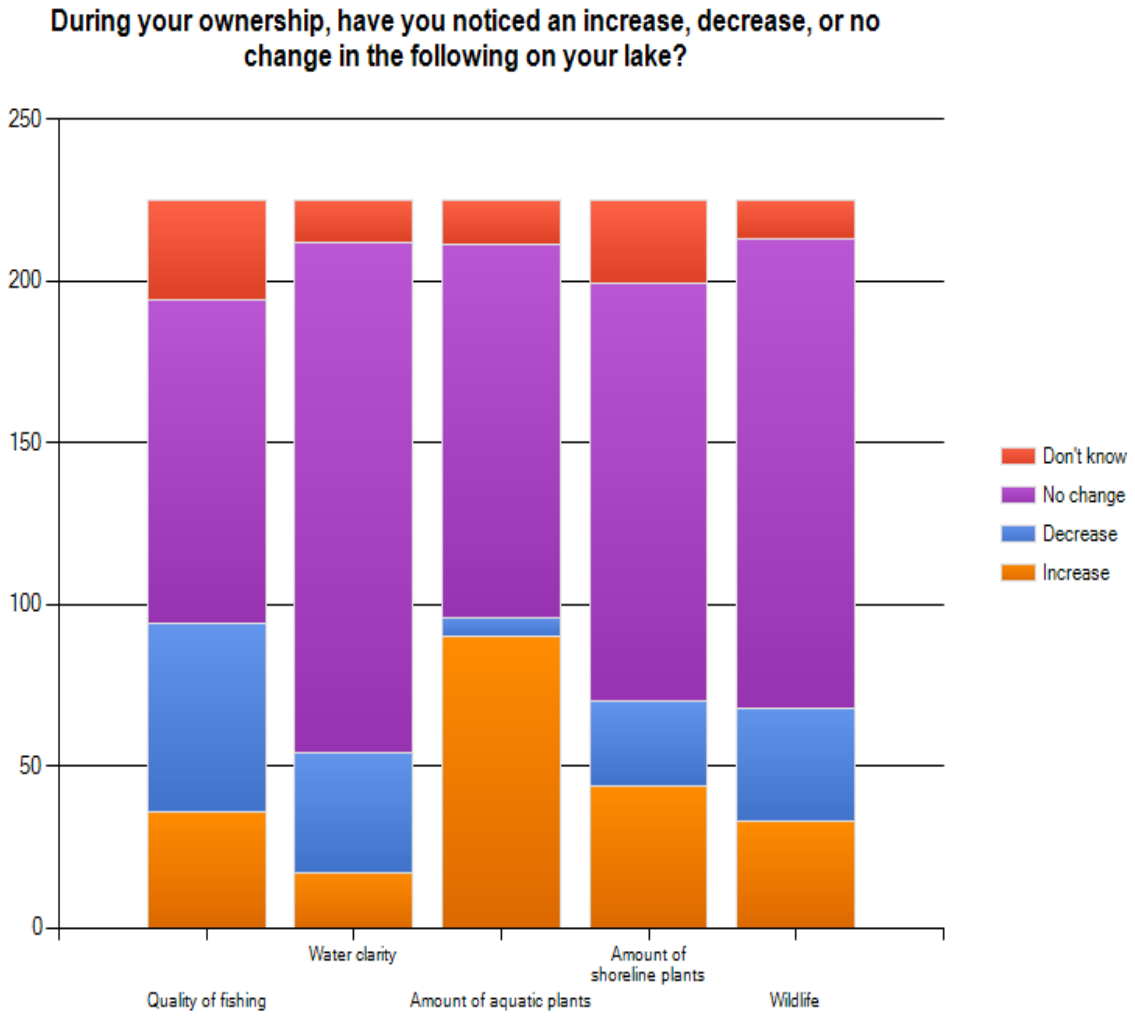
newspaper. Of those that had heard about the Challenge, eight had participated in the Itasca County Lake Challenge, fifty percent had not, while nineteen percent were not certain.

- Eighty-five percent of respondents stated that they would have engaged in lake and wildlife-friendly activities without the Lake Challenge; while fifteen percent replied in the affirmative. These results suggest that the high stewardship ethic noted in 2009 was possibly a motivating factor for the majority, but that the Itasca County Lake Challenge helped to motivate a smaller minority to take individual action on their properties. Seventy-eight percent of those participating in the Challenge would recommend it to friends or neighbors; while seventeen percent were not sure and three individuals responded negatively. For those who chose not to participate, a constraints question was posed. Sixty-two percent said that they already engaged in healthy lakeshore practices. Five individuals said that they liked the shoreline as it is and didn't want to change it. One respondent thought that it might take too much time, and another reported having physical limitations. Finally, respondents were asked if they might take the Challenge in the future. Fifty-three percent replied positively, while seventeen percent said no. Thirty percent were unsure.

Attitudes findings

Shoreland property owners were asked in 2009 about their **perceptions of change on the five lakes**. Results are shown in the following table.

Table 14: Perceptions of Change



Most respondents did not perceive significant changes over time on the condition of their lake. The majority of responded reported no change in the quality of fishing, water clarity, amount of aquatic and shoreline plants, and wildlife. Forty percent reported an increase in aquatic plants, and twenty percent noticed an increase in shoreline plants. A minority (26%) noted a decline in fishing quality. This question was not repeated in 2011.

Several questions about **shoreland preferences** were posed to respondents. Photos of a typical natural shoreline, a replanted shoreline, and a lawn shoreline were shown to respondents. In 2009, sixty-three percent disliked the general appearance of lawns, and the majority (84%) preferred the appearance of a natural shoreline**.** Seventy-six percent disliked the lack of privacy

that turf landscapes provide. Sixty-four percent, however, liked the access to the lake that lawns provide; while thirty-nine percent liked the view that lawns provide. Fifty-three percent liked the enjoyment of the lake that lawns provide. The following table summarizes the 2009 results. The highest ranked response for each category is in bold font.

Table 15: Preferences for Shoreline Characteristics (2009)

I'm going to show you three photos of different kinds of shorelines. Tell me whether you like or dislike the following characteristics of each.

Lawn shoreline

	Like	Dislike	Neutral/Don't know	Response Count
General appearance	24.7% (55)	**62.8% (140)**	12.6% (28)	223
View from house	39.4% (87)	**51.6% (114)**	9.0% (20)	221
Privacy	10.9% (24)	**75.5% (166)**	13.6% (30)	220
Lake access	**63.8% (141)**	22.2% (49)	14.0% (31)	221
Potential maintenance associated with this shoreline	15.8% (35)	**70.3% (156)**	14.0% (31)	222
Use of the shoreline for enjoyment	**53.4% (117)**	30.6% (67)	16.0% (35)	219

Replanted shoreline

	Like	Dislike	Neutral/Don't know	Response Count
General appearance	**72.5% (161)**	19.4% (43)	8.1% (18)	222
View from house	**68.3% (151)**	17.2% (38)	14.5% (32)	221
Privacy	**45.5% (100)**	23.6% (52)	30.9% (68)	220
Lake access	**56.1% (124)**	23.1% (51)	20.8% (46)	221
Potential maintenance associated with this shoreline	40.7% (90)	**44.3% (98)**	14.9% (33)	221

Use of the shoreline for enjoyment	**49.8% (109)**	29.2% (64)	21.0% (46)	219

Natural shoreline

	Like	Dislike	Neutral/Don't know	Response Count
General appearance	**83.9% (187)**	9.4% (21)	6.7% (15)	223
View from house	**84.8% (189)**	9.4% (21)	5.8% (13)	223
Privacy	**80.6% (179)**	7.7% (17)	11.7% (26)	222
Lake access	**80.3% (179)**	13.9% (31)	5.8% (13)	223
Potential maintenance associated with this shoreline	**80.2% (178)**	10.4% (23)	9.5% (21)	222
Use of the shoreline for enjoyment	**70.5% (155)**	20.5% (45)	9.1% (20)	220

For the lawn shoreline, sixty-three percent disliked the general appearance, seventy-six percent disliked the degree of privacy provided, and seventy percent disliked the potential maintenance associated with lawns. This shoreline was rated positively for lake access by sixty-four percent, and for use of the shoreline for enjoyment (fifty-three percent).

Concerning landscaping preferences, in 2009 a majority preferred the appearance and functions of a natural shoreline. Eighty-six percent liked the general appearance of a natural shoreline. Eighty-seven percent liked the view; eighty-one percent liked the privacy; and eighty-three percent liked the shoreline access. Eighty-one percent liked the maintenance associated with a natural shoreline; and seventy-three percent liked the use of the lake that it affords.

For replanted shoreline landscaping, in 2009 seventy-three percent liked the general appearance; sixty-eight percent liked the view; forty-six percent liked the privacy of a replanted shoreline; and fifty-six percent liked the access afforded. Fifty percent liked the use of the shoreline for enjoyment with this landscaping treatment. Forty-four percent disliked the maintenance of a replanted shoreline.

The same question (with photographs) was posed to respondents in 2011. Responses are tabulated in the table below. The highest ranked response for each category is in bold font.

Table 16: Preferences for Shoreline Characteristics (2011)

Below are three photos of different kinds of shorelines. Please indicate whether you like, dislike, or are neutral towards the following characteristics.

Lawn shoreline

	Like	Dislike	Neutral/Don't know	Response Count
General appearance	23.4% (22)	**55.3% (52)**	21.3% (20)	94
View from house	**43.0% (40)**	41.9% (39)	15.1% (14)	93
Privacy	14.3% (13)	**68.1% (62)**	17.6% (16)	91
Lake access	**64.5% (60)**	22.6% (21)	12.9% (12)	93
Potential maintenance associated with this shoreline	8.6% (8)	**75.3% (70)**	16.1% (15)	93
Use of the shoreline for enjoyment	**50.5% (47)**	26.9% (25)	22.6% (21)	93

Replanted shoreline

	Like	Dislike	Neutral/Don't know	Response Count
General appearance	**75.3% (70)**	18.3% (17)	6.5% (6)	93
View from house	**69.9% (65)**	18.3% (17)	11.8% (11)	93
Privacy	**34.4% (32)**	31.2% (29)	34.4% (32)	93
Lake access	**48.4% (45)**	22.6% (21)	29.0% (27)	93
Potential maintenance associated with this shoreline	30.1% (28)	**53.8% (50)**	16.1% (15)	93
Use of the shoreline for enjoyment	**46.2% (42)**	23.1% (21)	30.8% (28)	91

Natural shoreline

	Like	Dislike	Neutral/Don't know	Response Count
General appearance	**83.5% (76)**	8.8% (8)	7.7% (7)	91
View from	**82.8% (77)**	10.8% (10)	6.5% (6)	93

house				
Privacy	**66.7% (62)**	11.8% (11)	21.5% (20)	93
Lake access	**73.1% (68)**	11.8% (11)	15.1% (14)	93
Potential maintenance associated with this shoreline	**80.6% (75)**	8.6% (8)	10.8% (10)	93
Use of the shoreline for enjoyment	**70.0% (63)**	14.4% (13)	15.6% (14)	90

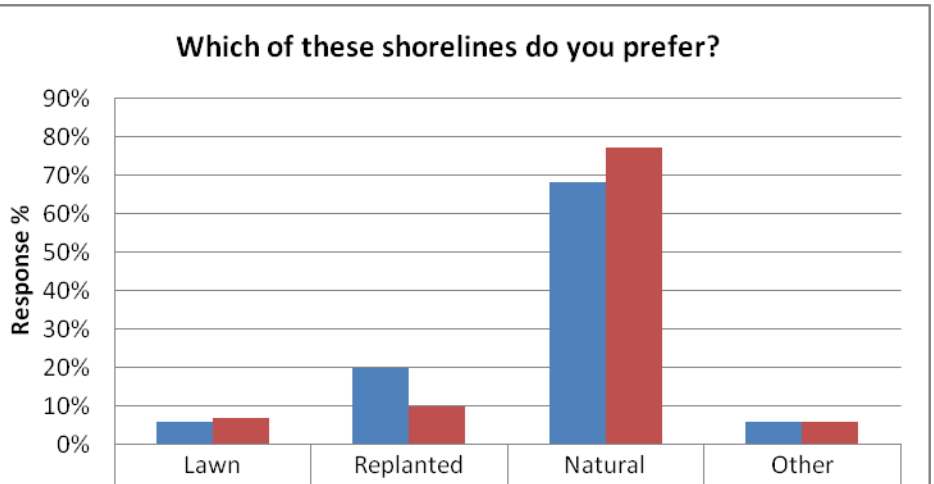
When comparing the 2009 and 2011 highest-ranked responses for each category, the clearest trend is the modest decline in preference for a lawn shoreline. "General appearance" for lawn shorelines declined by 7.5%; "View from the house" declined by 8.6%; "Privacy" declined by 7.4%; and "Use of the shoreline for enjoyment" declined by 2.9%. Dislike for potential maintenance increased by 5%. The only value that moved in a positive direction was "Lake access," which increased by .7%.

For the replanted shoreline, comparative results are mixed. Respondent attitudes increased for the following factors: "General appearance" (+2.8%) and "View from house" (+1.6%). However, there were declines in "Privacy" (-11.1%); "Lake access" (-7.7%); and "Use of the shoreline for enjoyment" (-3.6%). There was a 9.5% increase in "Dislike" of potential maintenance associated with this shoreline.

Despite the increased dislike in 2011 for the lawn shoreline, there is not a corresponding preference for natural shorelines expressed in this ranked question. Liking for the general appearance of a natural shoreline declined slightly (-.4%); as did "View from the house" (-.2%); "Privacy" (-13.9%); "Lake access" (-7.2%); and "Use of the shoreline for enjoyment" (-.5%). The only "Like" factor to increase was "Potential maintenance associated with this shoreline" (+.4%).

A follow-up question was posed about **shoreline preferences** in both surveys, asking which shoreline the respondent preferred overall. The following results were obtained:

Table 17: Shoreline Preferences



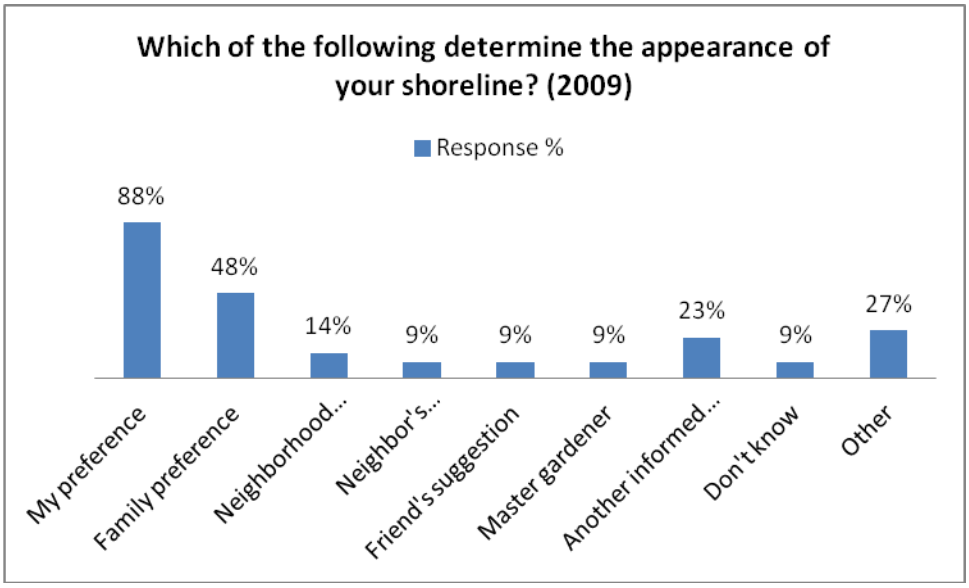
	Lawn	Replanted	Natural	Other
2009	6%	20%	68%	6%
2011	7%	10%	77%	6%

Sixty-eight percent preferred a natural shoreline in 2009; twenty percent preferred a replanted shoreline; six percent preferred a lawn; and six percent reported "Other." Of these, more "weekenders" than permanent residents preferred a natural shoreline. This challenges the conventional belief that "weekenders" want their properties to look like their yards in the city. In 2011, there was stronger preference expressed for the natural shoreline (77%); followed by the replanted shoreline (10%). "Lawn" and "Other" preferences were 7% and 6% respectively.

Respondents were asked the same question posed in 2009 about their preferences of shoreline appearance. By 2011 these values shifted generally in a positive direction, as was hoped. In 2009, six percent of respondents preferred a lawn shoreline, and in 2011 seven percent did so. About twenty percent preferred a replanted shoreline in 2009. This number dropped to nine percent in 2011. In 2009 sixty-eight percent preferred a natural shoreline, and this number increased to seventy-eight percent in 2011.

A question was posed in the 2009 survey on **determinants of the appearance of the respondent's shoreline.** Results are summarized as follows:

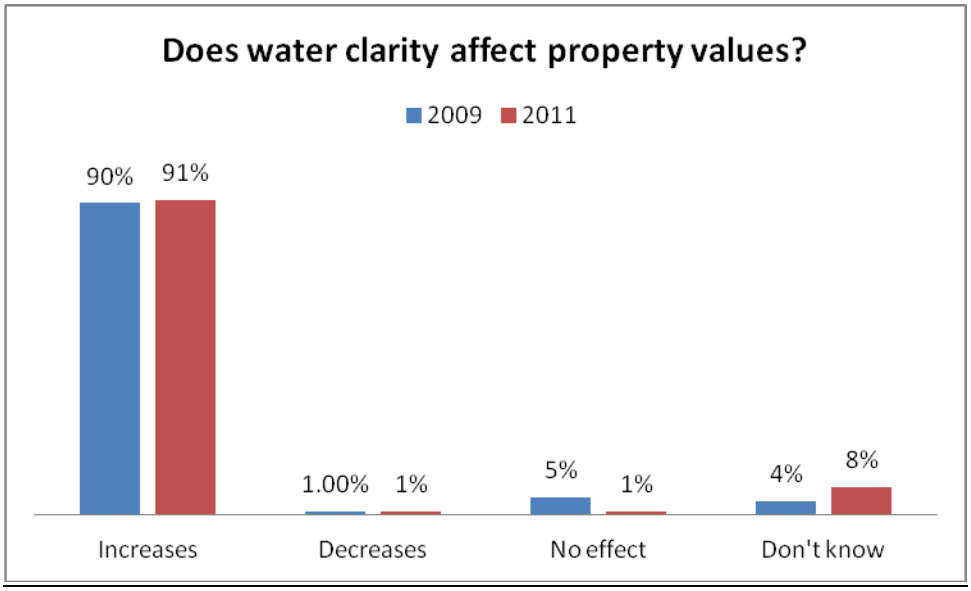
Table 18: Determinants of Shoreline Appearance



Most respondents (88%) reported that their own personal preferences determined how their property looks, and about half (48%) indicated that family preferences also play a role. Nearly two thirds commenting on the question (of which 27% did) indicated that local ordinances or DNR rules played a role in determining how their property looked as well. This is an interesting finding given the widespread lack of understanding about the Itasca County shoreland ordinance. Other informed people influenced some property owners (23%) while neighborhood trends (14%) and suggestions from neighbors (9%), friends (9%) or Master Gardeners (9%) seemed to have less influence. This question was not repeated in the 2011 survey.

Respondents were asked their opinion about whether water quality affects **property values**. The table below compares the 2009 and 2011 values.

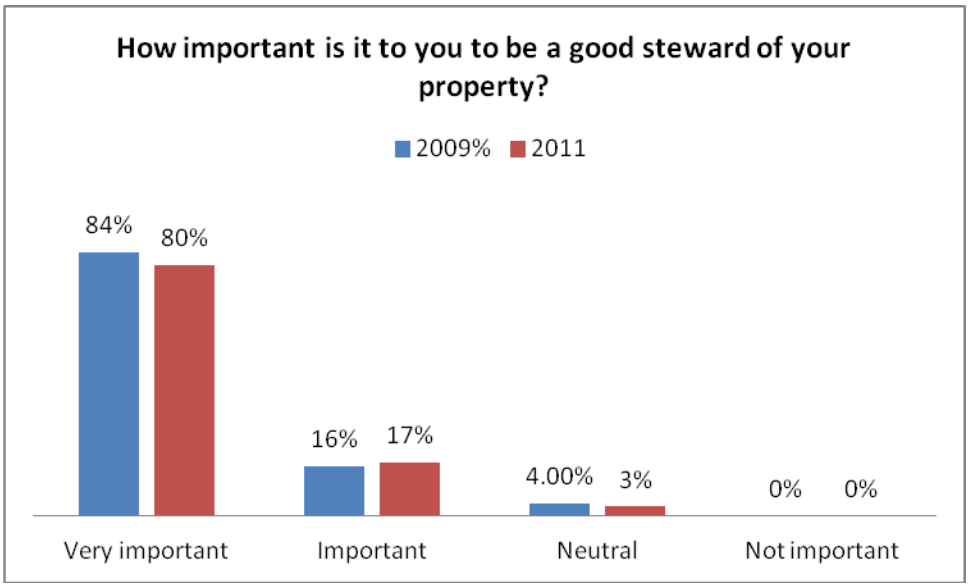
Table 19: Water Clarity and Property Values



A significant majority (90%) felt that water clarity positively affects property values in 2009. Five percent felt that water clarity did not affect property values; while none felt that water clarity inversely affects property values. Four percent did not know. The strong perception that water clarity affects property values was almost unchanged from the 2009 survey**.** Ninety one percent felt that water clarity increases property values, compared with 90% in 2009. Only one respondent felt that water clarity does not affect property values in the second-round survey, compared with twelve people in 2009. Seven percent in 2011 did not know, compared with eleven in 2009. While values did not shift significantly for this question, there were fewer saying that water clarity had no effect; and a slightly higher degree of uncertainty expressed in the 2011 survey.

Respondents were asked in both surveys about **stewardship of their property**. Results are shown in the table below:

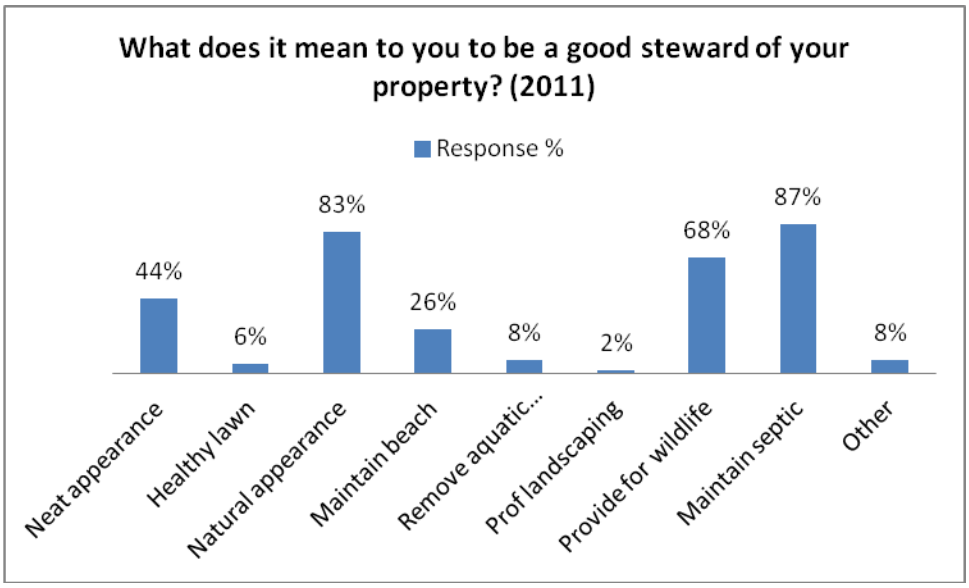
Table 20: Importance of Stewardship



Eighty-percent reported in 2011 that it is very important for them to be a good steward of their property (compared with eighty-four percent in 2009) and another seventeen percent said that it was important (compared with sixteen percent in 2009**).** A strong stewardship ethic was expressed by almost 99% of respondents in total. This value was shared by permanent residents and "weekender" alike. Only one individual reported being neutral, and no one said that it is not important. There were numerous written comments that underscored the importance of environmental stewardship to the respondents. The strong stewardship ethic voiced by shoreland property owners is an important core value upon which to build a shoreland conservation strategy.

A follow-up question was asked about the **meaning of stewardship**. Results are as follows:

Table 21: Meaning of Stewardship

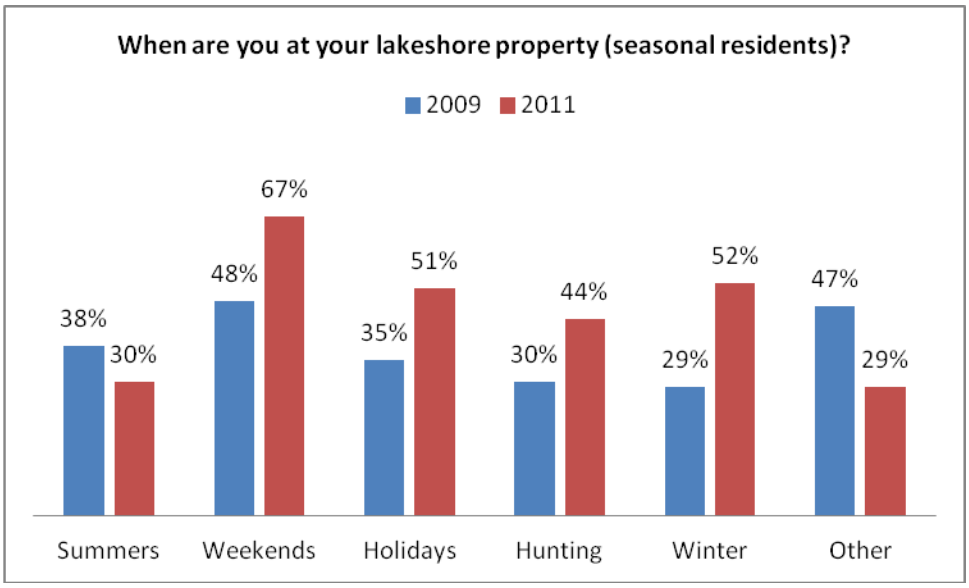


- The most frequently reported response was "Check and maintain my septic system regularly" (87%); followed by "Maintain a natural appearance" (83%) and "Provide wildlife with food and shelter" (68%); "Maintain a neat appearance (mowed and trimmed)" (44%); "Maintain the beach area" (26%); "Remove plants in the water" (8%); "Other" (8%); "Maintain a healthy lawn" (6%); and "Have my property landscaped by a professional (2%). This question was not asked in the 2009 survey. The "take-home" message from these findings is that environmental stewardship has the potential to be a significant driver of behavior.

Practices findings

Two practices questions aimed at establishing whether respondents were **full-time or seasonal residents**. In 2009, 32% were full-time residents, and 68% were not. In 2011, full-time residents increased to 35%, and 65% were not. For those who were not full-time residents, a follow-up question asked when they are at their lakeshore property. Results are summarized in Table 22 below.

Table 22: Amount of Time Spent At Shoreland Property

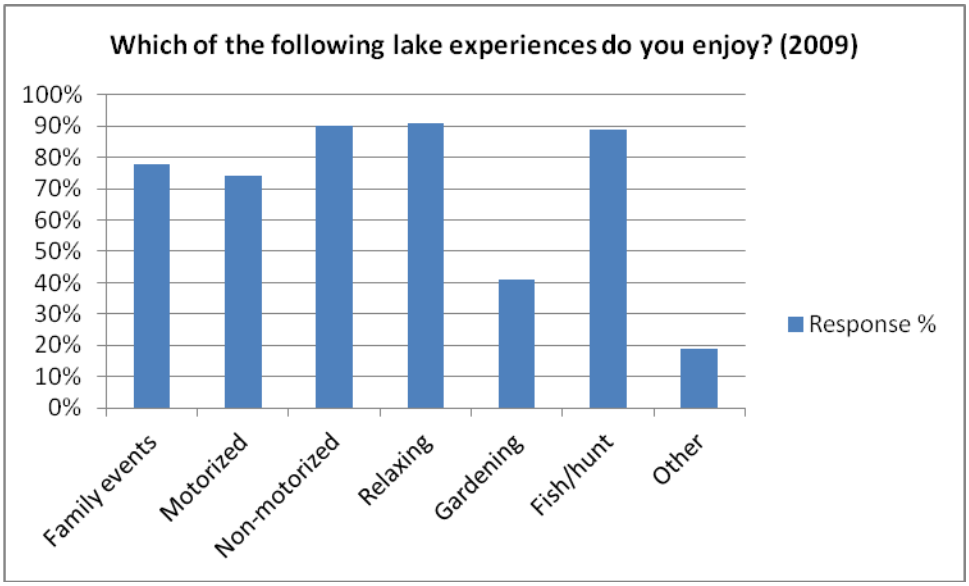


As noted, the majority of property owners in 2009 were weekenders (67%), and thirty-two percent were year-round residents. About half (48%) of nonresidents were at their property on weekends. Twenty-nine percent were there in winter; 38% during the entire summer; thirty percent during hunting season; and 35% on holidays. In 2011 sixty-seven percent report spending weekends at their shoreland property, while thirty percent spent "all summer." Fifty-one percent spend holidays at their property, and fifty-two percent make winter visits. Forty-four percent are at their property during hunting season.

💧 Seasonal respondents appear to spend somewhat less time on their property "all summer," and somewhat more time on holidays and weekends. Weekends during the summer are the best time for contacting property owners.

In 2009, a question was posed about **enjoyment of lake experiences**. The following results were obtained:

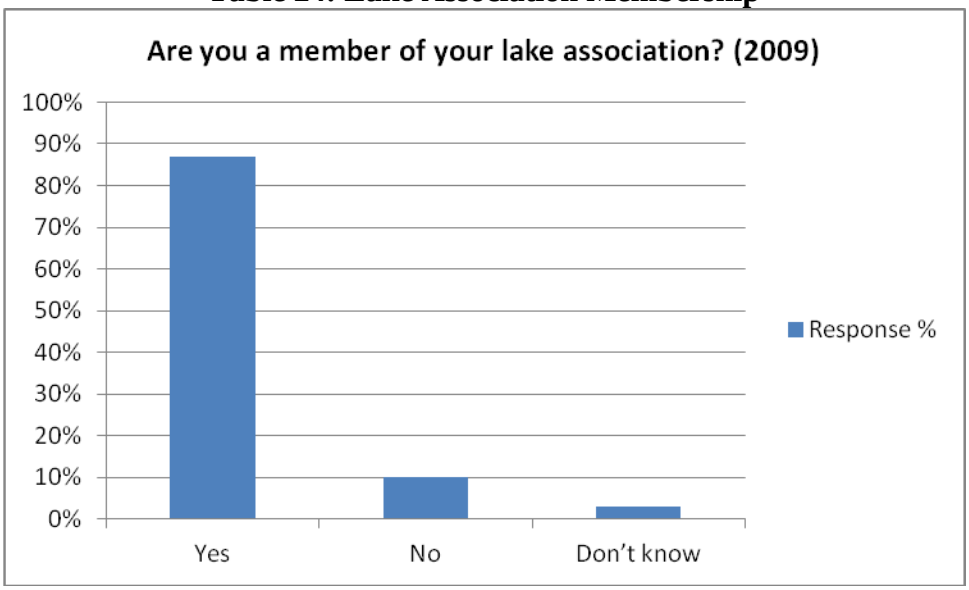
Table 23: Enjoyment of Lake Experiences



The majority of residents routinely used their properties for either active or passive activities. Many shoreland owners reported relaxing, engaging in non-motorized activities, and fishing/hunting/trapping (all near 90%) as their preferred activities. To a lesser extent they enjoyed socializing and participating in motorized recreation (near 75%). About 40% reported engaging in yard and garden care at their lake property. This question was not repeated in 2011.

Respondents were asked if they are a **member of their lake association**. Results are summarized Table 24 below.

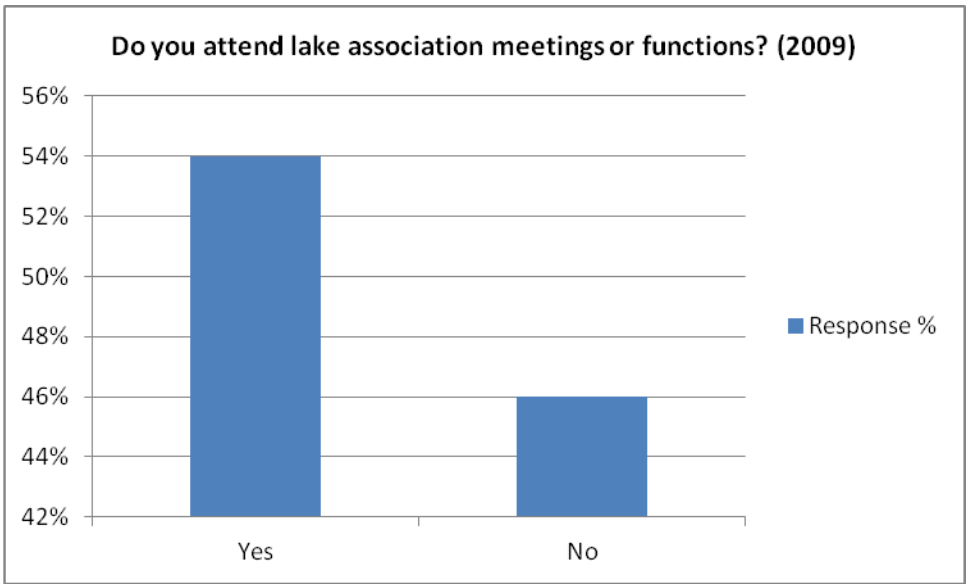
Table 24: Lake Association Membership



The great majority of respondents are lake association members. Eighty-seven percent said "Yes," while ten percent said "No." Three percent were unsure. This question was not repeated in 2011.

A follow-up question was posed asked about **attendance at lake association meetings** or functions. Results are in the table below:

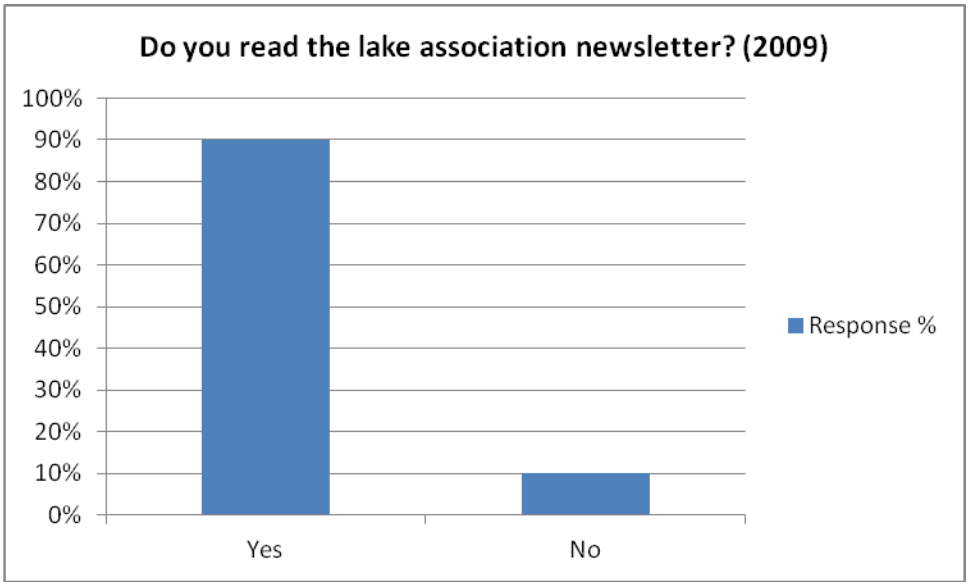
Table 25: Attendance at Lake Association Functions



- Fifty-four percent replied "Yes," and forty-six percent responded "No." While 87% of respondents are association members, only 54% attend association meetings.

A follow-up question was posed in 2009 whether respondents read the **lake association newsletter**, yielding the following results:

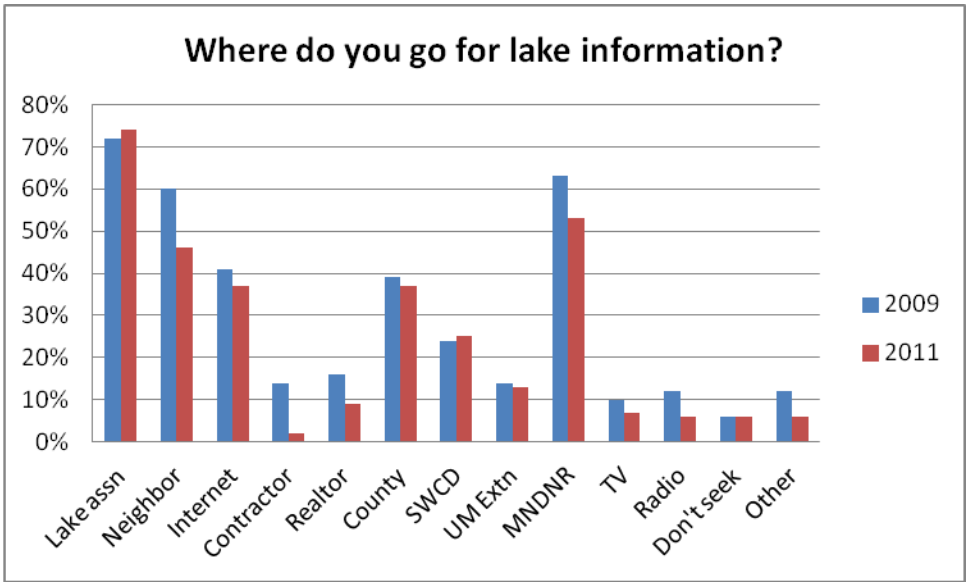
Table 26: Lake Association Newsletter



- Ninety-percent responded "Yes" and ten percent replied "No." This question was not repeated in 2011. This indicates that while only 54% of respondents attend meetings, 90% read the newsletter. High readership levels suggest that lake association newsletters are a useful vehicle for disseminating information about shoreline conservation.

Respondents were asked about their **most important sources of information** about their lake. Results are presented in Table 27 below.

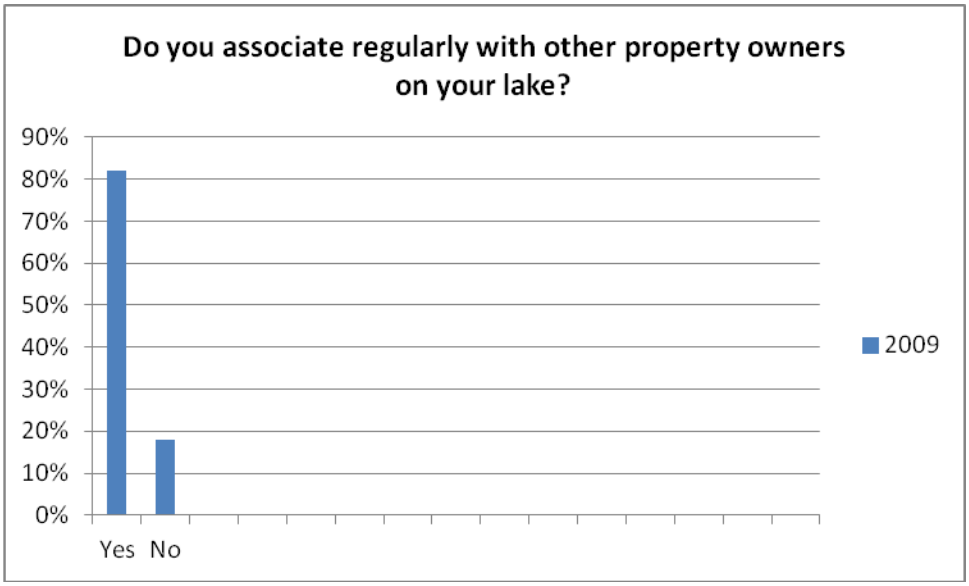
Table 27: Sources of Lake Information



Lake associations continue to be the most important sources of information for 74% of property owners. This value was almost unchanged from 2009 (73%). However, the importance of neighbors as a source of information declined from sixty percent in 2009 to forty-six percent in 2011. The Internet declined from forty-one percent in 2009 to thirty-seven percent in 2011; and local contractors declined in importance from fourteen percent in 2009 to two percent in 2011. Realtors declined from sixteen percent in 2009 to nine percent in 2011. Itasca County declined slightly from thirty-nine percent in 2009 to thirty-seven percent in 2011. The Itasca SWCD very slightly increased from twenty-four percent in 2009 to twenty-five percent in 2011; as did UM Extension (fourteen percent in 2009 to thirteen percent in 2011). The DNR also decreased from sixty-three percent in 2009 to fifty-three percent in 2011. In 2009 about ten percent sought information on television but this declined to seven percent in 2011. Radio also declined from twelve percent in 2009 to six percent in 2011. About the same number reported that they don't seek information (six percent in both surveys). Lake associations are the most sought-after sources of information about the lake, and are key entry points and conduits for working with shoreland property owners.

Respondents were then asked whether they **socialize with other property owners** regularly on their lake. This question was posed only in 2009, and yielded the following results:

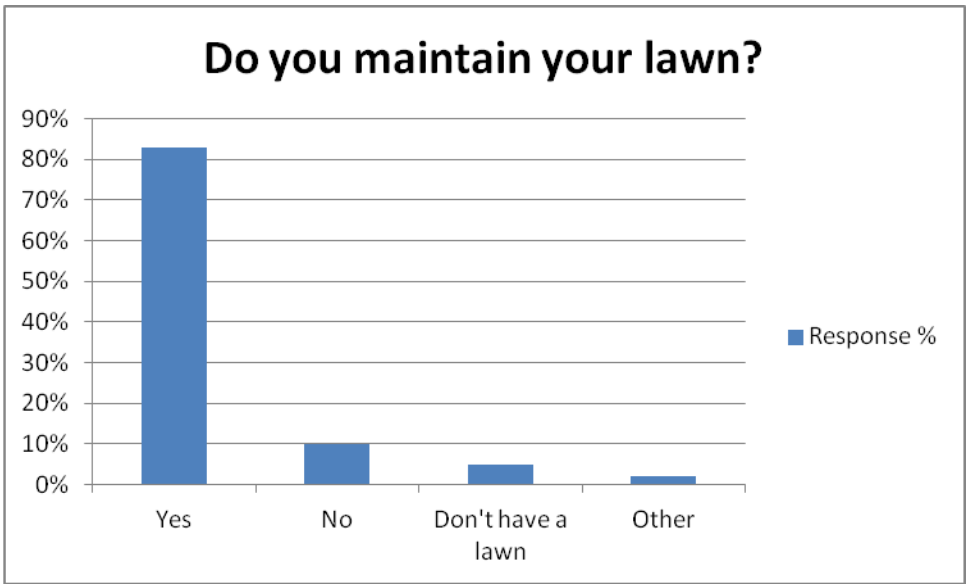
Table 28: Socialization among Property Owners



Eighty-two percent replied "Yes" in 2009, while eighteen responded "No." This indicates a fairly high degree of socialization among lakeshore property owners, and may present an opportunity for peer-to-peer communication and networking. This question was not repeated in 2011.

A series of questions were posed in the first-round (2009) survey about l**awn and yard care practices**. The first question asked respondents if they maintain a lawn:

Table 29: Lawn Maintenance

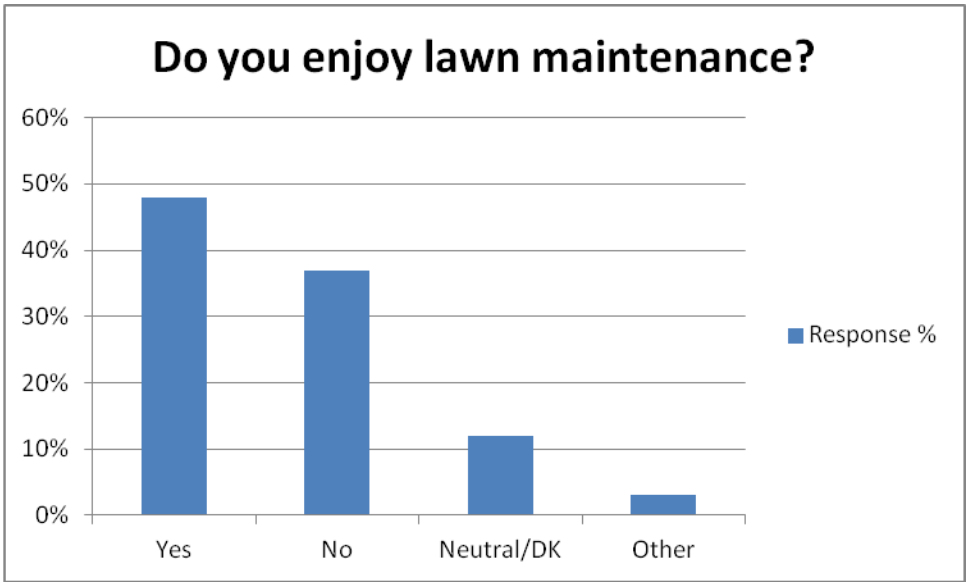


Most respondents maintained their own lawn (83%); ten percent do not maintain a lawn; and 5% reported not having a lawn. 2.2% reported "Other." This question was not repeated in 2011.

For those checking "No" on the above question, respondents were asked "Who maintains your lawn?" Eight percent reported using a landscape professional, and ninety-two percent replied "Other."

A follow-up question asked about **enjoyment of lawn care**. Results are summarized in Table 30 below:

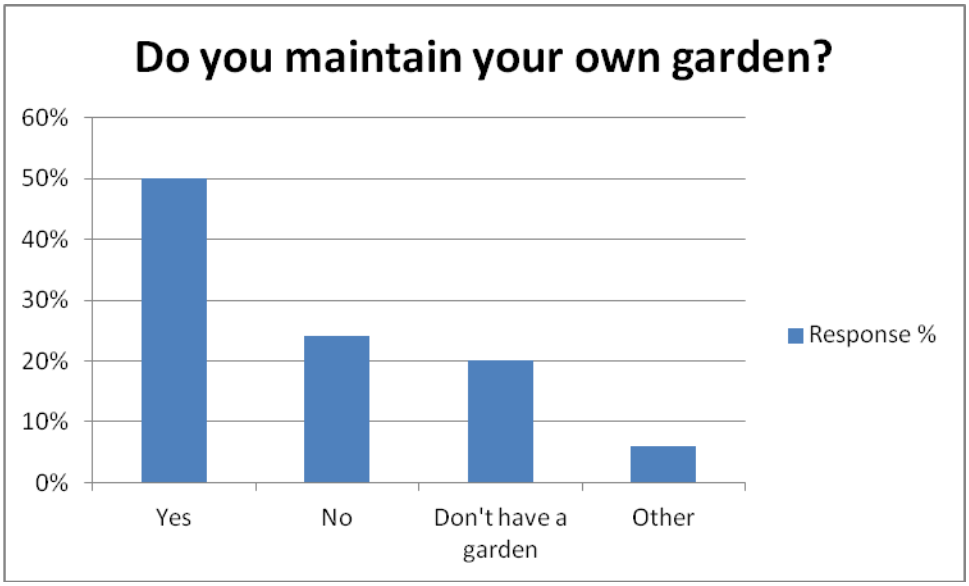
Table 30: Lawn Care Enjoyment



About half (48%) responded affirmatively; while 37% replied "No." Twelve percent replied "Neutral/Don't know" and three percent responded "Other." This question was not included in the 2011 survey. Year-round residents reported a higher level of enjoyment with maintaining a lawn (Q24, 53.9%; Q6, 61.6%) than seasonal residents (Q24, 45%; Q6, 31%). Year-round residents were more likely to maintain their own lawns (Q23, 96%) than seasonal residents (Q 23, 76%). This question was not repeated in 2011.

Respondents were next asked if they **maintain a garden** (2009). The following results were obtained:

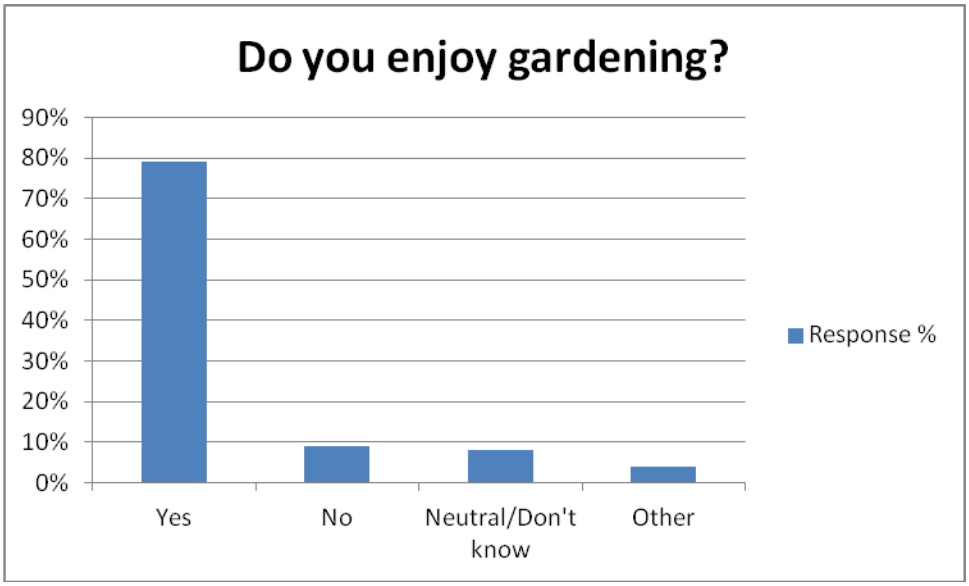
Table 31: Garden Maintenance



Fifty percent responded "Yes;" twenty-four percent replied "No;" twenty percent replied "I don't have a garden;" and six percent responded "Other." This question was not repeated in the 2011 survey.

A follow-on question asked "Do you **enjoy gardening**?" The following table summarizes the 2009 responses:

Table 32: Gardening Enjoyment

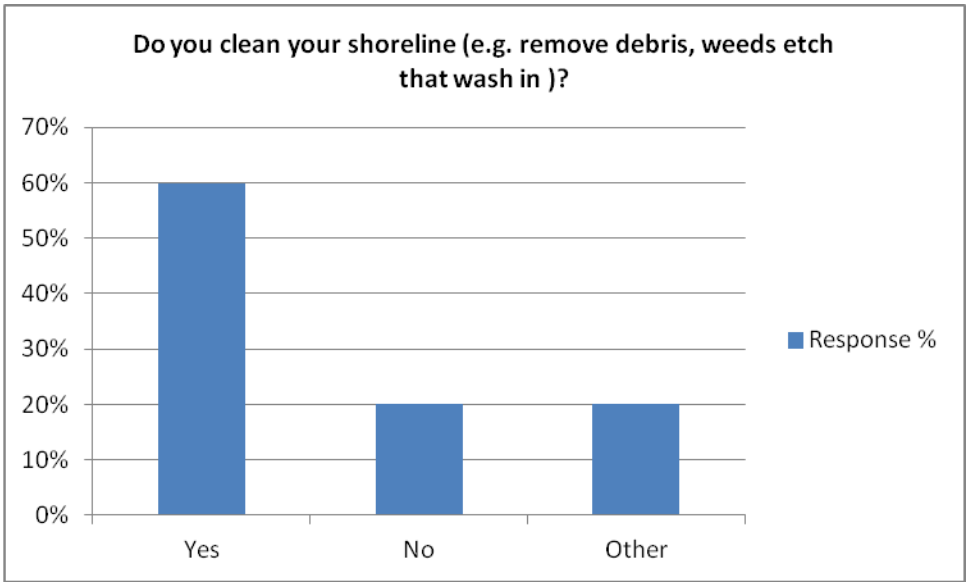


Seventy-nine percent responded “Yes;” nine percent said “No;” eight percent said “Neutral/Don’t know:’ and four percent said “Other.” This question was not repeated in 2011.

In sum, about half of respondents maintain a garden, and of those, about 80% enjoy gardening.

Respondents were then asked if they **clean their shoreline** (e.g. remove debris, weeds etc. that wash in). The following 2009 results were obtained:

Table 33: Shoreline Cleaning

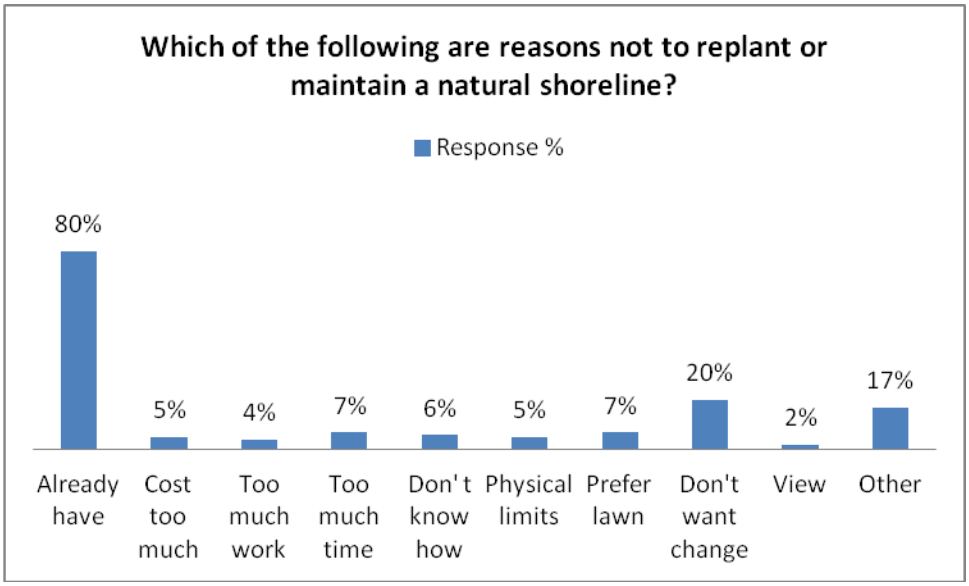


Sixty percent of respondents report cleaning their shoreline**.** Twenty percent do not clean their shoreline, and another twenty percent checked “other.” This question was not repeated in 2011.

Constraints findings

In the 2009 survey a series of questions were posed that explored possible constraints and barriers to shoreline adoption. The first question aimed at exploring the **reasons that respondents might not want a natural shoreline**. This was a check-all-that-apply question. The following results were obtained:

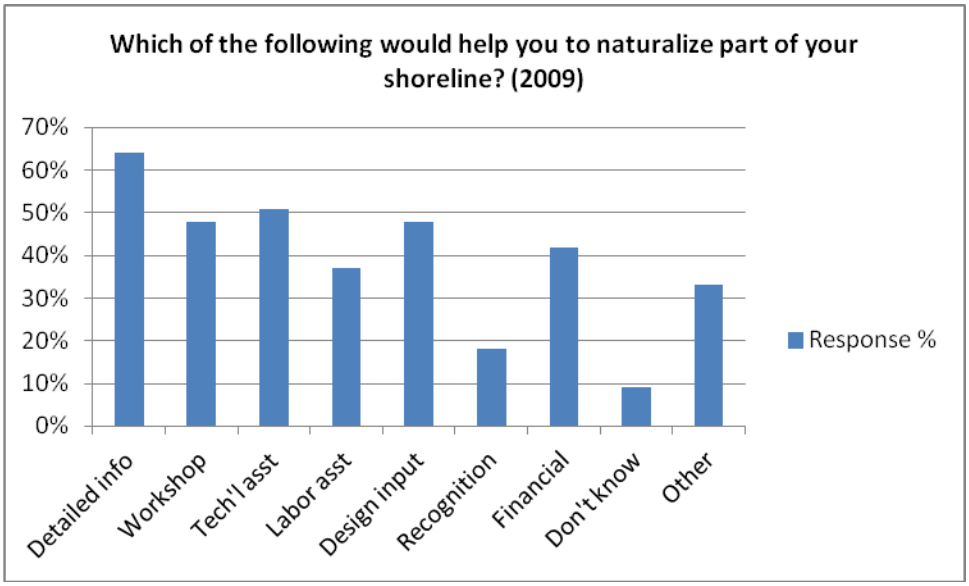
Table 34: Reasons Not to Maintain a Natural Shoreline



Of the reasons NOT to have a natural shoreline, there were few major insurmountable constraints reported except for a reluctance to change that was expressed by one-fifth of the respondents. Indeed, eighty percent reported that they already have a natural shoreline. For those reporting negative reasons, seven percent felt that it would take too much time. Five percent felt that it might cost too much, while another four percent felt that it might be too much work. Six percent did not know where to start. Five percent reported that they had physical limitations. Seven percent reported that they liked the look of a mowed yard. Two percent felt that a natural shoreline might limit their view of the lake. Twenty percent reported that they liked shore as is and didn't want to change. Seventeen percent gave a range of "other" answers. This question was not repeated in 2011.

A follow-up question was asked about **enabling mechanisms** ("Which of the following would help you to naturalize part of your shoreline?"). The following results were obtained:

Table 35: Incentive Preferences



Results helped the Itasca County partners to focus education, outreach and incentives strategies for the Itasca County NSBI. The most frequently checked option was "Detailed information and instructions on naturalizing my shoreline" (64%); followed by "Technical assistance in designing the shoreline and selecting and ordering plants" (51%); a "How-to workshop on design, installation and maintenance of a natural shoreline" (48%); "Having input into the design" (48%); "Financial help" (42%); "Other" (33%); "Recognition as a lake steward" (18%); and "Don't know" (9%).

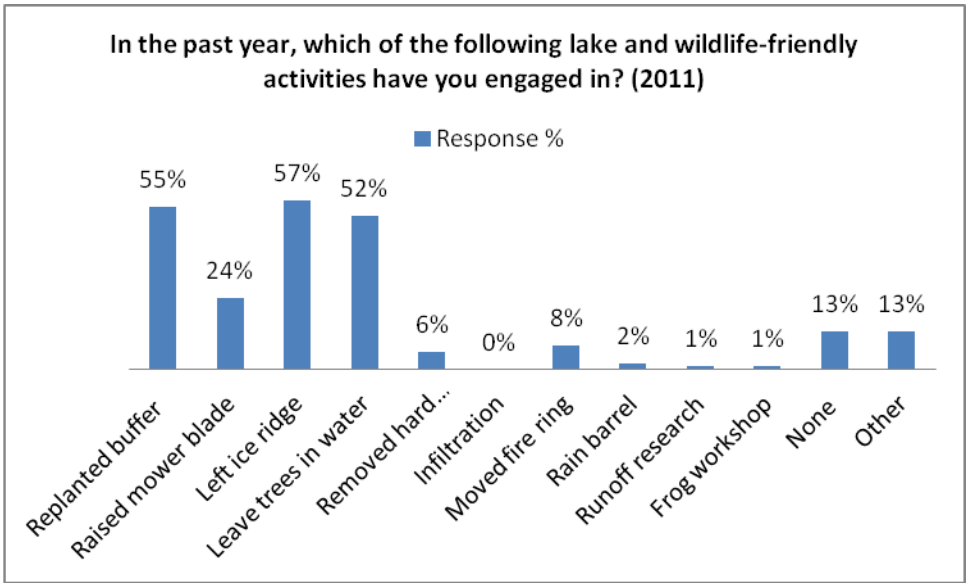
The top three preferences expressed by respondents were all services provided by natural resources educators or professionals. Financial incentives ranked fifth at 42%. Direct "hands-on" technical information from a natural resources professional is more highly valued than financial incentives. Interestingly, few respondents actually adopted a buffer because they were offered a financial incentive, as will be discussed below. This question was not repeated in 2011.

Efficacy questions

In the 2011 KAP study, a series of efficacy questions were posed to learn about the utility and acceptability of the NSBI strategy to project participants, and to determine whether there were positive outcomes as a result of implementation.

A question was asked about which **lake and wildlife-friendly activities** respondents had engaged in, and that were promoted by the NSBI project education and outreach efforts. Results are summarized in Table 36 below.

Table 36: NSBI Engagement



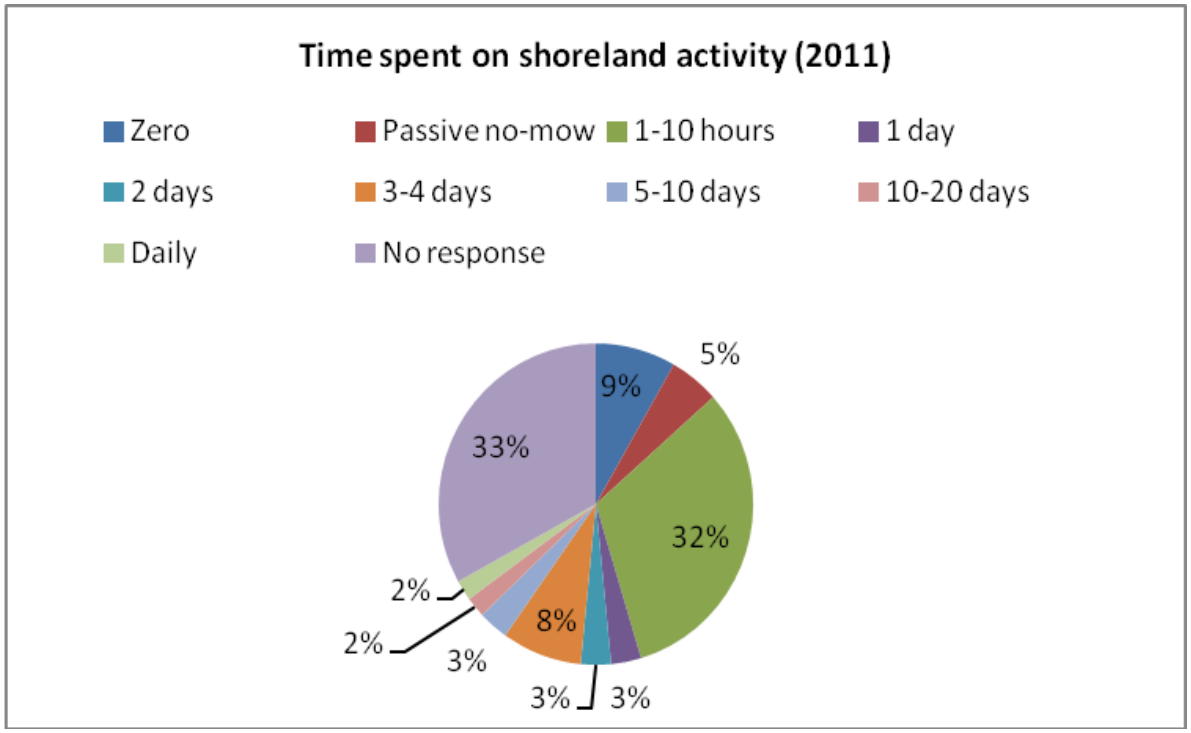
The most frequently reported option was "Left ice ridge in place" (57%; fifty property owners); followed by "Planted shoreland plants or allowed native plants to grow back" (55%; forty-eight property owners); "Let downed trees remain in the water" (52%; forty-six property owners); "Raised the blade on my mower" (24%; twenty-one property owners); "None" (13%; eleven property owners); "Other" (13%; eleven property owners); "Moved the fire ring away from the lake" (8%, or seven property owners); "Moved or removed hard surfaces" (6%. Or five property owners); "Installed a rain barrel or rain garden" (2%, or two property owners); "Conducted runoff research" (1%, one property owner); "Attended a frog workshop" (1%, or one property owner); and "Modified my lake access to redirect or filter rainwater into the soil" (0%).

A follow-up question was asked about how much **time was spent on lake-friendly activities**. Results are summarized in Table 37 below.

Table 37: Time Spent on Shoreland Activity (A)

The frequency table offered no clues into the specific amount of time spent, so a content analysis was done of the comments written on the questionnaires. Results are show in Table 38 below.

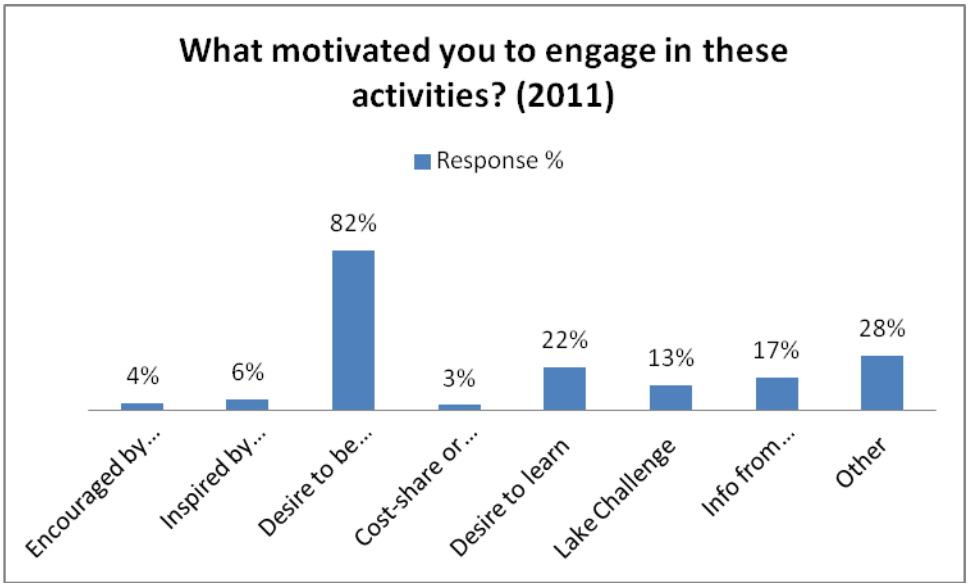
Table 38: Time Spent on Shoreland Activity (B)



Many of property owners (33%) did not respond to this question. Of those that did, thirty-two percent spent one to ten hours on their activity during the 2011 season; followed by nine percent who spent no time; eight percent who spent three to four days; and another five percent who passively allowed their shoreline to naturalize (no-mow). Smaller numbers of respondents mentioned other, longer periods of time. The majority, however, spent less than four days maintaining their shoreland activity.

A critical question in the 2011 KAP study investigated the **motivational factors behind adoption** of a recommended BMP. Responses are summarized in the table below:

Table 39: Motivating Factors

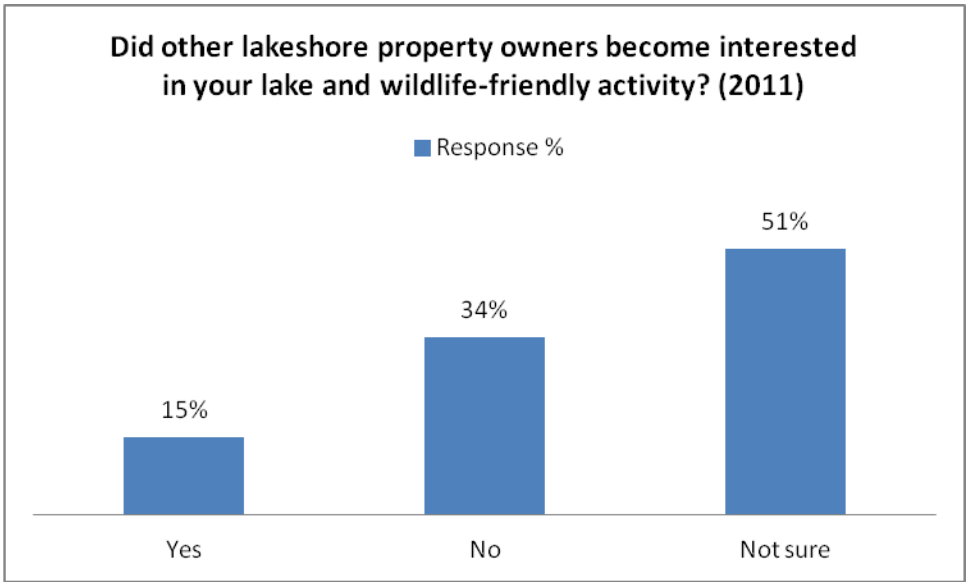


Clearly, the most important factor was "Desire to be a good steward of the lake and wildlife" (82%). This was followed by "Other" (28%); "Desire to learn more about the lake and wildlife" (22%); "Information provided by another source (17%); "Information provided by the Itasca County Lake Challenge" (13%); "Inspired by a neighbor participating in a lake and wildlife-friendly activity" (6%); "A neighbor encouraged me" (4%); and lastly, "I received a cost share and/or assistance with the activity" (3%). Many of the "Other" handwritten comments reiterated intensions and commitments to be a good steward of their lake.

Interestingly, only 3% reported in 2011 that "Cost-share" motivated them to engage in lake and wildlife-friendly activities, while in 2009 42% reported that "Financial help" would help them to naturalize part of their shoreline. The great majority of respondents (82%) indicate that their stewardship values far outweigh the motivation provided by a financial incentive (3%).

The NSBI team wanted to learn **how shoreland information and activities are spread locally**. A question was therefore posed "Did other lakeshore property owners become interested in your lake and wildlife-friendly activity?" Results are summarized in the table below:

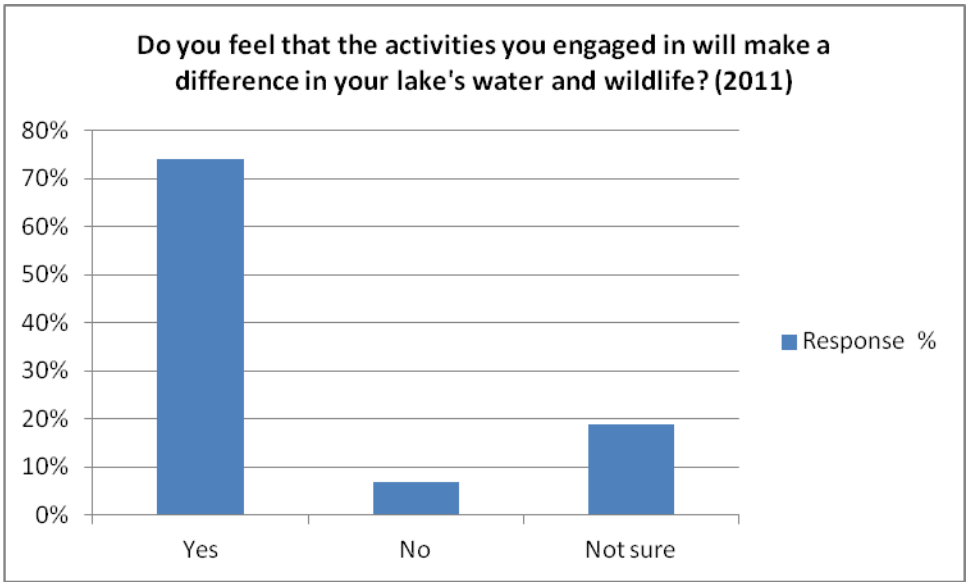
Table 40: Neighbors' Interest in Shoreland Installation



Fifteen percent responded affirmatively, and thirty-four percent responded "No." A slight majority (51%) are not sure. One observation is that too little time has passed for participants to know whether others have become interested in their projects, as the survey took place during buffer installation.

Respondents were then asked about **perceived effectiveness of the adopted practice**. Results are summarized below in Table 41.

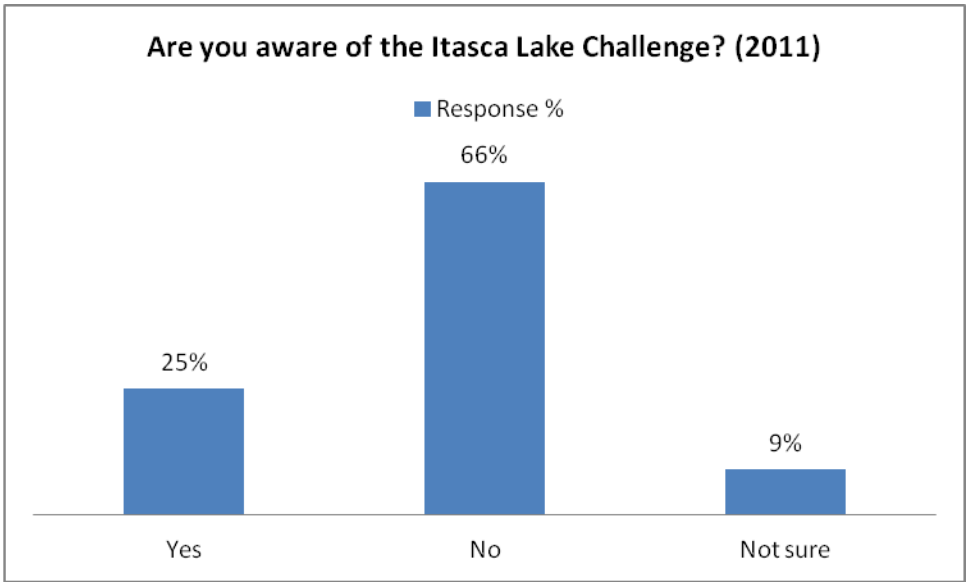
Table 41: Perception of Buffer Effectiveness



- Seventy-four percent of respondents replied affirmatively; seven percent said "No;" and nineteen percent were not sure.

Itasca County NSBI staff (Blickenderfer) designed, tested and piloted the Itasca Lake Challenge in the fall of 2010, and announcements were sent to lake associations (three of five lakes) at that time. In May of 2011 Action Media, a local partner specializing in social marketing, conducted training on the Itasca Lake Challenge with students. The Iasca NSBI project lead, Mary Blickenderfer, gave presentations statewide in 2010 and 2011 on the Itasca Lake Challenge, including the Minnesota Waters Conference. To test awareness of Itasca residents about the Itasca Lake Challenge, a question was asked in the 2011 KAP study whether responds had heard about it (Table 42 below).

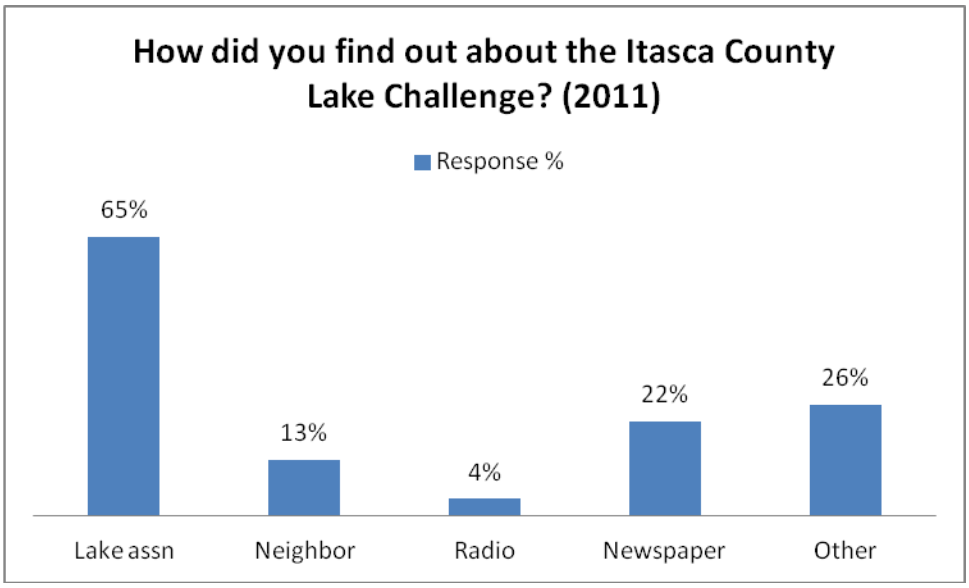
Table 42: Awareness of Itasca Lake Challenge



Sixty-six percent of respondents had not heard about the Itasca Lake Challenge; twenty-five percent knew about it; and nine percent were uncertain.

Several follow-up questions were asked about **sources of information**, including how respondents found out about the Challenge. Results are summarized in Table 42.

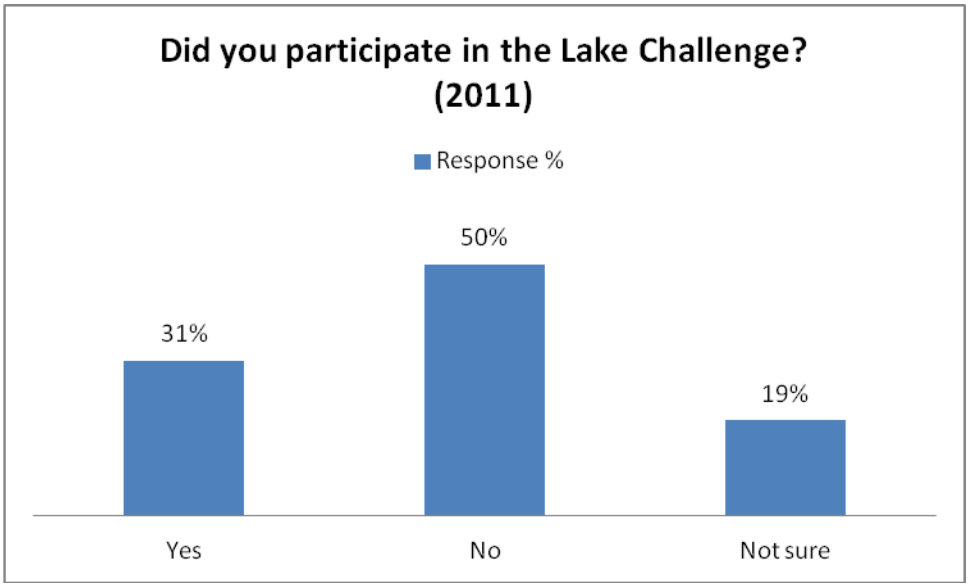
Table 43: Source of Information about the Lake Challenge



Lake associations were the most commonly reported source of information (65%), followed by "Other" (26%), "Newspaper" (22%), "Neighbor (13%) and Radio (4%). These data reinforce the finding that lake associations are the most important source of information for lakeshore property owners.

Respondents were then asked if they had **participated in the Itasca Lake Challenge**. Results are summarized below in Table 44.

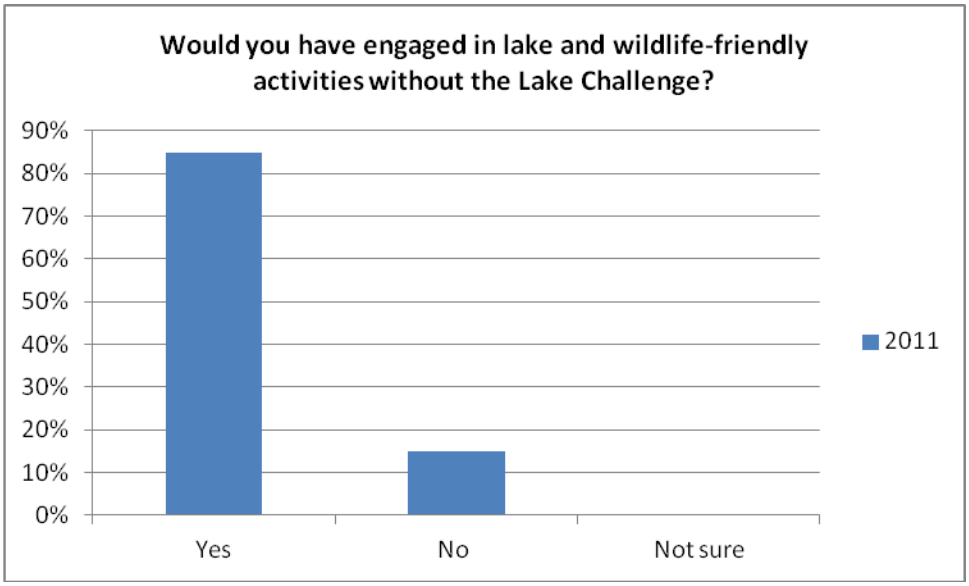
Table 44: Participation in the Lake Challenge



Half of the second-round KAP respondents had not participated (*n*=13), while 31% (*n*= 8) had. Nineteen percent (*n*=5) were uncertain.

The next question was a "**with and without**" question. Results are summarized in Table 45.

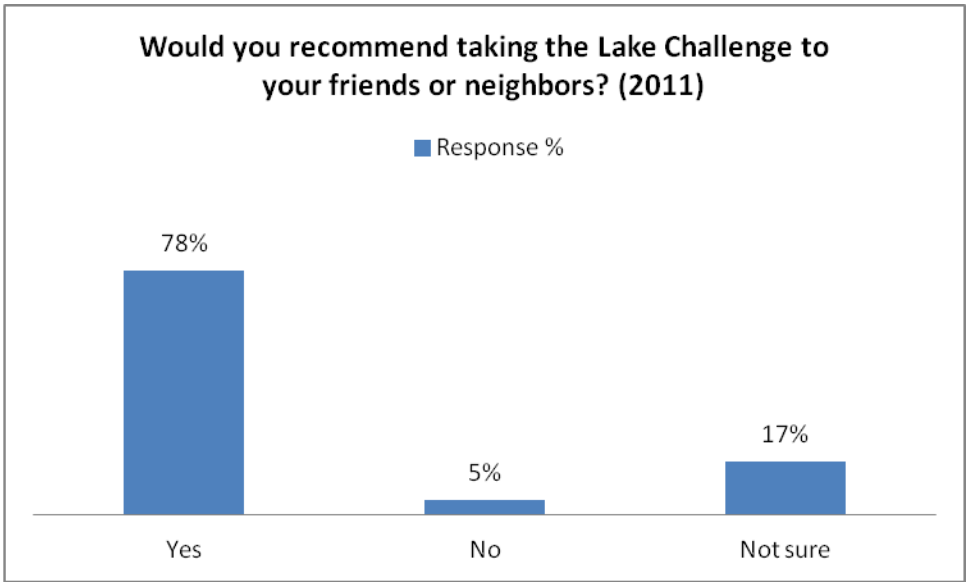
Table 45: "Moving the Maybes" with the Itasca Lake Challenge



Eighty-five percent (*n* = 17) would have engaged without the Lake Challenge. The Challenge helped to motivate fifteen percent of respondents (*n* = 3) to adopt shoreland-friendly activities.

The next follow-up question asked respondents if they would **recommend taking the Lake Challenge** to their friends and neighbors. Results are summarized in Table 46.

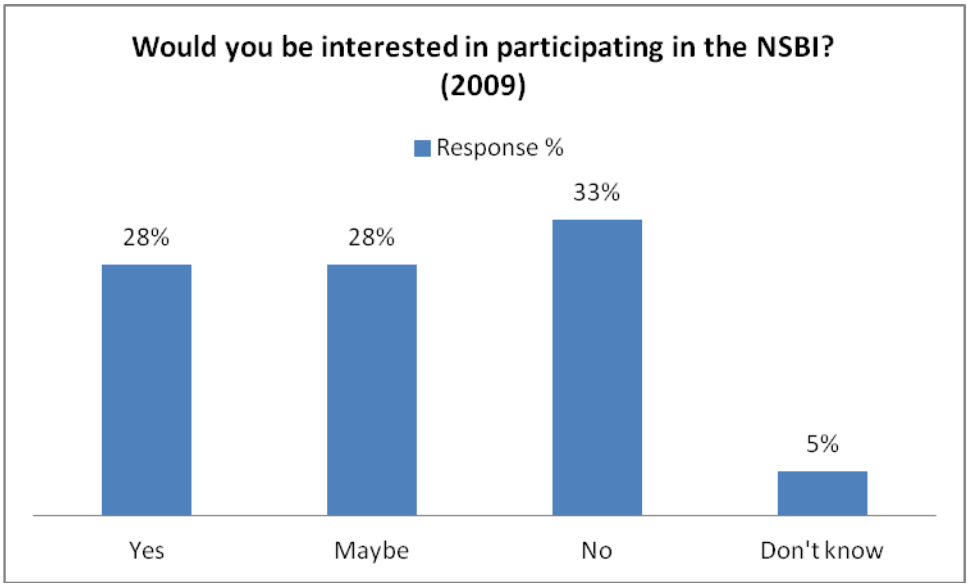
Table 46: Propensity to Recommend the Lake Challenge



Seventy-eight percent would recommend the Challenge; five percent would not; and seventeen percent were uncertain.

Respondents were asked in 2009 about their **interest in participating** in the NSBI ("There is a new program in Itasca County to assist lakeshore property owners to replant or maintain a natural shoreline. It is called the NSBI. Would you be interested in participating in this project?"). Results are summarized in Table 47.

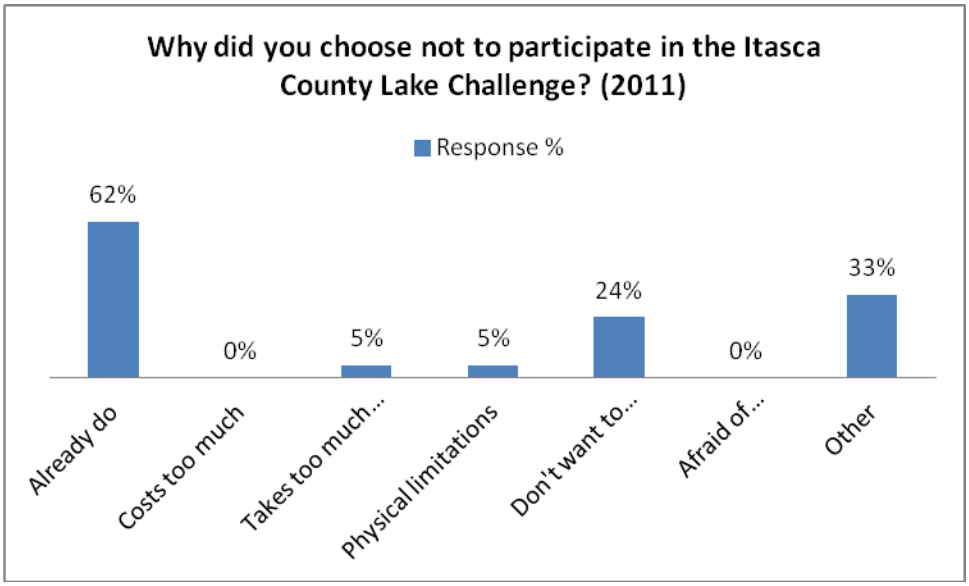
Table 47: Interest in NSBI Participation (2009)



More than a quarter of respondents (28%) indicated that they would be interested in participating in NSBI, and twenty-eight percent said they might be interested. Of those who weren't interested (33%), half stated they weren't interested because they already have a natural shoreline. Five percent responded "Don't know."

A follow-up **barriers question** was posed, asking non-participating respondents why they chose not to participate in the Itasca County Lake Challenge. Results are summarized in Table 48 below.

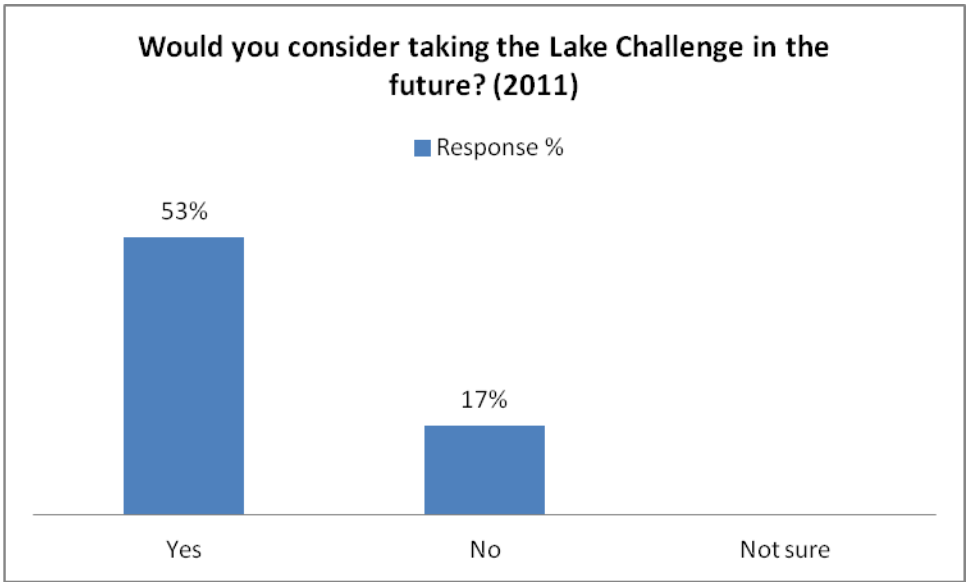
Table 48: Reasons Not to Participate in NSBI



The most common reason given by respondents was that they already engage in healthy lakeshore practices (62%). This was followed by "Other" (33%); "I like the shoreline as it is and don't want to change" (24%); "I have physical limitations" (5%); and "It might take too much time." No respondents checked "It might cost too much," or " I'm afraid the information might be reported and used against me."

Finally, in 2011, respondents were asked about their **interest in taking the Lake Challenge** ("The Itasca County Lake Challenge is a no-cost, no-strings-attached evaluation of your property to provide you with feedback on lake and wildlife-friendly practices and resources. Would you consider taking the Lake Challenge in the future?"). Results are summarized in Table 49 below.

Table 49: Propensity to Take the Lake Challenge



A slight majority (53%) responded affirmatively, while seventeen percent declined.

Discussion

This section synthesizes the social science research findings from the pre/post KAP data and participant interviews, and includes input from key project staff.

<u>Key Findings of KAP 1 (2009)</u>

The traditional viewpoint that local audiences lack knowledge about conservation and water quality is not completely accurate for this study area. Data show that landowners have significant (but generalized) knowledge about habitat, lake condition, stormwater conveyance and other water quality aspects. Ninety-two percent of respondents were aware that land management impacts water quality. The KAP data also revealed very high concerns for water quality in "their" lake. There was also considerable receptivity toward learning more about lake ecosystems and shoreland management.

In general, ***shoreland owners do not perceive trends on their lake***, in particular trends related to water clarity (70% reported "no change"). As one respondent noted, "longer-term residents feel that the lake will always stay the same; they don't perceive change." And "newer residents come because they love nature and want to keep the natural beauty." A notable exception was the perception of aquatic plants, which forty percent reported had increased in abundance over time. About a quarter (26%) perceived a decrease in fishing quality, while twenty percent perceived an increase in shoreline plants.

Most ***were members of their lake association (87%), and even more (90%) reported that they read the lake association newsletter.*** However, only about half reported that they attend lake association meetings with any regularity (once per year was the most common response). Most reported regularly socializing with 1-5 people at their lake property; 27% reported socializing with more than ten people on their lake. These findings confirm that lake associations are the most effective means of transmitting information about shoreland conservation, and that neighbor networking is also useful but of secondary importance.

Nearly two-thirds of respondents maintained a garden at the lake, and of those, half maintained it themselves. While sixty percent reported that they "clean" their shoreline, a large number of responses in the comment field indicated that respondents knew that they should do this only minimally. Forty-nine percent reported that they only did so sometimes; and thirty-two percent reported that they did so only around beaches, swimming areas and docks. Twelve percent commented that they removed deadfalls and large limbs.

With regard to natural shoreline vegetation, when shown three pictures of shorelines (lawn, replanted, and natural), ***respondents strongly preferred the natural shoreline*** (68%) over the replanted (20%) or lawn (6%) images. When looking at the lawn shoreline, respondents strongly disliked the privacy turf landscapes provided (76%), the maintenance of lawns 70%), and the general appearance of lawns (70%). For the replanted shoreline, the only negative reported was that it might require more maintenance than respondents wanted (44%). However, nearly as many respondents indicated that they would enjoy the maintenance associated with the replanted shoreline (41%). Respondents strongly liked nearly all of the elements of the natural shoreline (greater than 80% like the attributes listed). The exception was a slightly lower percentage for ability to "use" the shoreline (71% reported that they liked the shoreline usage v. 21% reporting that they disliked the shoreline for that attribute. Respondents generally like lawn care (48%) and garden maintenance (79%). Respondents overwhelmingly consider being a steward of their land to be very important (84%) or important (16%).

With regard to incentives, the first-round KAP findings did not support the notion that financial incentives would be needed to motivate the adoption of recommended practices. In fact, ***the availability of technical expertise in the form of human interaction was clearly more important and valued than financial incentives***. Financial incentives ranked only fifth among respondents, behind detailed information and instruction, labor assistance, a "how-to" workshop, or input on their site design. ***These first-round KAP findings challenged the conventional wisdom that people need a financial incentive to adopt a new behavior.*** In this instance, direct access to knowledge and information from a trained natural resources professional was clearly much more important and motivating to shoreland property owners.

How was the KAP 1 data used?

The social research data from the first KAP study was used to design and refine education and outreach strategies that were tailored to expressed local needs. We learned that "high touch," community-building and peer-to-peer incentives seem to work better in the context of the Itasca County sample. However, not enough time has passed to say with certainty that a high-touch strategy is more effective than a medium or low-touch approach.

The outcome of the first-round KAP and the boat-by was confirmation that people generally know what to do and want to do the right thing, but they could be doing more. Most residents self-report that they already have a natural shoreline (verified by observational methods), and report doing some level of environmental activity. However, such knowledge reaches a certain level beyond which respondents need (and request) additional technical support and guidance. Their strong preference, as already noted, is not for a financial incentive but rather direct, in-person interaction.

We learned that a strong environmental stewardship is nearly universal, and that stewardship binds lakeshore property owners together socially. We learned that there are existing social networks present on most lakes, and that lakeshore associations are trusted and important sources of information. Collectively, these are essential building blocks for any successful program effort. Indeed, this extends beyond shoreland conservation and water quality efforts, and could be utilized for more comprehensive environmental efforts (habitat conservation, fisheries, nongame or migratory species, etc.).

Photo 4: Testing the boat-by shoreland assessment technique

Photo 5: Testing the boat-by shoreland assessment technique

The experimental "boat-by" (total lake survey) was used to triangulate and to verify self-reported practices. This observational method was tested in 2010. It was determined to be too labor-intensive and not quantitative enough for the purposes of assessing shoreline changes. Nor could it quantify changes longitudinally with accuracy. Nonetheless it was useful because it allowed staff to ground-truth self-reported practices from KAP questionnaires. The "boat-by" information was consistent with the self-reported KAP data, confirming that the majority of owners already had natural shorelines or were doing the "correct" things (maintaining buffers). We also discovered that those with buffers were likely contributing to water quality problems via other practices (*e.g*. inappropriate boat access and footpath designs; storage of boats and water accessories; breaching ice ridges, fire rings close to water's edge, etc.).

<u>What did people know?</u>

People had a relatively high level of knowledge and awareness about water quality and lake health, but only to a certain extent. Knowledge was mostly gained from each other and through lake associations. The social research confirmed that lake associations are the obvious conduit and most significant entry point to shoreland property owners.

With those already doing the "right thing" it is also a matter of awareness. A cluster of elements seem to reinforce citizen behavior: sense of community; a sense of caring about "our" lake; peer pressure and social networks; and informal networking all appear to contribute to the spread of conservation messages among lakeshore property owners. One property owner commented that an informal lake group had rallied around the removal of a beaver dam. Individual property owners had previously had very different opinions and values, but that the issue brought people together about the condition of the lake.

While almost all respondents (99%) consider themselves to be stewards, some expressed uncertainty as to what to do. Many felt that they had inadequate resources/information to take the next step, and needed technical information and guidance to take action. Access to a natural resources professional and experiential learning-by-doing seemed to be a motivating factor, which resulted in neighbor-to-neighbor dissemination.

What civic engagement actions did property owners take as a result of the Lake Challenge?
The Lake Challenge to date has been piloted with a small number of lakes and residents. The activities have included buffers; citizen research (runoff); and training/citizen monitoring of frogs and fish. Frog workshop participants expressed sense of curiosity; some wanted to get their children interested in the natural world. Children "loved" the frog workshop. There was evidence from the key informant interviews that neighbors influenced each other to become engaged and to try new practices introduced by the Lake Challenge.

Conclusions

This section of the paper revisits the underlying questions posed by the NSBI team, and summarizes what was learned through the combined social research tools. A comparison of the first and second-round KAP study data has already been presented in this report. This section synthesizes the findings from the pre/post KAP studies, focus group (2009) and key informant interviews (2011).

To recap the "big picture" questions posed earlier:

- What motivates people to adopt and maintain a recommended practice? Why are some individuals inclined and others disinclined to adopt?
- Are the customary financial incentives offered by state and local agencies sustainable? Do people maintain the practice after the incentives end?
- How can education and outreach strategies be designed for better impact?
- How can we, as natural resources professionals, foster civic engagement?
- How do we know what impact the NSBI project has on property owners? What are the social outcomes?

These questions were explored in both the East Otter Tail and Itasca NSBI cases. The answers to these questions undoubtedly vary from one location to another, and depend upon demographics (age, education, income, etc), predominant cultural norms and many other factors. The social research methods used were customized specifically for Itasca County (especially the KAP studies), and the sample size was not representative. Therefore, caution must be used in drawing conclusions and inferring representativeness or broader patterns. Nevertheless, some insights were gained and are summarized here.

- **What motivates people to adopt and maintain a recommended practice? Why are some individuals inclined and others disinclined to adopt?**

<u>What motivated people to participate in the NSBI and Lake Challenge?</u>
Motivation is clearly related to sense of stewardship. Most property owners already had a buffer; were aware of its link to clear water; and liked what they saw. Those individuals influenced a few other neighbors to adopt, demonstrating that neighbor-to neighbor connections were important. One family had an erosion problem and wanted to do the "right thing." All five projects were based on sense of stewardship. The NSBI effort "piggybacked" on a popular weekly radio program about phenology by John Latimer on KAXE, with each delivering complementary environmental messages.

<u>Were financial incentives the most important factor motivating participation and adoption?</u>
Clearly not, and the evidence from KAP data, key informant interviews and focus groups served to verify this finding. Only 3% (n = 2) of respondents reported that for them the motivating factor was receiving a cost-share and/or assistance with their activity. The most important motivating factor was the opportunity to interact directly with a natural resources professional, and to gain technical advice, support and information.

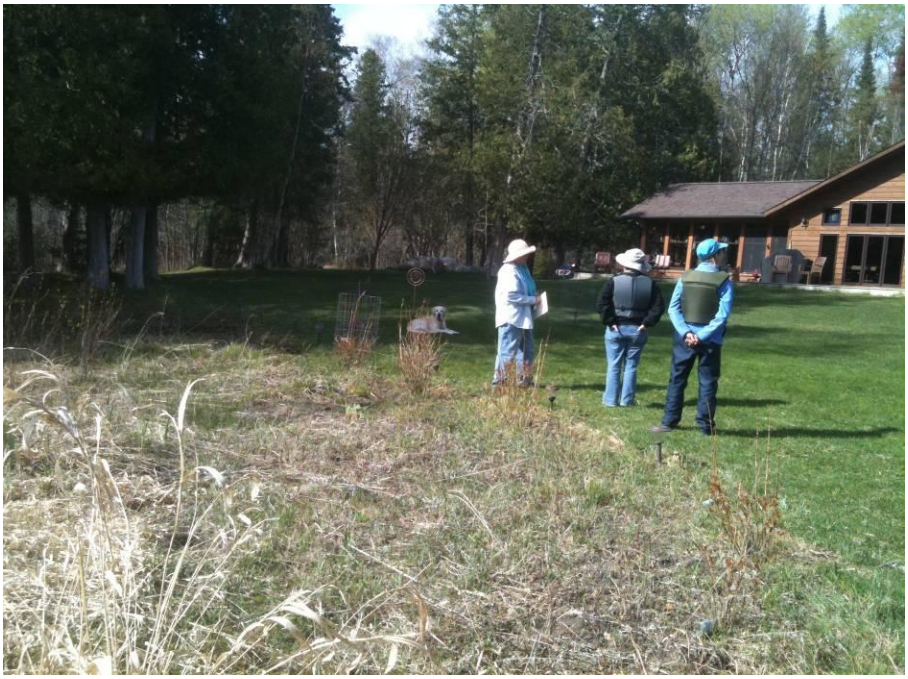


Photo 6: NSBI team members talking with a landowner on Johnson Lake (North)

The KAP study data found that financial incentives (such as a cost-share) ranked only as fifth in importance.

At the Marcell focus group (December 2009) participants said they needed a trained "warm body" to interact with, and to "tell us what to do on our lot." Participants expressed a need for somewhat customized information and recommendations. People said "we need more practical, hands-on information, and we need more informational resources" (*e.g.* lists of plants; plant sources; speaker at lake association meeting). Focus group participants were mostly retired people, possibly reflecting the demographic trends for recreational property in the county. Many already had printed information and literature, but this was not sufficient for them. The focus group reinforced and verified the results gained in the first-round KAP study.

Comments from the key informant interviews (June 2011) confirmed the importance and value to property owners of "high-touch" technical advice provided by a natural resources professional, as well as labor assistance:

- ✓ "We got good technical advice from our local specialist; they know what they're doing. Technical support was the most valuable aspect to us."

- ✓ "I really like the help with shoreline plans and plantings…I liked the technical advice that was customized for our lot. The cost-share helped, but the technical advice was much more important."

✓"Cost was not so important to us; we needed help with what to do and how to plan it."

✓"The most valuable part for us was labor and trees. And we actively seek technical support and information.

✓"What helped the most? Labor assistance."

● **Are the customary financial incentives offered by state and local agencies sustainable? Do people maintain the practice after the incentives end?**

There are many counties in Minnesota with limited resources. County staff often find themselves in a position of "doing more with less." Clearly, county staff must organize their time and resources to reach the maximum number of people, and collaborating with lakeshore associations, volunteers and peer-to-peer networks are important means of doing so. Budgetary resources that currently are dedicated to financial incentives (such as cost-shares) should be reconsidered because cost-shares were shown in this case to be ineffective.

While some property owners accepted financial incentives, there appear to be very few (if any) that adopted a shoreland-friendly practice only because of the cost-share. In this light, resources dedicated to cost-shares might be better utilized if invested in civic engagement and outreach efforts, and in trained natural resources professionals who can interact directly with property owners. The opportunity costs and overall cost-effectiveness of this recommendation should be further explored. The customary model of offering financial incentives to foster adoption should be questioned. Property owners will almost always accept a financial incentive, but they will readily adopt without it. Financial incentives may be an ineffective opportunity cost that could be used in a more efficacious way if invested in the mechanism shown to be more effective (direct contact with a natural resources professional, paired with peer-to-peer engagement and the Lake Challenge).

The higher-touch models tested in the NSBI have been shown to be more effective in terms of improving respondent knowledge. However, in Itasca County, not many property owners installed new buffers. In part, this is because the majority already had a naturalized shoreline. Property owners were receptive to "lake and wildlife friendly" activities, particularly those associated with the Itasca Lake Challenge, and participated in run-off research, frog and fish workshops, and other activities.

● **How can education and outreach strategies be designed according to local needs for better impact?**

The social science research methods used in the Itasca NSBI contributed to the design of incentives (especially non-financial incentives), and helped staff to customize education

messages and outreach efforts. The research findings put to rest some preconceived notions, including the assumption that people go to the DNR and MN Extension for primary sources of information. Rather it was learned that lake associations was the most commonly sought and preferred resource, with county, SWCD and state agencies well behind.

The social research also laid to rest the assumption that it is seasonal people from the metro area and snowbirds that are "bad" stewards, and that weekenders and "snowbirds" are causing environmental problems. In fact, weekenders also had a very strong stewardship ethic, and demonstrated somewhat higher knowledge and awareness of water quality. "Snowbirds" and weekenders also preferred the natural shoreline in higher numbers than permanent residents, which was ground-truthed by enumerators during the KAP field work. More weekenders than permanent residents were willing to consider a natural buffer.

The social research also contributed to the design of education and outreach strategies. As the existing level and content of respondent knowledge became known, specific gaps in respondent knowledge and awareness were identified. This enabled the team to customize educational messages and craft them at an appropriate level. It was also recognized that while people were generally knowledgeable and concerned, there was potential to enhance their knowledge about water quality, habitat and lake condition/trend. That extra "touch" enabled those property owners to take the next step and adopt new practices.

Eighty percent of NSBI KAP study respondents state that they already have a natural shoreline. Summarizing the outcomes of the high, medium and low touch strategies in Itasca County, the following patterns of adoption and maintenance took place:

> **"*High-touch*"** (frequent and direct on-site contact by shoreland specialists, with multiple shoreland activity options,buffer installations, multiple messengers, site visits, and peer to peer contact).
> <u>Adoption rate (percentage that adopted a shoreland-friendly practice)</u>:
> Turtle Lake (204 parcels): 4%
> South Johnson Lake (63 parcels): 6%
>
> **"*Medium-touch*"** (less frequent contact, but with some site visits, and peer to peer contact).
> <u>Adoption rate (percentage that adopted a shoreland-friendly practice)</u>:
> North Johnson (33 parcels): 27%
>
> **"*Low-touch*"** (one direct contact with the property owner, who received a newsletter only.
> <u>Adoption rate (percentage that adopted a shoreland-friendly practice)</u>

Mike Lake (5 parcels): 0
Horseshoe Lake (26 parcels): 0
Other “low-touch: lakes:
Wabana: (0)
Deer: 3 took the Lake Challenge
Pokegama: 4 took the Lake Challenge

Photo 7: Buffer installation on “meedium-touch” Johnson Lake (North)

The second-round KAP study provided additional information about adoption. Fifty-five owners installed shoreland plants or allowed native plants to grow back (55%); Twenty-one people raised the blade on their lawn mower (24%); fifty owners left the ice ridge in place (57%); five owners removed hard surfaces (6%); seven owners moved their fire rings away from the lake (8%); two installed a rain barrel or rain garden (2%); and a few attended workshops or conducted runoff research.

Photo 8: Simple materials and processes are used in run-off research on shoreland property owners' parcels

- **How can we, as natural resources professionals, foster civic engagement?**

This is an area of active discussion among many state and local agencies, and several are making strides with new models and approaches. This is especially the case for watershed planning and the TMDL process. The NSBI project has shown that the use of basic social science research tools, and application of resulting data, can contribute to the understanding of public preferences, concerns and needs. The KAP study data provided the NSBI team with social information that was useful in identifying constraints, motivating property owners, highlighting preferences (especially for treatments that people are likely to dislike), and selecting likely options and venues for public participation. The data helped to define the appearance and content of educational materials, and provided staff with insights into what property owners would most likely respond to. With a better understanding of the priorities and concerns of property owners,

the NSBI staff were able to change their engagement approach from a top-down conventional delivery system to be much more responsive, people-centered model.

In addition, social reinforcement and networking that is lake-focused (*e.g* "our" lake), and that features neighbor-to-neighbor activities and lake associations, was well-received by property owners in this Itasca County sample. Smaller lakes seem to have more social cohesiveness and possibly a greater sense of community (even North Johnson Lake, which has no lake association). Neighbor-to-neighbor (peer-to-peer) communication and group-centered activities may aid in the dissemination and adoption of lakeshore-friendly practices. Directly engaging property owners and lake associations in knowledge dissemination was also an important step that helped to maximize scarce resources while fostering civic engagement.

Photo9: Buffer installation on "high-touch" South Johnson Lake

- **How do we know what impact the NSBI project has on property owners? What are the social outcomes?**

Actual outcomes have been measured in this project through comparison of pre/post data from the KAP study. The KAP data facilitated the evaluation of social outcomes, and documented actual changes in adoption, maintenance, and acceptability of shoreland-friendly practices. In general the social research aided in understanding of adoption patterns. The social research was insightful to staff, contributing hard data and evidence that resolved uncertainty and disproved some assumptions. It was determined to be worthwhile to undertake, and provided many insights

about how to best invest staff time to obtain better results. Staff agreed that social research enables natural resources professionals to become more effective in their efforts.

Recommendations

The following recommendations are offered based upon the experience of the NSBI in Itasca County.

1. Reorient shoreland education/outreach activities from a conventional, top-down service delivery model to a peer-based experiential one, where participants can become active learners.

2. Further research. There are a number of areas outlined in this report where further research would be useful. Much of this can be accomplished by key informant interviews or focus groups. Some of the areas where further research would be useful include perceptions of what constitutes a natural shoreline; and further work on how to foster neighbor-to-neighbor or peer-to-peer networking about buffer adoption.

3. Expand the Lake Challenge model, and adapt it for other settings in Minnesota. The NSBI experience has shown that property owners in Itasca and East Otter Tail counties differ considerably in perceptions, practices and inclinations. The Lake Challenge is a very useful framework for engagement, but it should not be a "one-size-fits-all" model. We are currently discussing modalities to scale-up and scale-out the Lake Challenge for broader application in Minnesota.

5. Invest in staffing. Property owners seem more receptive to adoption and maintenance of shoreland buffers when they have direct access to a natural resources professional. We recommend that those budgetary resources used for cost-shares instead be invested in shoreland professionals using a medium to high touch civic engagement strategy, as efficacy will be maximized.

Contact Information

Karlyn Eckman, Ph.D.
Senior Research Associate
University of Minnesota Water Resources Center
173 McNeal Hall
1985 Buford Avenue
Saint Paul, MN 55108
612-625-6781
eckma001@umn.edu

Mary Blickenderfer, Ph.D.
Associate Extension Professor
University of Minnesota Extension
1861 Hwy 169 East
Grand Rapids, MN 55744
218-244-7996
blick002@umn.edu

Mark Hauck, DNR
Community Assistance Specialist
Minnesota Department of Natural Resources Regional Operations
940 Industrial Dr. So. #103
Sauk Rapids, MN 56379
320-255-4279 Ext. 236
mark.hauck@state.mn.us

Acknowledgements

- Minnesota Environment & Natural Resources Trust Fund (LCCMR)
- Erika Rivers, DNR
- Minnesota Department of Natural Resources
- Minnesota Pollution Control Agency
- Water Resources Center, University of MN
- University of Minnesota Extension
- Itasca Water Legacy Partnership / Itasca SWCD

References

http://www.co.itasca.mn.us/Home/Departments/Environmental%20Services/Documents/Zoning%20Ordinance.pdf

Eckman, Karlyn. February 2012. *Native Shoreland Buffer Incentives (NSBI) Project Final Report – Social Research and Efficacy Outcomes*. Saint Paul: University of Minnesota Water Resources Center.

Eckman, Karlyn. August 2011. Literature Review Report: Adapting the Knowledge, Attitudes and Practices (KAP) Study Method for Natural Resources Projects in Minnesota. WRC Working paper. Saint Paul: University of Minnesota Water Resources Center.

Eckman, Karlyn. In preparation for submission to the *American Journal of Evaluation*. *Crossing Disciplinary Boundaries: Adapting the KAP Study Method to Evaluate Environmental Programs*.

Eckman, Karlyn. *Evaluating Outcomes of Water Resources Projects on Target Audiences.* Presentation given at the Watershed Partners Meeting, October 13 2010, at the Capitol Region Watershed District.

Eckman, Karlyn. *Evaluating Social Outcomes in Water Resources Projects: Lessons from Minnesota.* Presented at the 2010 UCOWR/NIWR Conference July 13 2010, Seattle.

Karlyn Eckman, Kimberly Nuckles, Erika Rivers and Valerie Were. *Adapting Interdisciplinary Methods to Evaluate Social Outcomes of Environmental Programs: Five Lessons From Minnesota.* Paper presented November 10 2010 at the American Evaluation Association 2010 Annual Conference, San Antonio, Texas.

Erika Rivers and Karlyn Eckman. *What Will it Take to Get You to Conserve? Lessons from the Native Shoreland Buffer Incentives Program Surveys*. Minnesota Waters Conference, October 2009.

Eckman, Karlyn and Rachel Walker, with Kimberly Nuckles and Lilao Bouapao. 2008. *Minnesota Non-point Source Pollution (NPS) Project Evaluation Practices: Survey Report.* Saint Paul: University of Minnesota Water Resources Center.

Annex 1: Comparison of First and Second Round Data

Annex 2: Itasca Lakes Challenge Worksheet

Annex 3: First-Round KAP Questionnaire

Annex 4: Second-Round KAP Questionnaire

2008 Project Abstract
For the Period Ending June 30, 2011

PROJECT TITLE: South-Central Minnesota Groundwater Monitoring of the Mt. Simon Aquifer
PROJECT MANAGER: James a. Berg
AFFILLITION: Minnesota Department of Natural Resources
MAILING ADDRESS: 500 Lafayette Road
CITY/STATE/ZIP: St. Paul, MN 55155
PHONE: 651-259-5680
E-MAIL: jim.a.berg@state.mn.us
WEBSITE: http://www.dnr.state.mn.us/index.html
FUNDING SOURCE: Environment and Natural Resources Trust Fund
LEGAL CITATION: ML 2008, Chap.367, Sec. 2, Subd. 4 (h).

APPROPRIATION AMOUNT: $894,000

Overall Project Outcome and Results

To better understand the recharge dynamics of the Mt. Simon aquifer the western edge of this aquifer was investigated through observation well installations, water level monitoring, groundwater chemical analysis, and aquifer capacity testing. Most data collected for this study are derived from the 27 observation wells, drilled to depths of 70 to 718 feet, that were installed at 14 locations by contracted drilling companies.

The combination of chemical residence time indictors, continuous water level data from nested well locations, and a general knowledge of the regional hydrostratigraphy, shows the Mt. Simon aquifer in this region has a very slow recharge rate from a large source area located south of the Minnesota River, and a smaller source area located in the northern portion of the study area. The younger Carbon-14 residence time values of Mt. Simon groundwater (7,000-8,000 years) from this project roughly correspond to a time after the last ice sheet had receded from southern Minnesota suggesting groundwater in the Mt. Simon aquifer in this region began as precipitation that infiltrated during the post-glacial period. The stable isotope data of oxygen and hydrogen support this conclusion. A recharge estimate of the Mt. Simon aquifer south of the Minnesota River based on these minimum residence time data suggest an infiltration rate of approximately 2 cm/year. The resulting 5 billion gallons/year of recharge from the southern source area is approximately equal to permitted volumes (volume of water that the users are allowed to pump) for appropriators in this area. At current groundwater extraction rates the region appears to be in a steady state. A major accomplishment of this project was the creation of a network of observation well nests, base line water level data, and geochemical data in this region that will enable future hydrologists to evaluate the local and regional affects of any future expansion of Mt. Simon groundwater pumping beyond current volumes. This effort is documented in a report “South-Central Minnesota Groundwater Monitoring of the Mt. Simon Aquifer” (http://files.dnr.state.mn.us/publications/waters/south_central_mn_gw_monitoring.pdf).

A document titled “Minnesota Groundwater Level Monitoring Network-Guidance Document for network Development” (http://files.dnr.state.mn.us/publications/waters/groundwater_network_guidance.pdf) was also completed as part of this project. The Guidance Document outlines how Minnesota’s current groundwater level monitoring network of approximately 750 wells should be expanded to meet monitoring needs. This expansion is necessary because large areas in Minnesota are not adequately monitored. Many areas of Minnesota are underlain by multiple aquifers, all of which must be considered in developing the long-term network that will provide adequate resource data.

Project Results Use and Dissemination

The reports from this project will be available on the DNR website during the summer of 2011. An abstract of the project results will be submitted to the Geological Society of America for the national conference in Minneapolis during October 2011. In addition, a summary of the project will be submitted to the Minnesota Groundwater Association for inclusion in the quarterly newsletter.

The well log and well construction information is currently available in the project report and the Minnesota Department of Health County Well Index (http://www.health.state.mn.us/divs/eh/cwi/index.html). The wells have become part of the DNR observation well network. Water level data is currently available at: http://climate.umn.edu/ground_water_level/

Environment and Natural Resource Trust Fund 2008 Work Program
Final Report and Trust Fund 2009 Work Program

Date of Report: 8/30/11
Date of Next Status Report: 12/01/11, Final report for M.L.2008

	M.L. 2008	**M.L. 2009**
Date of Work program Approval:	June 10, 2008	June 16, 2009
Project Completion Date:	June, 30 2011	June 30, 2012

I. PROJECT TITLES: South-Central Minnesota Groundwater Monitoring and County Geologic Atlases (2008), County Geological Atlas and South-Central Minnesota Groundwater (2009)

Project Manager: Jim Berg
Affiliation: Minnesota Department of Natural Resources
Mailing Address: 500 Lafayette Road
City / State / Zip : St. Paul, MN 55155
Telephone Number: 651-259-5680
E-mail Address: jim.a.berg@state.mn.us
FAX Number: 651-296-0445
Web Page address: http://www.dnr.state.mn.us/index.html

Location: Martin, Watonwan, Brown, Nicollet, Blue Earth, and Sibley Counties (2008 project). McLeod, Wright, Sherburne, Isanti, Anoka, and Hennepin Counties (Mt. Simon aquifer monitoring - 2009 project); The Part B atlases that will be funded during the project period (2009 project) will include Todd, Carlton, McLeod, Carver, Benton, and Chisago counties.

	M.L. 2008	**M.L. 2009**	**Total**
Total Trust Fund Project Budget:	**$1,600,000**	**$2,695,000**	**$4,295,000**
DNR Total	*$894,000*	*$1,875,000*	*$2,769,000*
MGS Total	*$706,000*	*$820,000*	*$1,526,000*
DNR Trust Fund Appropriation	**$894,000**	**$1,875,000**	**$2,769,000**
Minus Amount Spent:	**$894,000**	**$1,277,063**	**$2,171,063**
DNR Equal Balance:	**$0**	**$597,937**	**$597,937**

Legal Citation:
ML 2008, Chap.367, Sec. 2, Subd. 4 (h).
Appropriation Language (2008):
$1,600,000 is from the trust fund for collection and interpretation of subsurface geological information and acceleration of the county geologic atlas program. $706,000 of this appropriation is to the Board of Regents of the University of Minnesota for the Geological Survey to begin county geologic atlases in three counties. $894,000 of this appropriation is to the commissioner of natural resources to investigate the physical and recharge characteristics of the Mt. Simon aquifer. This appropriation represents a continuing effort to complete the county geologic atlases throughout the state. This

appropriation is available until June 30, 2011, at which time the project must be completed and final products delivered, unless an earlier date is specified in the work program.

Legal Citation: ML 2009, Chap.143, Sec. 2, Subd. 3 (b)
Appropriation Language (2009):

$2,695,000 is from the trust fund for collection and interpretation of subsurface geological information and acceleration of the county geologic atlas program. $820,000 of this appropriation is to the Board of Regents of the University of Minnesota for the geological survey to continue and to initiate the production of county geologic atlases. $1,875,000 of this appropriation is to the commissioner of natural resources to investigate the physical and recharge characteristics of the Mt. Simon aquifer. This appropriation represents a continuing effort to complete the county geologic atlases throughout the state. This appropriation is available until June 30, 2012, at which time the project must be completed and final products delivered, unless an earlier date is specified in the work program.

II. 2008 FINAL PROJECT SUMMARY, AND 2009 PROJECT SUMMARY AND RESULTS:

M.L. 2008
Abstract

Overall Project Outcome and Results

To better understand the recharge dynamics of the Mt. Simon aquifer the western edge of this aquifer was investigated through observation well installations, water level monitoring, groundwater chemical analysis, and aquifer capacity testing. Most data collected for this study are derived from the 27 observation wells, drilled to depths of 70 to 718 feet, that were installed at 14 locations by contracted drilling companies.

The combination of chemical residence time indictors, continuous water level data from nested well locations, and a general knowledge of the regional hydrostratigraphy, shows the Mt. Simon aquifer in this region has a very slow recharge rate from a large source area located south of the Minnesota River, and a smaller source area located in the northern portion of the study area. The younger Carbon-14 residence time values of Mt. Simon groundwater (7,000-8,000 years) from this project roughly correspond to a time after the last ice sheet had receded from southern Minnesota suggesting groundwater in the Mt. Simon aquifer in this region began as precipitation that infiltrated during the post-glacial period. The stable isotope data of oxygen and hydrogen support this conclusion. A recharge estimate of the Mt. Simon aquifer south of the Minnesota River based on these minimum residence time data suggest an infiltration rate of approximately 2 cm/year. The resulting 5 billion gallons/year of recharge from the southern source area is approximately equal to permitted volumes (volume of water that the users are allowed to pump) for appropriators in this area. At current groundwater extraction rates the region appears to be in a steady state. A major accomplishment of this project was the creation of a network of observation well nests, base line water level data, and geochemical data in this region that will enable future hydrologists to evaluate the local and regional affects of any future expansion of Mt. Simon groundwater

pumping beyond current volumes. This effort is documented in a report "South-Central Minnesota Groundwater Monitoring of the Mt. Simon Aquifer" (http://files.dnr.state.mn.us/publications/waters/south_central_mn_gw_monitoring.pdf).

A document titled "Minnesota Groundwater Level Monitoring Network-Guidance Document for network Development" (http://files.dnr.state.mn.us/publications/waters/groundwater_network_guidance.pdf) was also completed as part of this project. The Guidance Document outlines how Minnesota's current groundwater level monitoring network of approximately 750 wells should be expanded to meet monitoring needs. This expansion is necessary because large areas in Minnesota are not adequately monitored. Many areas of Minnesota are underlain by multiple aquifers, all of which must be considered in developing the long-term network that will provide adequate resource data.

Project Results Use and Dissemination

The reports from this project will be available on the DNR website during the summer of 2011. An abstract of the project results will be submitted to the Geological Society of America for the national conference in Minneapolis during October 2011. In addition, a summary of the project will be submitted to the Minnesota Groundwater Association for inclusion in the quarterly newsletter.

The well log and well construction information is currently available in the project report and the Minnesota Department of Health County Well Index (http://www.health.state.mn.us/divs/eh/cwi/index.html). The wells have become part of the DNR observation well network. Water level data is currently available at: http://climate.umn.edu/ground_water_level/

M.L. 2009

The County Geologic atlas series provide information essential to sustainable management of ground water resources. They define aquifer boundaries, the connection of aquifers to the land surface, and the connection of aquifers to surface water resources. They facilitate and enhance the operations of natural resource management and regulation by state and local government units. Part A (geology) is completed by the Minnesota Geological Survey and Part B (groundwater and pollution sensitivity) is completed by the Minnesota Department of Natural Resources.

The deepest bedrock aquifer of south central Minnesota and the metro area – the Mt. Simon aquifer, supplies all or some of the water needs of over one million Minnesotans. The few water level measurements available from this aquifer in the Mankato and Twin Cities metro area indicate declining water levels in some areas. Critical recharge areas for the Mt. Simon aquifer exist in the northwestern and western metro area and portions of south central Minnesota. The recharge and physical characteristics of the Mt. Simon aquifer along this zone are poorly understood. This recharge zone will be investigated and characterized through monitoring well installations, water level monitoring, groundwater chemical analysis, and aquifer capacity testing to help determine recharge pathways and sustainable limits for this aquifer.

This project will be an expansion of the 2008 LCCMR funded project to investigate the Mt. Simon aquifer recharge zone in south central Minnesota and to fund additional Part A County Geologic Atlases. In addition, the 2009 project will fund the initiation and completion of Part B atlases. Part A is completed before work on part B commences. The Part B atlases focus on defining aquifer boundaries; natural water chemistry; ground water flow; and identifying the connection of aquifers to the land surface and surface water resources. Atlas reports facilitate and enhance the operations of natural resource management and regulation by state and local government units.

This project will support completion of County Geologic Atlas Part B reports by expanding production capacity by providing additional staff to existing staff of the ongoing Part B project and providing additional project funds for water sampling and analysis and report printing consistent with the ongoing project.

III. 2008 FINAL PROJECT SUMMARY AND 2009 PROGRESS SUMMARY

M.L. 2008

Overall Project Outcome and Results

To better understand the recharge dynamics of the Mt. Simon aquifer the western edge of this aquifer was investigated through observation well installations, water level monitoring, groundwater chemical analysis, and aquifer capacity testing. Most data collected for this study are derived from the 27 observation wells, drilled to depths of 70 to 718 feet, that were installed at 14 locations by contracted drilling companies.

The combination of chemical residence time indictors, continuous water level data from nested well locations, and a general knowledge of the regional hydrostratigraphy, shows the Mt. Simon aquifer in this region has a very slow recharge rate from a large source area located south of the Minnesota River, and a smaller source area located in the northern portion of the study area. The younger Carbon-14 residence time values of Mt. Simon groundwater (7,000-8,000 years) from this project roughly correspond to a time after the last ice sheet had receded from southern Minnesota suggesting groundwater in the Mt. Simon aquifer in this region began as precipitation that infiltrated during the post-glacial period. The stable isotope data of oxygen and hydrogen support this conclusion. A recharge estimate of the Mt. Simon aquifer south of the Minnesota River based on these minimum residence time data suggest an infiltration rate of approximately 2 cm/year. The resulting 5 billion gallons/year of recharge from the southern source area is approximately equal to permitted volumes (volume of water that the users are allowed to pump) for appropriators in this area. At current groundwater extraction rates the region appears to be in a steady state. A major accomplishment of this project was the creation of a network of observation well nests, base line water level data, and geochemical data in this region that will enable future hydrologists to evaluate the local and regional affects of any future expansion of Mt. Simon groundwater pumping beyond current volumes. This effort is documented in a report “South-Central Minnesota Groundwater Monitoring of the Mt. Simon Aquifer” (http://files.dnr.state.mn.us/publications/waters/south_central_mn_gw_monitoring.pdf).

A document titled "Minnesota Groundwater Level Monitoring Network-Guidance Document for network Development" (http://files.dnr.state.mn.us/publications/waters/groundwater_network_guidance.pdf) was also completed as part of this project. The Guidance Document outlines how Minnesota's current groundwater level monitoring network of approximately 750 wells should be expanded to meet monitoring needs. This expansion is necessary because large areas in Minnesota are not adequately monitored. Many areas of Minnesota are underlain by multiple aquifers, all of which must be considered in developing the long-term network that will provide adequate resource data.

Project Results Use and Dissemination

The reports from this project will be available on the DNR website during the summer of 2011. An abstract of the project results will be submitted to the Geological Society of America for the national conference in Minneapolis during October 2011. In addition, a summary of the project will be submitted to the Minnesota Groundwater Association for inclusion in the quarterly newsletter.

The well log and well construction information is currently available in the project report and the Minnesota Department of Health County Well Index (http://www.health.state.mn.us/divs/eh/cwi/index.html). The wells have become part of the DNR observation well network. Water level data is currently available at: http://climate.umn.edu/ground_water_level/

M.L. 2009

12/1/09 **Result 2** All the drilling sites have been chosen and SHPO assessments have been requested. Currently we are seeking permission to drill on non-DNR public property in Wright and Sherburne Counties. Two well nests in McLeod County have been contracted for drilling.

12/1/09 **Result 6** One hydrologist 2 was hired as of Oct 14, 2009. The opening for the other hydrologist to be hired will likely be reposted. The opening for the Research Analyst (GIS) will be reposted. Due to staff changes an Information Officer 2 will be hired instead of Information Officer1 to provide the necessary level of expertise for the editing work. That opening has yet to be posted. The new hydrologist 2 has begun preliminary work on the Benton County Geologic Atlas Part B.

Amendment Requested (12/1/09)

Result 6 The "Personnel –wages and benefits" was reduced $4,000 to 1) cover costs for a GIS workstation for each of the new hydrologists (total $3,000) and 2) cover costs of expendable water sampling supplies. Ordinary desktop computers do not have sufficient memory, hard drive, or graphics card capability to meet the intensive GIS needs of the hydrologist positions. The delayed hire will cover the costs. Software is departmental standard software. These computers will continue to be used as GIS workstations for future County Geologic Atlas projects. See the attached project status

chart. The expendable water sampling supplies ($1,000) include bottles and other supplies that are either one-use only or are consumed in the sampling process.

Amendment Approved: (12/21/09)

Amendment Request (2/24/10)
Result 6 Two changes are requested to assure the county geologic atlas work is both accurate and done efficiently. The "Personnel – wages and benefits", if approved, will be reduced $2,700 to cover the increased cost of an approved GIS workstation for the new Hydrologist 2 hire and also the cost of a third GIS workstation for the new Research Analyst (GIS) hire. These GIS workstations incorporate a higher rated graphics card and a second monitor for larger on-screen active work area. Experience has shown that an ordinary desktop computer does not have the memory or graphics capability for the intensive GIS work that is needed to complete the atlas projects. These GIS workstations will continue to be used on future County Geologic Atlas projects.

Also, the "Personnel – wages and benefits", if approved, will be reduced an additional $1,500 and a separate line item added for "GIS training of new hires". Experience with new hires has shown that this training is needed to bring the new hires up to the advanced level needed to execute the atlas work efficiently. New hires, especially hydrogeologists, have not worked with GIS intensively or at the advanced level the atlas projects require; they are hired primarily for their hydrogeologic expertise and not their GIS capability. The Research Analyst (GIS) position is entry level and will need minimal advanced training to work effectively with other atlas staff working at advanced levels.

GIS Training could be provided by commercial vendors at much higher cost, typically $900 to $1500 per class or the GIS training could be provided by DNR for $150 or $300 per class. We have confirmed with the DNR GIS training manager that DNR GIS training is funded by class fees only and not General Fund. Therefore, this allocation would not conflict with the supplanting of General Funds restrictions of the ENRTF. The DNR offers a series of three increasingly higher-level GIS classes specially focused on the GIS skills needed and data used by DNR atlas projects staff. The three classes include "ArcMap" ($300), "Editing ArcMap" ($300), and "ArcToolbox" ($150). The proposed training budget was calculated based on new hire training needs of 1 – ArcMap class, 3 - Editing ArcMap classes, and 2 – ArcToolbox classes, totaling $1,500.

Amendment Approved: (3/18/10)

7/15/10 **Result 2** Eight wells at four locations in McLeod, Wright, and Sherburne counties have been drilled. A drilling company has been contracted for the remaining 6 locations in Sherburne, Isanti, Anoka, and Hennepin Counties.

7/15/10 **Result 6** The remaining three hires for the atlas staff have been accomplished. The approved four staff for Result 6 include two project hydrogeologists, one technical editor, and one research analyst. Well sampling for the Benton part B atlas is scheduled to begin the middle of July and will be complete in early August. The Todd part B is in final review draft and in preparation for printing. Chisago Part B has been initiated and is

currently focused on development of the well sampling design; well sampling is to be completed late summer or fall 2010.

Amendment Requested: (7/15/10)

Result 2 The budget for lab analysis of groundwater samples was increased to cover the possibility of submitting a greater number of samples for the expensive carbon 14 analysis. We won't know the exact number of samples that we will submit for this analysis until we drill the remaining wells in the northern portion of the study area. If the geologic conditions suggest the Mt. Simon is very open to recent recharge we may submit fewer samples for carbon 14 analysis. The increased costs for this budget item are offset by a decrease in the wages line item. The decrease in the wages budget will be offset by using the remainder of the wages budget from the 2008 project and by using a less expensive DNR hydrologist (not normally compensated by general fund) for some of the routine data logger tasks.

Result 6 Attachment A shows a minor adjustment between cost categories to assure that adequate sampling supplies are available for the planned work. These sampling supplies are primarily expendable materials that are used in the sampling protocol. The additional cost is offset by a reduction in the travel expense item.

Amendment Approved: 10/5/10

12/1/10 **Result 2** All of the wells for the project (17 wells at 10 locations) have been completed. All of the wells except two have been sampled for laboratory chemical analysis and all of the wells except four have continuous water level measurement data loggers installed.

12/1/10 **Result 6** The Todd County Geologic Atlas, Part B was printed November 2010. The Carlton County Geologic Atlas, Part B, is in report preparation. All chemistry sampling in Benton County is complete and submitted for laboratory analysis, except the carbon-14 sampling planned for spring 2011. Chemistry sampling in the other three project counties (Chisago, Carver, and McLeod) is at least half completed and will be essentially complete in spring 2011. The Benton atlas project is well on track and report preparation will be underway in the fall 2011. The hydrologist hired for the Chisago atlas project was released from state service in early December 2010; that position will be refilled as soon as possible. Administrative approval to rehire has been obtained.

7/1/11 **Result 2**
Since 12/1/10 all the wells have been sampled and all data loggers have been installed. Data from the water level data loggers have been retrieved twice.

7/1/11 **Result 6**

The Carlton County Geologic Atlas, Part B, was printed June 2011. Paper copies of the report will be delivered to the county in August 2011. The report will be presented to county commissioners and staff in September 2011. Report plate PDFs are posted on-line and the GIS data are being prepared for on-line distribution in August 2011. A

training workshop for the Carlton County Geologic Atlas, Part B, is tentatively planned for October 2011. Report preparation of the Benton County Geologic Atlas, Part B, is underway and publication is planned for December 2011. Three other Part B atlases are in progress: Chisago, Carver, McLeod. Almost all planned water sampling has been completed and most analytical data has been received. Filling the hydrologist vacancy for the Chisago project has proven extremely difficult; the position has been vacant since December 2010. Finally, a candidate has been identified who should start in early September.

Future atlas projects planned to start during FY12 include Blue Earth, Nicollet, and Sibley. The exact schedule depends on delivery of data for these projects from the Minnesota Geological Survey and DNR atlas staff availability.

Amendment Requested: (8/30/11)

Result 2 The budget for drilling contracts and continuous water level monitoring equipment was increased to cover actual costs. This increase was covered by funds from the chemistry, SHPO assessment, well pumping supplies, wages, and travel expenses budgets.

Result 6 The budget for field expenses (travel and supplies) has been increased by $10,000 to cover expected costs in the final year of the project that had been underestimated in the original budget. In addition, the budget for laboratory expenses has been increased by $25,000 to cover half of the laboratory expenses for a new atlas project (Blue Earth County Geologic Atlas, Part B) that is starting in FY12. This increase was covered by funds from wages and benefits which has more funds than needed to cover wages and benefits for staff during the final year of the project. Delayed hires and a six-month Hydrologist 2 position vacancy resulted in salary savings. During the vacancy, other project staff worked on the project that had been started (Chisago) as time allowed from their project (Benton) so that the planned well water sampling was accomplished, with the exception of ten carbon-14 samples for age dating. Those samples are planned for September 2011. Because of the vacancy, progress on both the Benton and Chisago projects has been delayed, with most of the impact on the Chisago project. The Benton atlas Part B report is currently in production with publication planned about December 2011.

Amendment Approved:

IV. OUTLINE OF PROJECT RESULTS*:*

Result 1: Groundwater level monitoring guidance document

Description: The purpose of this document is to create a strategic plan for developing a statewide network of water level monitoring wells (observation wells). The document, created by DNR Waters, will review the current state of Minnesota's network, monitoring frequency, database protocols, costs, data uses, and limitations. The document will include a review of networks in other states or countries that may have advantageous approaches that the Minnesota DNR could consider. Finally, the document will make recommendations for how to evaluate the adequacy of the existing network and make recommendations for improving the existing network.

Summary Budget Information for Result 1:

	M.L. 2008	M.L. 2009	Total
Trust Fund Budget:	**$33,000**	**$0**	**$33,000**
Amount Spent:	**$33,000**	**$0**	**$33,000**
Balance:	**$0**	**$0**	**$0**

Deliverable	Completion Date	Budget	Status
1. Existing sources of information from other states and countries.	1/05/09	$1,000	complete
2. Information and status of the Minnesota observation well network.	7/1/09	$1,000	complete
3. Information and methods used by other government entities	12/1/09	$11,000	complete
4. Final Report: Information and recommendations for Minnesota groundwater monitoring	5/31/11	$20,000	complete

Completion Date: M.L. 2008: 5/31/11

Final Report Summary:
Minnesota's environmental and economic future depends on a continued and available supply of groundwater that is managed sustainably. The Minnesota Department of Natural Resources is responsible for managing the quantity of groundwater use through appropriation permits and monitoring water levels. Groundwater quantity estimates for management purposes depend on a historical record of water level measurements. However, the state's current groundwater level monitoring network does not provide adequate statewide groundwater quantity information because many areas and groundwater resources are unmonitored.

This Guidance Document outlines how Minnesota's current groundwater level monitoring network of approximately 750 wells should be expanded to approximately 7000 groundwater level monitoring wells to meet monitoring needs. This expansion is necessary because large areas in Minnesota are not adequately monitored. Many areas of Minnesota are underlain by multiple aquifers, all of which must be considered in developing the long-term network that will provide adequate resource data. A more complete and integrated network of groundwater level monitoring wells will provide stakeholders, local government officials, and groundwater resource managers with the information needed to:

• Understand the status of groundwater quantity throughout the state
• Formulate management responses to changing water levels
• Plan for the future based on current scientific data

This document is intended to provide the DNR with a guide to build the backbone network that will support the state's current and future groundwater level monitoring

information needs. Network wells will become long-term assets used to fully understand, manage, and assess Minnesota's groundwater resources. As described in this document, this is an unprecedented expansion project that will vastly improve the understanding of Minnesota's groundwater resources. The envisioned expansion is a very significant undertaking, estimated to require 30 years to complete and cost $94.7 million. The continued operation and maintenance of the network assets as the network expands is also a significant undertaking, requiring on-going support to acquire, analyze, and interpret groundwater level data and to make the data readily available to a wide variety of users.

The Minnesota groundwater level network as it develops into the future is intended to meet information needs for sustainable management of water resources. The existing network, while limited, provides invaluable data for resource managers; the expanded network will provide greatly improved data resource to understand groundwater system response to change and provide the groundwater quantity data needed to make informed decisions to protect Minnesota's groundwater resource for the future.

Result 2: Test drilling, monitoring well installation, sampling, laboratory analysis, water level measurement

Description: Monitoring wells (observation wells) will be drilled and completed at 14 locations in the 2008 project area and approximately 10 locations in the 2009 project area. The monitoring well installations will be completed with contracted drilling services hired and coordinated by the DNR. Each location will consist of a two-well nest with a deep well completed in the lowermost bedrock aquifer (Mt. Simon Formation), and another well completed in a shallower unconsolidated sand and gravel aquifer. The well nests will be located on public property and completed to depths of approximately 100 to 1000 feet. Drill cuttings (ground-up rock and sediment brought to the surface by the drilling process) will be collected at 5-foot intervals by DNR staff and archived for analysis by the Minnesota Geological Survey. DNR or MGS staff will complete downhole geophysical surveys after the full depth of the deep borehole has been drilled. A reverse circulation/dual rotary drilling method will be used as much as possible to generate high quality drill cuttings. These high quality samples will significantly improve stratigraphic interpretations of glacial and bedrock materials. This drilling method advances an 8 - inch diameter steel casing during the drilling process. The wells will be pumped prior to sampling providing some specific capacity information. The specific capacity test will provide some information regarding the aquifers producing capacity.

Most of the test holes will be completed as 4-inch diameter water level monitoring wells (observation wells) in the lowermost bedrock aquifer (Mt. Simon Sandstone) and shallower aquifers, to help track long-term groundwater level trends. The wells will be sampled by DNR staff for general chemistry, trace elements, tritium, carbon 14 and stable oxygen and deuterium isotopes to determine the residence time of the ground water in the formations. In addition, DNR staff will instrument the wells with continuous water level recording equipment to track short and long term changes in water levels. The chemistry and water level information will help determine the sustainable limitations for future use of this aquifer.

Summary Budget Information for Result 2:

	M.L. 2008	M.L. 2009	Total
Trust Fund Budget:	**$861,000**	**$985,000**	**$1,846,000**
Amount Spent:	**$861,000**	**$837,885**	**$1,698,885**
Balance:	**$0**	**$147,115**	**$147,115**

Deliverable	Completion Date	Budget	Status
1. All the drilling sites will have been chosen and several of the wells will have been installed, instrumented and sampled. The drilling logs, geophysical logs, flow logs, locations, well construction diagrams, and water level data from the wells that have been installed by this date will be available.	12/01/08	$250,000	complete
2. Same as above with several more sites completed (M.L. 2008)	7/1/09	$250,000	complete
3. Same as above with several more sites completed (M.L. 2008). Sites have been chosen for M.L. 2009 and contractor bidding, SHPO reviews and access permission requests are underway. Several of the wells will have been installed.	12/1/09	$250,000 (2008) $250,000 (2009)	complete
4. All the monitoring wells will have been installed, instrumented, and sampled. During the remaining one-year period The data loggers will downloaded and maintained on a regular basis. Remaining data compilation and interpretation will continue and creation of final report will begin (M.L. 2008). Several more well nests for the M.L. 2009 will have been completed and associated data loggers installed.	7/1/10	$37,000 (2008) $300,000 (2009)	complete
5. Same as above with more data compilation and progress toward completion of final report (M.L. 2008). All of the well nests will have been completed, associated data loggers installed, and water samples collected and submitted for lab analysis (M.L. 2009).	12/1/10	$37,000 (2008) $300,000 (2009)	complete
6. Project completion (M.L. 2008) and final report to include maps summarizing	6/30/11	$37,000 (2008)	complete

thickness and extent of Mt. Simon aquifer in project area. Interpretation of collected water level data and chemistry and implications for sustainable use of Mt. Simon aquifer. Recommendations for future investigations and/or monitoring. Routine downloading of data loggers, data compilation, interpretation and report preparation (M.L. 2009)		$33,750 (2009)	
7. Routine downloading of data loggers, data compilation, interpretation and report preparation (M.L. 2009)	7/1/11	$33,750 (2009)	
8. Same as above (M.L. 2009)	12/1/11	$33,750 (2009)	
9. Project completion (M.L. 2009) and final report to include maps summarizing thickness and extent of Mt. Simon aquifer in project area integrated with 2008 project results. Report will include interpretation of collected water level data and chemistry and implications for sustainable use of Mt. Simon aquifer. Recommendations for future investigations and/or monitoring.	6/30/12	$33,750 (2009)	

Completion Date **M.L. 2008:** 6/30/11
M.L. 2009: 6/30/12

M.L. 2008 Final Report Summary:
Drilling, well installation, groundwater sampling, and data logger installations have been completed at all the 2008 project sites for a total of 27 wells at 14 sites in 5 counties. All wells drilled have been mud logged and gamma logged. In addition, rock and sediment samples have been sent to the Minnesota Geological Survey for analysis.

Result 2 Status (M.L. 2009) as of 12/1/09:
All the 2009 project drilling sites have been chosen and SHPO assessments have been requested. Currently we are seeking permission to drill on non-DNR public property in Wright and Sherburne Counties. Two well nests in McLeod County have been contracted for drilling.

Result 2 Status (M.L. 2009) as of 7/15/10:
Eight wells at four locations in McLeod, Wright, and Sherburne counties have been drilled. A drilling company has been contracted for the remaining 6 locations in Sherburne, Isanti, Anoka, and Hennepin Counties.

Result 2 Status (M.L. 2009) as of 1/10/11:

All of the wells for the project (17 wells at 10 locations) have been completed. All of the wells have been sampled for laboratory chemical analysis, and all of the wells except four have continuous water level measurement data loggers installed.

Result Status (M.L. 2009) as of 6/30/11: *All of the wells for the project (17 wells at 10 locations) have been completed. All of the wells have been sampled for laboratory chemical analysis, and all of the wells have continuous water level measurement data loggers installed.*

Result Status as of 7/1/11: *All of the wells for the project (17 wells at 10 locations) have been completed. All of the wells have been sampled for laboratory chemical analysis, and all of the wells have continuous water level measurement data loggers installed.*

Result Status as of 12/1/12:

Result Status as of 6/30/12:

M.L. 2009 Final Report Summary:

Result 3 (to be completed by the MGS who will be providing separate work program updates): Initiate Part A County Geologic Atlases for Blue Earth, Nicollet, and Sibley Counties. Note: all components listed below may not be completed within the time frame and budget of this project, but substantial progress in all three counties is anticipated.

Result 4 (to be completed by the MGS): MGS support for DNR Drilling Program
Description: MGS will process, examine, interpret, and archive samples from the DNR test drilling. MGS will also conduct downhole geophysical logging of selected test holes to observe aquifer properties.

Result 5 (to be completed by the MGS): Production and Printing of the Benton and Chisago County Geologic Atlases

Result 6: Acceleration of County Geologic Atlas Part B reports.
Description: Initiate and complete the Benton and Chisago county geologic atlas Part B projects. Support initiation of three (Carlton, McLeod, Carver) and completion of four (Todd, Carlton, McLeod, Carver) county geologic atlas Part B projects. Progress on Part B atlas development includes ground water sample collection and analysis; geophysics field data collection and analysis; aquifer mapping and technical analysis of ground water systems. Publication of Part B atlas reports include preparation and printing of the County Geologic Atlases, Part B and delivery of printed reports to county; preparation and delivery of Part B materials to MGS for DVD version of each, along with geographic information system (GIS) files, database files, pdfs, and additional digital products. Digital products will be posted on DNR webspace.

Summary Budget Information for Result 6:

	M.L. 2008	M.L. 2009	Total
Trust Fund Budget:	**$0**	**$890,000**	**$890,000**
Amount Spent:	**$0**	**$333,882**	**$333,882**
Balance:	**$0**	**$556,118**	**$556,118**

Deliverable	Completion Date	Budget	Status
1. Additional staff hired (2 hydrologists; research analyst; half-time editor) to support additional atlas projects to be developed and completed during the project. Support continuation of ongoing projects: Todd County. Support publication of Todd County Part B.	12/01/09	$205,333	active
2. Support continuation of ongoing work. Start Benton, and Chisago counties. Support start of Carlton, McLeod, and Carver Counties.	7/1/10	$153,333	active
3. Continue ongoing projects.	12/1/10	$123,333	active
4. Continue ongoing projects. Support publication of Carlton County Part B.	7/1/11	$147,333	active
5. Continue ongoing projects. Support publication of Part B for McLeod and Carver counties	12/1/11	$133,334	
6. Publish Part B for Benton and Chisago counties.	6/30/12	$127,334	

Completion Date M.L. 2009: 6/30/12

Result 6 Status as of 12/01/09:
One hydrologist 2 was hired as of Oct 14, 2009. The opening for the other hydrologist to be hired will likely be reposted. The opening for the Research Analyst (GIS) will be

reposted. Due to staff changes an Information Officer 2 will be hired instead of Information Officer1 to provide the necessary level of expertise for the editing work. That opening has yet to be posted. The new hydrologist 2 has begun preliminary work on the Benton County Geologic Atlas Part B.

Result 6 Status as of 7/15/10:
The second hydrologist 2 was hired April 19, 2010 and will work on the Chisago Part B atlas. At about that same time the Chisago Part A atlas data was available from the MGS. The technical editor (Information Officer 2) was hired May 17, 2010. The research analyst-GIS was hired June 29, 2010. Work on the Benton atlas Part B has proceeded to the point that well water sampling for about 100 wells is scheduled to begin mid-July 2010. To better understand water table conditions in part of Benton County the project hydrologist has initiated a series of synoptic water level measurements. Work on the Chisago atlas Part B has been initiated with planning for well sampling for about 100 wells. The sampling will take place late summer or fall 2010.The Todd atlas Part B report is in final draft form following peer review and being prepared for print production. Other atlas program projects including Carlton, McLeod, and Carver are underway by base program hydrologists.

Result 6 Status as of 1/10/11: *The Todd County Geologic Atlas, Part B, was printed November 2010. The paper copies of the report will be delivered to the county in January 2011 when the contents of the report will be presented to local staff and the public. Report plate PDFs are posted on-line (http://www.dnr.state.mn.us/waters/programs/gw_section/mapping/platesum/toddcga.html) and the GIS data are being prepared for on-line distribution in January 2011. A training workshop for the Todd Atlas is tentatively planned for spring 2011. The report preparation of the Carlton Atlas, Part B, is underway and on schedule; printing of this report is planned for June 2011. Chemistry sampling of 100 wells in Benton County is complete, except the ten carbon-14 samples planned for spring 2011. The 100 Benton samples have been submitted for laboratory analysis. Chemistry sampling of 100 wells in each of the other three project counties, (Chisago, Carver, and McLeod) is at least half completed and will be essentially complete in spring 2011. The collected samples to date in those areas have been submitted for laboratory analysis. The Benton Atlas, Part B, project is well on track and report preparation will be underway by the fall 2011. The Benton project hydrologist will incorporate into the atlas report the result of the several synoptic measurements of the water table completed in part of Benton County. The hydrologist hired for the Chisago atlas project was released from state service in early December 2010; that position will be refilled as soon as possible. Administrative approval to rehire has been obtained.*

Result 6 Status as of 7/1/11: *The Carlton County Geologic Atlas, Part B, was printed June 2011. Paper copies of the report will be delivered to the county in August 2011. The report will be presented to county commissioners and staff in September 2011. Report plate PDFs are posted on-line (http://www.dnr.state.mn.us/waters/programs/gw_section/mapping/platesum/carlcga.html) and the GIS data are being prepared for on-line distribution in August 2011. A training workshop for the Carlton County Geologic Atlas, Part B, is tentatively planned for October 2011. Report preparation of the Benton County Geologic Atlas, Part B, is*

underway and publication is planned for December 2011. Three other Part B atlases are in progress: Chisago, Carver, McLeod. Almost all planned water sampling has been completed (about 100 wells in each project area) and most analytical data has been received. Assembling the remaining analytical data is a priority the next couple of months. Filling the hydrologist vacancy for the Chisago project has proven extremely difficult; the position has been vacant since December 2010. During the vacancy, other staff completed planned water sample collection with the exception of ten carbon-14 sample for age dating. Finally, a candidate has been identified who should start in early September.

Additional atlas projects planned to start during FY12 include Blue Earth, Nicollet, and Sibley. The exact schedule depends on delivery of data for these projects from the Minnesota Geological Survey and DNR atlas staff availability.

Result 6 Status as of 12/1/11:

Result 6 Status as of 6/30/12:

V. TOTAL TRUST FUND PROJECT BUDGET:

M.L. 2008

DNR Staff or Contract Services:	
Hydrologist 3, unclassified, 1.0 FTE x 2years (results 1 and 2)	$132,000
Drilling contractors	$694,474
Laboratory analysis of 30 ground water samples tritium, deuterium and 18 oxygen	$7,989
Archeological site assessment (SHPO)	$6,799
DNR Equipment:	
Down-hole geophysical logging tool (gamma, magnetic induction)	$0
Field computer	$4,267
Submersible sample pump, reel, tubing and cable (or contracted sampling services)	$8,645
Continuous water level monitoring equipment for 27 wells	$18,298
DNR Other:	
Overnight expenses	$9,253
Mileage	$9,835
Supplies	$2440
SUBTOTAL DNR PROJECT BUDGET:	$894,000
SUBTOTOTAL MGS (see MGS WP) **PROJECT BUDGET:**	$706,000
TOTAL TRUST FUND PROJECT BUDGET:	$1,600,000

M.L. 2009

DNR Staff or Contract Services (Result 2):

Hydrologist 3, unclassified, 1.0 FTE x 2years	$105,595
Drilling contractors	$812,145
Laboratory analysis of 17 ground water samples cations, anions, trace elements, tritium, stable isotopes, and 14 carbon	$32,862
Archeological site assessment (SHPO)	$5,325
Well pumping equipment for aquifer tests and sampling	$6,273
DNR Staff or Contract Services (Result 6):	
Hydrologist 2, unclassified. 2.0FTE x 2.5 years	$369,600
Research Analyst (GIS), unclassified 1.0 FTE x 2.5 years	$159,600
Information Officer 2, unclassified 1.0 FTE x 2.5 years	$161,600
GIS training for 3 new hires (2-Hydrogeologist 2's, 1-Research Analyst (GIS)	$1,500
Printing	$38,000
Laboratory analysis of 80 groundwater samples/county for cations, anions, trace elements, tritium and several 14 C	$133,000
DNR Equipment:	
(Result 2):	
Continuous water level monitoring equipment for 17 wells	$12,512
(Result 6):	
Three GIS Workstations	$5,672
DNR Other:	
(Result 2)	
Overnight expenses	$2,288
Mileage	$7,000
Supplies	$1,000
(Result 6)	
Overnight expenses (70 days @ $100/day)	$9,000
Mileage (4,167 miles @ $.48/mile)	$4,000
Supplies	$8,028
SUBTOTAL DNR PROJECT BUDGET:	$1,875,000
SUBTOTOTAL MGS (see MGS WP) **PROJECT BUDGET:**	$820,000
TOTAL TRUST FUND PROJECT BUDGET (2009):	$2,695,000

Explanation of Capital Expenditures Greater Than $3,500 (2008):

Down-hole geophysical logging tool (gamma, magnetic induction)
This tool is essential for any borehole subsurface investigation. The tool measures the natural gamma radiation and electrical conductivity (or resistivity) of the various downhole formations. A continuous profile of these downhole properties is created from this data that allows the geologist to determine what types of sediment (sand, silt, clay)

or layers of bedrock sandstone, shale etc.) exist at that location. Formations have characteristic profiles that aid in their identification and correlation. The physical properties of the aquifers (porosity and permeability) can also be estimated from this data. The use of this tool requires supporting equipment (truck, winch, cable computer, software) that the DNR currently possesses. At the end of this project this equipment will continue to be used as part of the DNR ground water level monitoring program and other related activities.

Field computer
Downloading the data from the data loggers requires regular use of a portable computer that can be used under all types of weather conditions and can survive occasional drops and bumps. This is a special laptop computer that has been manufactured to withstand moisture and shocks that would destroy other laptops. The extra toughness increases the cost compared to a standard laptop but we consider it essential for protecting our priceless data.

Submersible sample pump, reel, tubing and cable
One of the objectives of this project is to characterize the ground water residence time of the Mt. Simon aquifer through laboratory analysis of ground water samples. This data will represent an essential component for understanding the recharge characteristics of this aquifer and limits for sustainable use. Many of the ground water samples will be collected from depths greater than 50 feet below ground surface, which requires the use of a submersible pump. At the end of this project this equipment will continue to be used as part of the DNR county geologic atlas program and other related activities.

Continuous water level monitoring equipment for project wells
Another method for understanding the recharge characteristics of this aquifer and limits for sustainable use is to track water levels continuously over an extended time period. Fluctuations in water levels not caused by nearby pumping might be evidence of aquifer recharge. Tracking water levels with dedicated equipment is efficient and creates scientifically valid information versus manually gathering this data on a much less frequent basis. At the end of this project this equipment will probably remain on all the wells for water level data acquisition as part of the DNR ground water level monitoring program.

Explanation of Capital Expenditures Greater Than $3,500 (2009):

GIS Workstations for three new atlas projects hires
Ordinary desktop computers do not have sufficient memory, hard drive, or graphics card capability to meet the intensive GIS needs of the hydrologist or GIS positions. The delayed hire will cover the costs. Software is departmental standard software. These computers will continue to be used as GIS workstations for future County Geologic Atlas projects.

VI. OTHER FUNDS & PARTNERS/ PROJECT STRATEGY:

A. Project Partners

M.L. 2008

Minnesota Geological Survey, total from appropriation	$706,000
Nicollet County (well location verification)	in-kind contribution
Blue Earth County (well location verification)	in-kind contribution
Sibley County (well location verification)	in-kind contribution

M.L. 2009

Minnesota Geological Survey, total from appropriation	$820,000
Anoka County (well location verification)	in-kind contribution
Wright County (well location verification)	in-kind contribution

B. Other Funds proposed to be spent during the Project Period (2008 and 2009):

The report from Result 1 (Groundwater level monitoring guidance document) will be reviewed and edited by several senior staff at the DNR and other state and federal agencies. The project will be managed by existing DNR staff with salary paid through the general fund.

Result 6 (Acceleration of county geologic atlas Part B reports) will be supported by existing DNR staff with salary paid through the general fund. The project will be managed by existing DNR staff with salary paid through the general fund.

C. Spending History (2008 and 2009): LCMR provided funds for the Mankato State University, Water Resource Center to create and publish geologic atlases in the project area covered by this work plan.

D. Time:

E. Project Impact and Long-term Strategy (2008 and 2009):

This project will create both short and long-term benefits for the people and natural resources of the region. The information generated by this project will be immediately useful to water management scientists, planners, drillers, consultants, industrial users, and municipal officials for understanding and assessing local ground water conditions for protection and wise use. Atlas acceleration funds are part of a long-term plan to complete country geologic atlases for the entire state.

VII. DISSEMINATION:

The well logs, geophysical logs and well construction information from the borehole drilling will be submitted to the Minnesota Geological Survey (MGS) for inclusion in the county well index. The drill cuttings from the boreholes will be placed in sample bags and submitted to the MGS for archiving and analysis. Laboratory analysis results of water samples will be archived in a program database. The final report will be available on the DNR Waters website.

VIII. REPORTING REQUIREMENTS:

Periodic work program progress reports will be submitted not later than 12/1/08, 7/1/09, 12/1/09, 7/1/10, 12/1/10, 7/1/11, 12/1/11, 6/30/12

IX. RESEARCH PROJECTS:

Attachment A: Final Budget Detail for 2008 Projects

Project Manager Name: Jim Berg, DNR Waters

Trust Fund Appropriation: $ 894,000

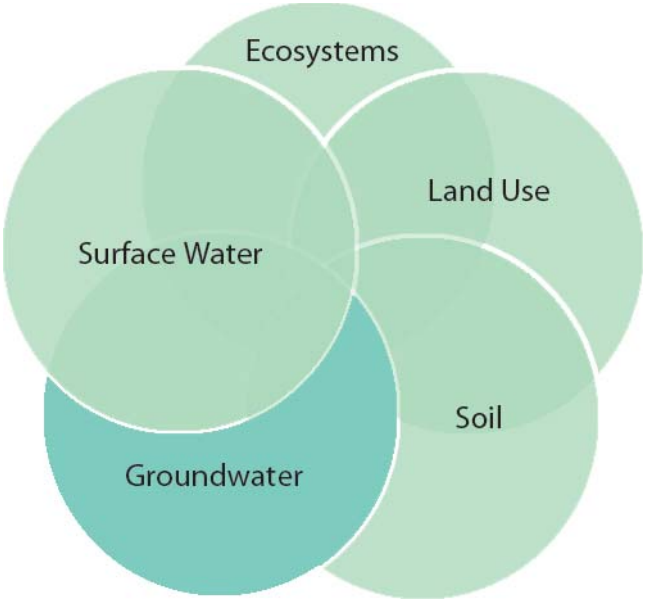
Project Title: South-Central Minnesota Groundwater Monitoring and County Geological Atlases

Date: 6/30/11

2008 Trust Fund Budget	**Result 1 (DNR) Budget:**	**Amount Spent**	**Balance**	**Result 2 (DNR) Budget:**	**Amount Spent**	**Balance**	**TOTAL BUDGET**	**TOTAL BALANCE**
	Groundwater level monitoring guidance document			*Test drilling, monitoring well installation, sampling, laboratory analysis, water level measurement*				
BUDGET ITEM								
PERSONNEL: wages and benefits	33,000	33,000	0	99,000	99,000	0	132,000	0
						0		
Contracts						0		
University of Minnesota hydrogeochemistry lab -- lab analysis of ground water samples				7,989	7,989	0	7,989	0
Drilling contracts				694,474	694,474	0	694,474	0
SHPO assessments				6,799	6,799	0	6,799	0
						0		
Equipment						0		
Down-hole geophysical logging tool				0	0	0	0	0
Submersible sampling pump and accessories or contracted sampling services				8,645	8,645	0	8,645	0
Field computer				4,267	4,267	0	4,267	0
Continuous water level monitoring equipment				18,298	18,298	0	18,298	0
						0		
Travel expenses				19,088	19,088	0	19,088	0
						0		
Other						0		
Supplies				2440	2,440	0	2,440	0
COLUMN TOTAL	**$33,000**	**$33,000**	**$0**	**$861,000**	**$861,000**	**$0**	**$894,000**	**$0**

Minnesota Groundwater Level Monitoring Network—

Guidance Document for Network Development



Minnesota Department of Natural Resources

ENVIRONMENT AND NATURAL RESOURCES TRUST FUND

May 2011

Funding for this project was provided by the Minnesota Environment and Natural Resources Trust Fund as recommended by the Legislative-Citizen Commission on Minnesota Resources (LCCMR).

This report represents Result 1 of the LCCMR project “South-Central Groundwater Monitoring and County Geologic Atlases” (M.L. 2008 Chap. 367, Sec. 2 Subd. 4 (h)).

Authors
Scott Pearson
Jan Falteisek
Jim Berg

Contributors and Reviewers
Mike MacDonald
Jeremy Rivord
Joy Loughry
Evan Drivas

Version 2.3, May 2011

If you have questions or would like additional information, please contact Jan Falteisek at 651-259-5665.

Minnesota Department of Natural Resources
500 Layfayette Road North | Saint Paul, MN 55155-4040 | www.dnr.state.mn.us | 651-296-6157
Toll free 888-MINNDNR | TTY 651-296-5484

This report is available in additional formats upon request, and online at www.dnr.state.mn.us

Contents

Executive Summary.....5

Section 1: Introduction.....6
1.1 Introduction.....6
1.2 Vision.....6
1.3 Mission Statement.....6
1.4 Goals and Objeces.....6
1.5 Groundwater: More than Just Aquifers.....8
1.6 Historical and Background Information.....8
1.7 Current State of the Minnesota Groundwater Level Monitoring Network.....10
1.8 Review of Groundwater Level Monitoring Networks in Other States.....17
1.9 National Efforts to Guide Groundwater Level Monitoring.....19
1.10 Network of Networks.....19
1.11 Monitoring a Three-Dimensional System.....20

Section 2: Designing the Network and Allocating Wells Within the Network.....21
2.1 Well Density as a Network Design Element.....21
2.2 Unit Areas as Network Design Elements.....23
2.3 Groundwater Level Monitoring Well Density and Distribution within the Unit Area.....25
2.4 Allocation of Groundwater Level Monitoring Wells.....28

Section 3: Network Operations.....36
3.1 Instrumentation.....36
3.2 Monitoring Length of Record and Continuity.....37
3.3 Monitoring Frequency.....37
3.4 Data Post-Processing and Hydrographs.....38
3.5 Data Uses and Limitations.....39
3.6 Database Management and Protocols.....39
3.7 Data Availability and Access.....40

Section 4: Estimated Cost to Develop a Statewide Backbone Groundwater Level Monitoring Network.....43

Section 5: Recommendations.....47
5.1 Technical Recommendations.....47
5.2 Implementation Recommendations.....48

Section 6: Conclusion.....49

References.....50

Glossary.....51

Appendices.....53

Appendix 1: Agreement for Installation and Maintenance of a GWLM Well.....53
Appendix 2: Groundwater Level Monitoring Field Check List.....55
Appendix 3: Special Terms, Conditions, and Specifications for Drilling Contracts.....56
Appendix 4: Site Safety Plan for DNR Staff Working on Drilling Sites.....62
Appendix 5: Network Policy and Criteria Documents.....66
A5.1: Accepting existing wells.....66
A5.2: Installing new wells.....69
A5.3: Removing wells.....71
A5.4: Installation and Use of Electronic Data.....74
A5.5: Vibrating Wire Transducer Use.....79
Appendix 6: DNR Waters Groundwater-Level Monitoring Program Technical Guides.....83
A6.1: Well Construction Methods and Materials.....83
A6.2: Well Siting Guide.....85

Executive Summary

Minnesota's environmental and economic future depends on a continued and available supply of groundwater that is managed sustainably. The Minnesota Department of Natural Resources is responsible for managing the quantity of groundwater use through appropriation permits and monitoring water levels. Groundwater quantity estimates for management purposes depend on a historical record of water level measurements. However, the state's current groundwater level monitoring network does not provide adequate statewide groundwater quantity information because many areas and groundwater resources are unmonitored.

This Guidance Document outlines how Minnesota's current groundwater level monitoring network of approximately 750 wells should be expanded to approximately 7000 groundwater level monitoring wells to meet monitoring needs. This expansion is necessary because large areas in Minnesota are not adequately monitored. Many areas of Minnesota are underlain by multiple aquifers, all of which must be considered in developing the long-term network that will provide adequate resource data. A more complete and integrated network of groundwater level monitoring wells will provide stakeholders, local government officials, and groundwater resource managers with the information needed to:

- Understand the status of groundwater quantity throughout the state
- Formulate management responses to changing water levels
- Plan for the future based on current scientific data

This document is intended to provide the DNR with a guide to build the backbone network that will support the state's current and future groundwater level monitoring information needs. Network wells will become long-term assets used to fully understand, manage, and assess Minnesota's groundwater resources. As described in this document, this is an unprecedented expansion project that will vastly improve the understanding of Minnesota's groundwater resources. The envisioned expansion is a very significant undertaking, estimated to require 30 years to complete and cost $94.7 million. The continued operation and maintenance of the network assets as the network expands is also a significant undertaking, requiring on-going support to acquire, analyze, and interpret groundwater level data and to make the data readily available to a wide variety of users.

The Minnesota groundwater level network as it develops into the future is intended to meet information needs for sustainable management of water resources. The existing network, while limited, provides invaluable data for resource managers; the expanded network will provide greatly improved data resource to understand groundwater system response to change and provide the groundwater quantity data needed to make informed decisions to protect Minnesota's groundwater resource for the future.

Section 1: Introduction

This document is a guide for the continuation and further development of the Minnesota Department of Natural Resources' (DNR's) Groundwater Level Monitoring (GWLM) Network. Groundwater level data obtained from network wells provides an essential portion of the information needed to understand groundwater system change over time and effectively manage the resource.

Staff of the DNR's Division of Ecological and Water Resources formed the Groundwater Level Monitoring Work Group and their efforts are reflected in this document. Sections 1.1 through 1.4 reflect a common understanding of DNR staff in the Work Group. The subsections following set forth background information that was considered in the network design discussed in Section 2.

1.1 - Introduction

This document provides a guide for expanding the existing network of groundwater level monitoring wells to provide the information needed to effectively manage the groundwater resource. The network, operated and managed by the Minnesota Department of Natural Resources, provides groundwater level data from monitoring wells that is used in conjunction with climate, stream flow, lake level, and other hydrologic system data to accurately track trends over time in the hydrologic system, including groundwater quantity. These data describing the hydrologic condition of streams, lakes, aquifers are necessary for the long-term sustainable management of the state's water resources.

Measurement of water levels in wells is currently the only reliable technology to monitor changes in the quantity of groundwater. Adequate assessment of groundwater system trends depends on knowing water level changes over time measured in a sufficiently large network of wells. The wells measured must be sited in proper locations, installed to measure desired water-bearing zones (i.e., aquifers), and measured according to standard procedures.

The vision and mission statements for the DNR groundwater level monitoring network define what is hoped to be achieved over time to support the protection and management the groundwater resources of Minnesota. The goals and objectives are the blueprint for the ongoing and future network operation and development.

1.2 Vision

To assure long-term sustainable management of Minnesota's groundwater resources.

1.3 Mission Statement

Since there is no alternative technology to reliably measure groundwater levels other than through the use of wells, DNR will need to collect, analyze, and provide groundwater level data acquired from an expanded and integrated network of wells. The network will allow the DNR to assess the quantity of the groundwater resources and its response over time to natural and human-induced changes.

1.4 - Goals and Objectives

The following six goals with stated objectives were developed by the DNR Division of Waters' Groundwater Level Monitoring Work Group:

> Goal 1: Develop and maintain a statewide, integrated long-term groundwater level monitoring well network.

Objectives:

- Continue and maintain the existing network.
- Complete network assessment and inventory
- Develop a long-range network plan to support resource management.
- Prepare a priority plan for adding wells to the network.
- Prepare a plan for removing non-functional wells from the network.
- Use wells owned or managed by others, as appropriate, to extend network coverage.
- Construct new wells where needed according to long-range and priority plans to extend network coverage.

Goal 2: Collect groundwater level measurements statewide.

Objectives:

- Collect regular, periodic groundwater level data statewide.
- Collect long-term data whenever possible.
- Collect data from well nests that measure different aquifers at the same location.
- Utilize electronic data collection and transfer methods when possible and appropriate.
- Establish agreements that allow access for measurements and maintenance.

Goal 3: Oversee data collection and maintain data collected through water appropriation permits and special studies.

Objectives:

- Consolidate groundwater level data generated by water appropriation permit requirements or special studies.
- Establish procedures and data review criteria for data acceptance into the GWLMN database.
- Maintain all data for long-term access and analysis.

Goal 4: Maintain a statewide groundwater level data storehouse.

Objectives:

- Consolidate all groundwater level data for shared access through a single portal.
- Maintain all data for long-term access and analysis.
- Provide easy access to the data to meet both internal and external users needs.

Goal 5: Provide general interpretations of groundwater level data, including trends and fluctuations due to human impacts and natural influences.

Objectives:

- Enhance the existing web-based well hydrograph application for individual wells.
- Provide additional correlated data interpretation, such as precipitation time series data, lake level data, climate events, and water use data so that relationships to groundwater level changes can be investigated.
- Develop tools and applications for automated or semi-automated general data analysis.

- Develop criteria and techniques to portray the general resource status by aquifer and/or area for both short-term and long-term trends.
- Provide interpretations to the public and users in a form that is flexible and cost effec tive.

Goal 6: Provide data and technical assistance for in-depth technical analysis.

Objectives:
- Consolidate and maintain collected groundwater level data through a single portal in a form that provides the necessary data elements for detailed technical analysis.
- Assist users to access the data or provide customized database queries on request.
- Assure that internal and external users have access to all relevant data.
- Provide technical assistance and data interpretation.

1.5 - Groundwater: More than Just Aquifers

The current groundwater level monitoring network is designed to measure water levels in the more significant aquifers in Minnesota. However, to fully assess the status of our groundwater resource, the non-aquifer formations that convey water to, from, or between aquifers also need to be monitored.

Aquifers are the most well known among water-bearing geologic units of rock and sediment, although groundwater occurs in geologic units that are not defined as aquifers. The sediment and rocks below the water table are saturated with groundwater; the more permeable formations that readily release water are defined as aquifers and can be used for a water supply. Less permeable formations tend to release water slowly and are generally not defined as aquifers or considered reliable water supplies. The less permeable sediments and rock can transmit, over time, significant quantities of water to replenish aquifers.

Groundwater is actually a flow system that occurs within a three-dimensional geologic container of sediment and rock. The geologic container comprises many different geologic materials with varying properties. Water moving from the land surface to aquifers beneath the land surface will move in and between both aquifers and non-aquifers on its path from recharge into the groundwater system to discharge from the groundwater system. and water saturates nearly the entire geologic container. Since water is essential for life, geologic materials that can supply water or are aquifers have been the focus of geologic mapping and monitoring. As aquifers are more intensively used for drinking water, industry, agriculture and other purposes, the replenishment of aquifers from non-aquifers requires more thorough understanding. In order to better quantify Minnesota's groundwater supply, the status or condition of non-aquifer units also need to be monitored and assessed. Therefore, both aquifer and non-aquifer groundwater monitoring sites need to be included in the GWLM Network.

1.6 - Historical and Background Information

Personnel from Minnesota's Department of Conservation, Division of Waters first began collecting groundwater level records in 1932. This network began as a modest collection of water level measurements from a small number of wells, and additional sites were added slowly during these early years. As of June 2010, DNR Waters managed a cooperative network of approximately 750 groundwater-level groundwater level monitoring wells. In 1975, R. F. Norvitch of the United States Geological Survey (USGS) described the beginnings of the first Federal water level measuring program:

"Groundwater level monitoring [in Minnesota] began in 1942, on the farm owned by Irwin

Kjelshus located in Brown County as part of a federally financed program for the collection of basic records. This and one other well in Morrison County were designated as Federal Index Wells. Water level data from the wells were sent monthly to the staff of the Water Resources Review."

The Norvitch report gave details of the USGS groundwater-level monitoring effort and represents one of the earlier descriptions of groundwater-level monitoring in Minnesota.

A 1993 DNR summary report outlined the progress of the Groundwater Level Monitoring Well Program. At that time, a total of 650 groundwater level monitoring wells were actively monitored and paper records were being organized. An electronic database was transferred from the USGS to the Division's network server, where missing information was appended to file records and file updates were completed. Also, at that same, 20 new groundwater level monitoring wells were added to the network. DNR personnel on these improvements to the GWLMN were partly funded by the 1989 Minnesota Clean Water Act.

Under contract with DNR, Soil and Water Conservation Districts (SWCD) cooperators currently measure water levels monthly at most of the groundwater level monitoring wells and report the readings to DNR. Readings are also obtained from volunteers at several locations.

Most recently, DNR has produced two detailed and closely-related reports titled "Long-Term Protection of the State's Surface and Groundwater Resources January 2010" and "Groundwater: Plan to Develop a Groundwater Level Monitoring Network for the 11-County Metropolitan Area". Both of these documents outline and discuss the DNR's groundwater perspectives and policies, including the need for long-term groundwater level monitoring. These and other reports are relevant to and interconnected with this document.

1.7 - Current State of the Minnesota Groundwater-Level Monitoring Network

The current network provides groundwater-level data measured at approximately 750 wells dsitributed throughout the state. Most, but not all, counties have at least one GWLM well that is measured, and most of the wells are measured once per month. Figure 1 shows the distribution of measured and unmeasured groundwater-level monitoring wells in the network. These wells tend to be located in areas underlain by significant aquifers. Some counties do not have any measured wells in the network because the counties are not participating in the network, population levels are low, or because water resources are limited in those locations.

Over the decades of network operation, the DNR has collected water level measurements from as many as 1,639 groundwater-level monitoring wells. Wells that used to be measured, but that are not currently measured are called unmeasured wells; the historical data from these 889 unmeasured wells are main-

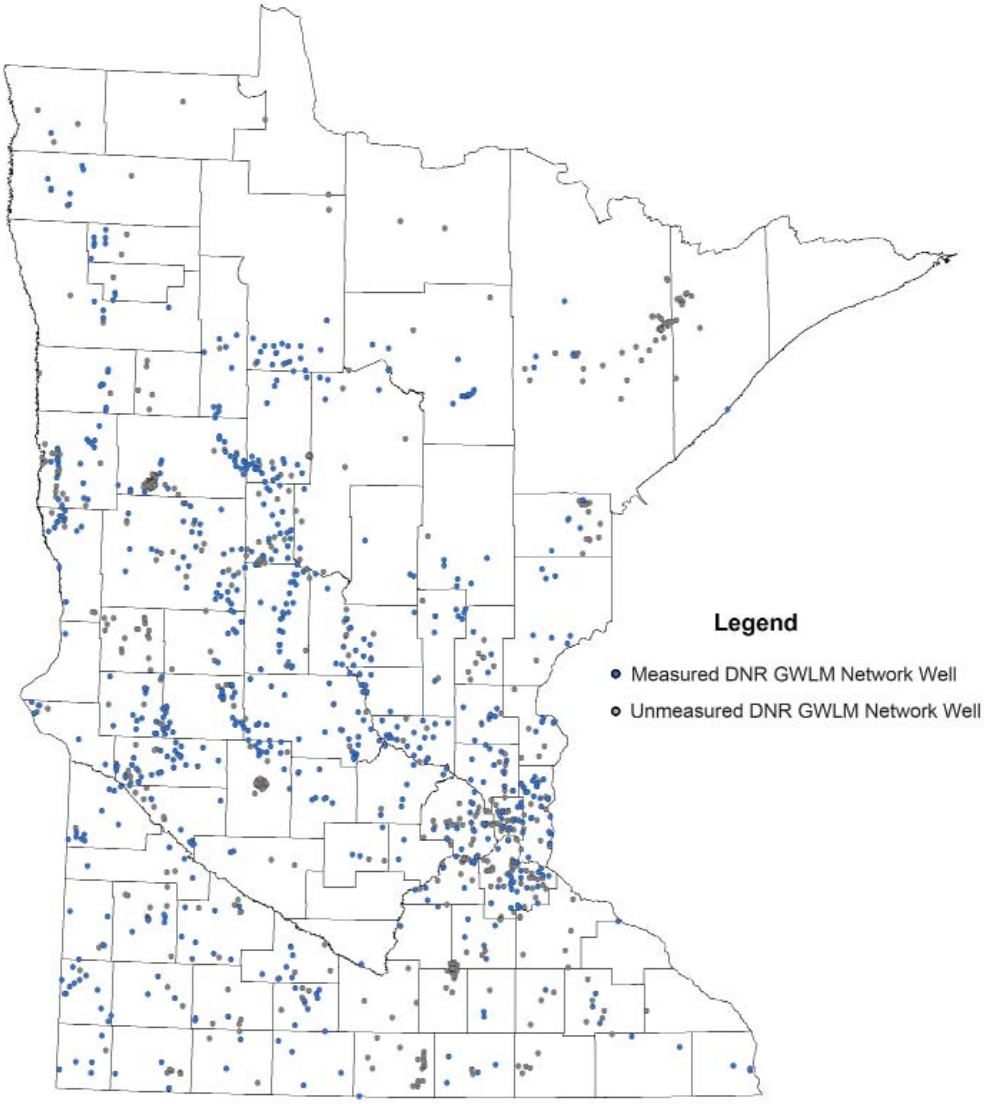


FIGURE 1. Map of Measured and Unmeasured DNR GWLM Wells.

tained in a database, and their locations are shown in Figure 1. Wells at unmeasured sites may still exist but are not measured, they be sealed and unmeasurable, or they may no longer exist. The reasons for not measuring wells include the following: the condition of the well degrades, access to the well changes, there is no local cooperator available to measure the well, or the well is pumped. There is an effort to stop measuring pumped wells, when possible, because the measured water level in a pumped well will not reflect the ambient aquifer water level, and may compromise the data.

The GWLM Network has been developed over decades with groundwater level monitoring wells added as the DNR gained access to each well. Typically, groundwater level monitoring wells were added to the network as a result of a groundwater inquiry or water use investigation. As a result, the current network consists of a patchwork of wells with varying purposes including: municipal supply wells, irrigation wells, monitoring wells, and private wells. Since the purposes vary, the construction of the wells also varies by depth, size, diameter, and aquifer monitored.

The GWLM Network includes wells that that were constructed at various times. These wells became part of the network at different points in the past, resulting in water level records of varying lengths. Table 1 shows the age profile of water level records with the corresponding number of wells in the network as of 2010. The length of well record is important because a long-term record contains the historic highs and lows that increase the data value. Most network wells have data records from 20-40 years. The network has relatively few groundwater-level monitoring wells with monitoring records longer than 40 years, relatively.

TABLE 1. Data Record Length Profile of Measured Wells in the Groundwater Level Monitoring Well Network

Years of Record	Number of Wells
0-10	121
10-20	116
20-30	255
30-40	173
40-50	53
>50	8
Total	726

The length of data record only indicates how long the wells have been measured; wells with long data records may have been constructed significantly earlier than the start of the data record. Some wells in the network were constructed many decades before becoming part of the network.

DNR Waters, supported through the state General Fund, is assessing the condition of all measured and unmeasured GWLM Network wells (Figure 2). The assessment includes locating the well with Global Positioning System (GPS) equipment, recording the well's elevation, taking site photographs, collecting physical well measurements and conducting hydraulic tests where appropriate. As of July 2010, the assessment of the GWLM Network wells has been completed in 61 of the 87 counties.

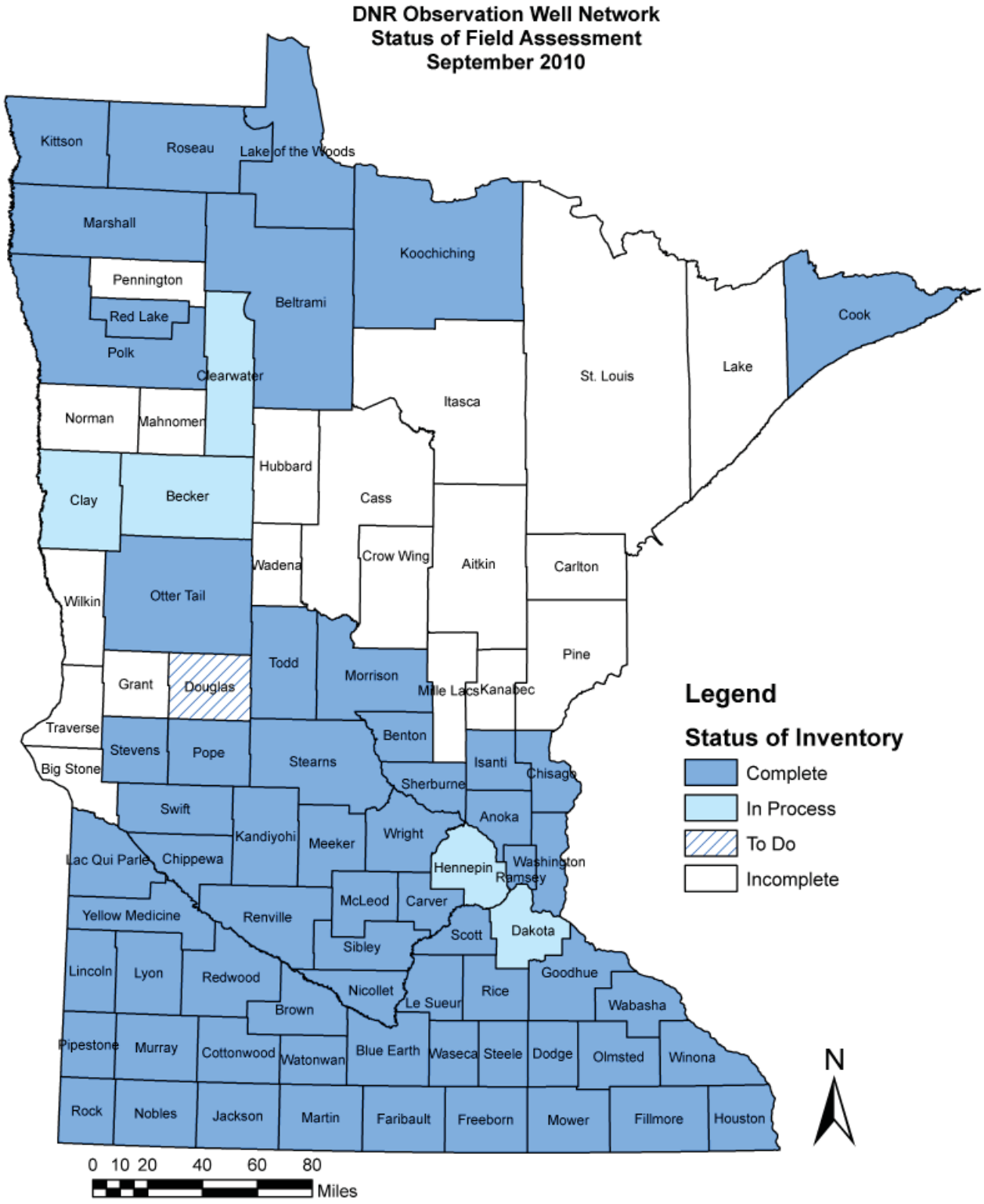


FIGURE 2. DNR Status of Field Assessment.

Approximately 1077 wells have been assessed, leaving approximately 562 wells remaining (Figure 2). Currently unmeasured wells are also included in the network assessment, and being revisited to verify records and to determine if it is possible to reactivate the well with a new groundwater level monitoring well, so that the continuity of water level records can be re-established. If the well is in poor condition, but the continuity of the long-term record is a priority, the well may be replaced. A copy of the Field Check List used for the groundwater level monitoring well assessment is included as Appendix 1. As part of the assessment process, a list of wells requiring maintenance has been created. The list includes specific items identified during the site visit that need attention or repair. The assessment is scheduled to be completed during 2011.

Most wells in the GWLM Network are located on private property and are privately owned. DNR staff are granted access to the well by the well owner through written or verbal access agreements. A process is underway to obtain updated written access agreements at all actively-measured groundwater-level monitoring well locations. A copy of an access agreement is included as Appendix 2. Experience has shown that basing a network mostly on private wells is difficult to operate because of the changes that disrupt access, such as ownership transfers and cancelled agreements. Establishing network wells on public property when possible is preferred since ownership is less likely to change.

Wells that are part of the network require ongoing maintenance. Over time, wells may be damaged or may not function properly. Wells need to be properly repaired and maintained if quality data are to be obtained. For privately-owned wells, the maintenance of those wells is the responsibility of the well owner. Network wells controlled by the DNR are maintained by the GWLM Network manager.

When the assessment described earlier or other information indicates that a GWLM Network well does not provide representative water levels, the GWLM Network manager evaluates the well condition and determines whether to redevelop, replace, or seal the well. Redevelopment of a well involves removing sediments, mineral scale, and biological slimes from the well. If the well does not respond to redevelopment, the well is sealed, and a replacement is considered by the GWLMN manager based on the importance of that particular location. The decision to replace a well is based on the presence of other GWLM Network wells in the vicinity. Simple well replacements to a depth of about 50 feet can be accomplished with the DNR Waters' staff with the hollow stem auger drill rig (Figure 3).

FIGURE 3. Installing a shallow GWLM well using a hollow stem auger drill.

This drill rig is operated under the supervision of DNR Waters-licensed well drillers. For deeper groundwater level monitoring wells, registered water well drilling contractors are hired through a competitive bidding process (see Appendix 3). If the DNR determines that a private well needs to be replaced, the DNR will work to place the replacement well on appropriate public property. If no public property is available, replacement on the existing private land will be evaluated and if necessary an agreement with the property owner will be obtained. The property owner would be responsible for sealing the private well on their property if the DNR no longer uses the well as an GWLM Network well.

The approximately 750 groundwater-level monitoring wells in the GWLMN may seem to provide adequate coverage (Figure 1). However, the map shown in Figure 1 tells an incomplete story; while an existing well may be indicated at a given location, this does not mean that all the aquifers in that location are adequately monitored.

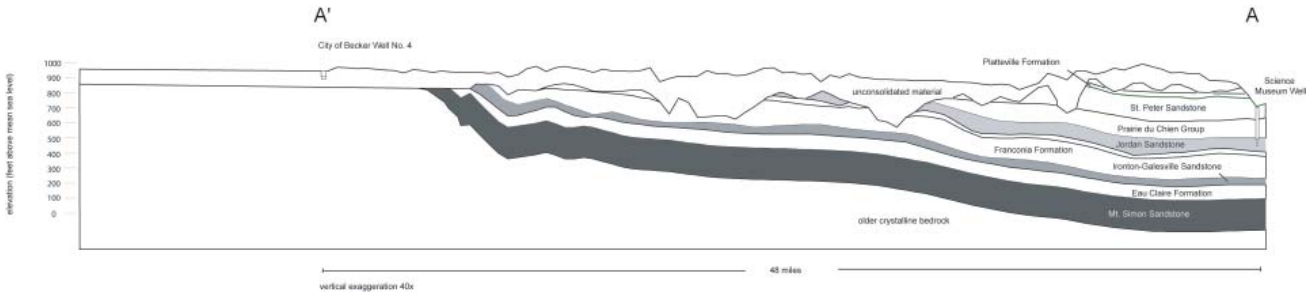


FIGURE 4a. Cross section from downtown St. Paul to the city of Becker showing multiple regional water supply aquifers.

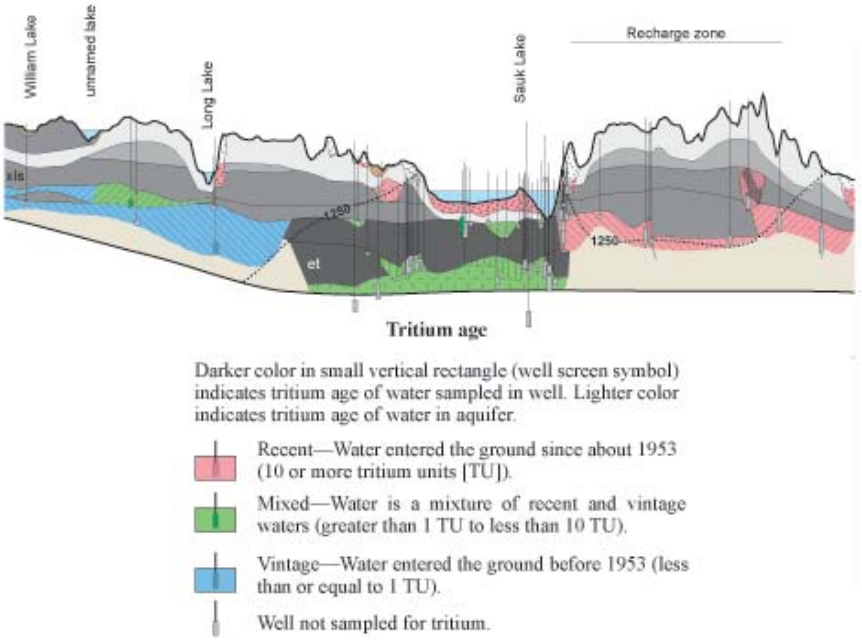


FIGURE 4b. Portion of cross section F-F' from the Todd County Geologic Atlas, Plate 8. The grays show the position of clay-rich sediments (till) in the subsurface. Lighter grays are more permeable.

The cross section example in Figure 4a of the northwestern portion of the Twin Cities metropolitan area shows how the major bedrock aquifers of southeastern Minnesota are continuous over regional areas. Some subsurface materials are less continuous, such as the Quaternary sediments that underlie most of the landscape of Minnesota. Minnesota's subsurface contains multiple layers of Quaternary sediment and more than one aquifer at a single location can be present at different depths. The aquifers within Quaternary sediments are less extensive than the bedrock aquifers in Figure 4a. Figure 4b shows a portion of northwestern Todd County. In this figure, sediments colored pink, green, and blue have been identified as aquifers and they illustrate how multiple aquifers can occur in one area but may not be continuous over larger areas. The statewide network design must understand and incorporate these variations in depth and continuity of groundwater resources to assure adequate monitoring. The mapping of Quaternary sediments and aquifers is incomplete in many parts of the state, and is ongoing as part of the County Geologic Atlas Program and other mapping investigations. As mapping proceeds, new information will guide future network development.

The following statewide well location and aquifer extent maps show the subsurface variability of aquifers in Minnesota and the existing monitoring well distribution within those aquifers. Figures 5a-5e shows the well locations for selected aquifers or aquifer groups. When the locations of measured wells from Figure 1 are presented according to aquifer or aquifer groups, unmonitored areas are revealed in the current GWLM network. The greater the distance between wells, the more uncertainty exists about the actual water level in an aquifer. The uncertainty varies by depth and resource. The water table and shallow Quaternary settings have the most variation and therefore require more monitoring wells in an area. In contrast, water levels in wells in deeper regional bedrock aquifers are more predictable and thus require fewer monitoring sites per given area.

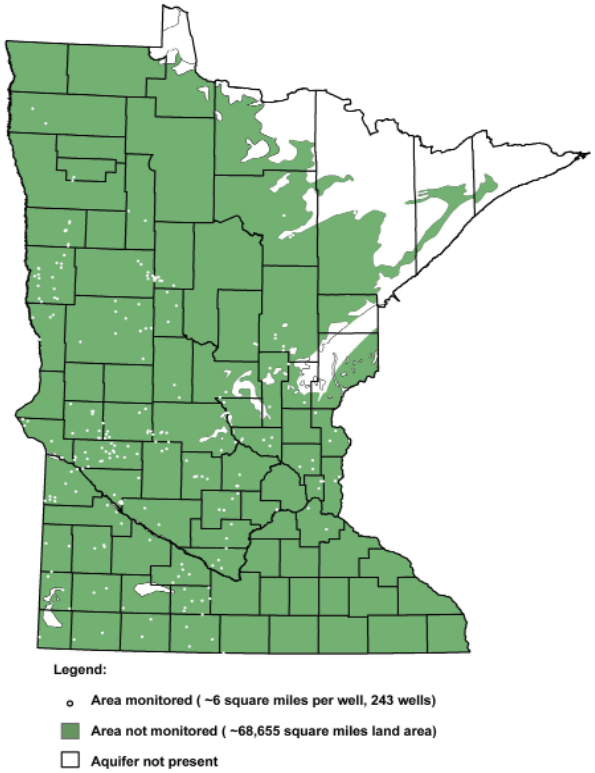


FIGURE 5a. Map of existing monitoring wells and potential extent of buried drift aquifers. The buried drift aquifers have not been completely mapped, and occur at multiple depths in many locations.

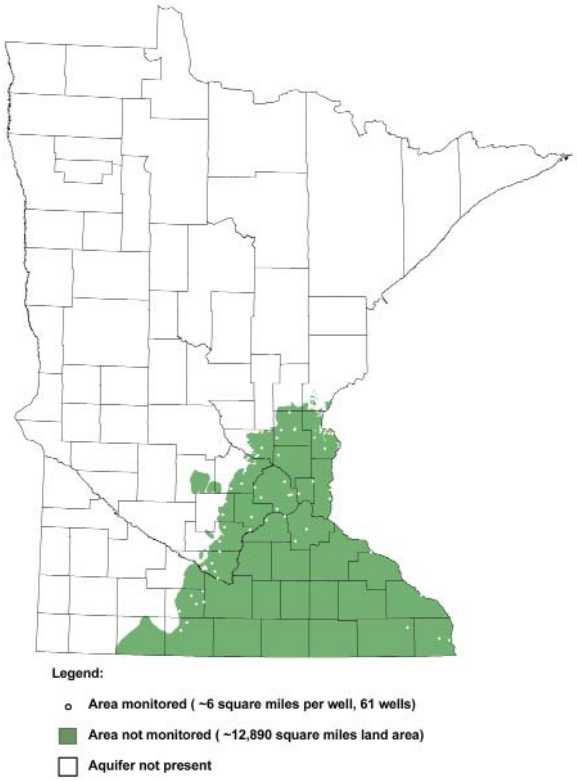


FIGURE 5b. Map of existing monitoring wells and the extent of the Mount Simon aquifer.

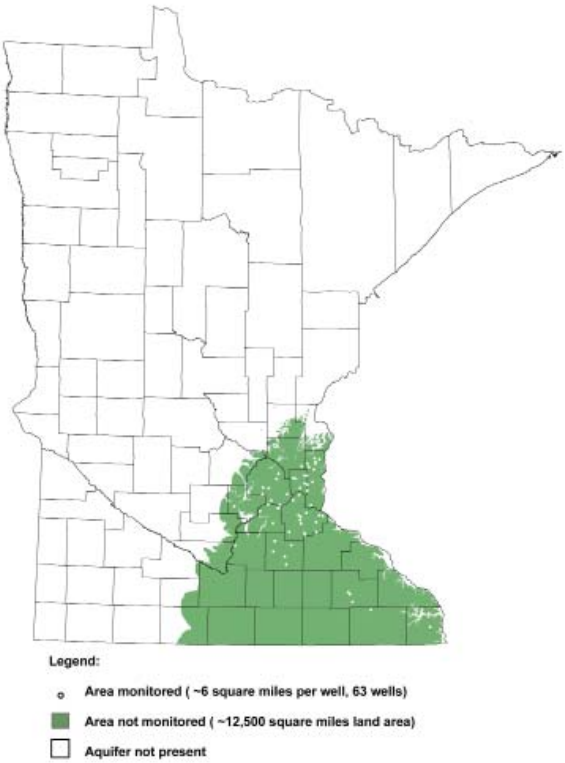


FIGURE 5c. Map of existing monitoring wells and the extent of the Prairie du Chien aquifer.

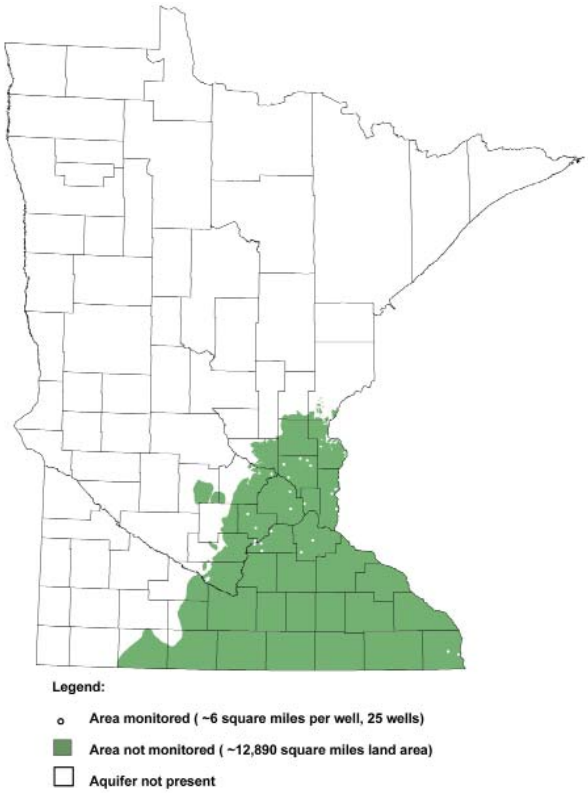


FIGURE 5d. Map of existing monitoring wells and the extent of the Tunnel City/Wonewoc aquifer.

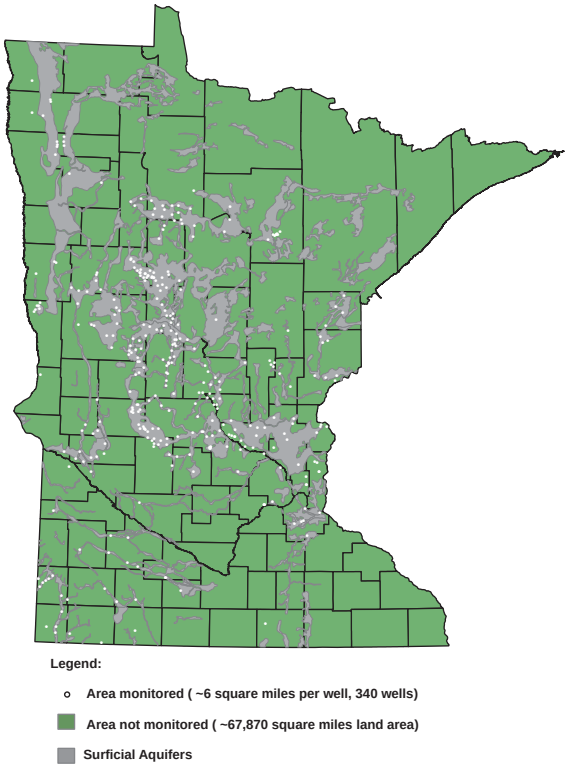


FIGURE 5e. Map of existing monitoring wells and the extent of the water table system. The extent of the water table system includes both aquifer and non-aquifer water table settings.

Additional network wells are brought into the network though accepting existing wells or installing new groundwater level monitoring wells. Policies and criteria for accepting existing wells or installing new wells into the network are included in Appendix 5. These policies and criteria are followed by the GWLM Network manager when evaluating a proposed existing well for inclusion in the network or when considering adding a new well to the network. The criteria include both technical and administrative criteria that are the basis for accepting existing wells or installing new wells. In the event a well is no longer needed as part of the network, related policies and criteria are considered for the removal of a well from the network.

Many aquifers throughout the state lack adequate groundwater level monitoring data. The extent and coverage of the current network show that there is a need for additional groundwater level monitoring wells to achieve long-term data goals that will help protect and manage the water resources of the state. A more detailed discussion of the network expansion is covered in Section 2. The initial network was built using a gathering of resources; the current network has been built and operated using limited funds. Recently, the need for additional groundwater level data has been recognized by citizen and Legislative advocates, and more funding has been allocated to begin needed expansion and improvement of the network.

1.8 - Review of State Groundwater Level Monitoring Networks in Other States

A review of groundwater level monitoring networks operated by other states was completed using information from public resources. During the review process it became clear that a fair comparison would be difficult because of variations in the reporting methods for individual state networks.

In 2007, a nationwide report was published that summarized states' monitoring efforts (Figure 6). In this report, the responding states provided answers to 24 questions including the number of wells, measurement frequency, and nature of that state's network(s). In that report, Minnesota ranked 18th out of the 36 states based on total number of wells. Minnesota's network ranks 15th among the 36 states based on well density.

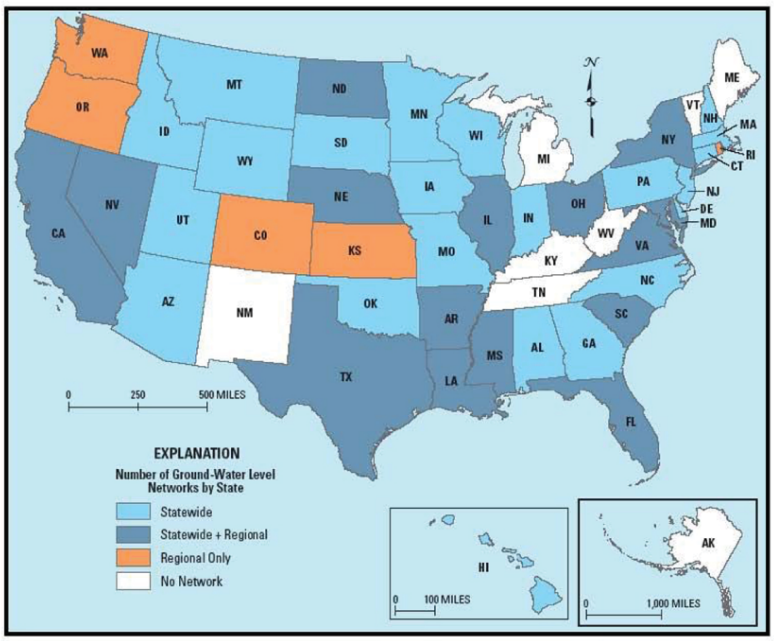


FIGURE 6. Summary of States' Groundwater Level Monitoring Efforts (Association of American State Geologists, 2007).

Based on 42,916 groundwater level monitoring wells, California appears to lead all other states. California's well density is 0.4 wells per square mile. However, while California reported having 8,245 wells with a five-year or longer length of record, the survey results did not indicate how many of these wells have been measured monthly.

To make a valid comparison, the Minnesota groundwater level monitoring well network was compared to the other 29 states that measure water levels once a month. North and South Dakota ranked first and second, Florida was third, and Minnesota ranked fourth. Table 2 lists the states that responded to the survey question that asked the number of wells that are measured monthly. Not all states responded to this survey, so the information presented on this table may be incomplete.

TABLE 2. States that Measure Groundwater Levels Monthly.
[Data from Association of American Geologists, 2007].

Rank	State	Total Wells Measured	Total Wells with at Least 5 Years of Measurements
1	North Dakota	2547	2547
2	South Dakota	1639	1639
3	Florida	1310	953
4	Minnesota	675	675
5	Texas	500	460
6	North Carolina	247	
7	Washington	200	
8	Georgia	180	180
9	New Jersey	163	156
10	Wyoming	150	140
11	Missouri	101	70
12	Massachusetts	92	90
13	Arizona	90	40
14	Virginia	80	46
15	Ohio	77	70
16	Illinois	50	50
17	New York	50	37
18	Delaware	45	45
19	Maryland	43	
20	Indiana	40	40
21	Nevada	38	38
22	New Hampshire	27	26
23	Montana	25	25
24	Arkansas	24	20
25	Kansas	20	20
26	Alabama	18	18
27	Nebraska	12	12
28	Louisiana	8	8
29	Oregon	4	4

1.9 - National Efforts to Guide Groundwater Level Monitoring

A national group of groundwater experts advises the federal government on water resource data issues. This group, known as the Advisory Committee on Water Information (ACWI), was originally formed by the Secretary of Interior under the Federal Advisory Committee Act; the ACWI formed a sub-group known as the Subcommittee on Groundwater (SOGW) that is working to develop and encourage implementation of a nationwide, long-term groundwater quantity and quality monitoring framework. This framework would provide information necessary for the planning, management, and development of groundwater supplies to meet current and future water needs, and ecosystem requirements.

In June of 2009, SOGW released the report "A National Framework for Groundwater Monitoring in the United States". This document outlines the building of a National Ground-Water Monitoring Network (NGWMN) to include both groundwater levels and groundwater quality. More recently, Minnesota's groundwater level monitoring wells located within southeast and south central Minnesota (including the Twin City Metropolitan Area) were selected by SOWG, as were wells from four other areas (Illinois-Indiana, Montana, New Jersey and Texas), for inclusion in a pilot project to implement a national network. The data acquired via the national network would be available through a national data portal that is currently under development.

1.10 - The Minnesota Groundwater Level Monitoring Network as Part of a Hydrologic Cycle Network of Networks

The current DNR GWLM Network includes about 750 wells that are measured manually. A small number of these wells are equipped with electronic data collection instruments that can obtain more frequent water level measurements. While the group of about 750 wells is considered the primary component of the network, the DNR network also includes related groups of wells or data collections that are also important components of the network. Examples of other network sources include data from wells that are no longer measured, wells and data required under conditions of DNR appropriation permits, and wells currently or historically part of special studies conducted by the DNR.

Minnesota's GWLM Network does not operate in isolation. The DNR GWLM Network is part of a multi-agency approach in Minnesota that directly or indirectly measures groundwater levels. Other state agencies have established groundwater quality monitoring networks for specific purposes such as groundwater quality assessment and long-term trends. The collection of groundwater levels is part of groundwater sampling protocols for natural groundwater chemistry surveys, investigations related to contaminant releases, and research studies. The efficient collaboration and sharing of groundwater level monitoring efforts and assets among state agencies has been advanced by the development of on-line applications for improved data access and distribution. However, an ongoing challenge is the assembly of groundwater level data from multiple sources.

In addition to the DNR GWLM Network being part of efforts by groundwater quantity and quality monitoring organizations, the DNR Network can also be considered to be part of a larger "Hydrologic Cycle Network of Networks". In concept, the "network of networks" includes the ongoing monitoring efforts by DNR, other state agencies, Federal agencies, and other organizations that track and measure water as it moves from atmosphere, to landscape, to subsurface, and back to the surface, eventually returning to the atmosphere. One example of this "hydrologic cycle network of networks" concept is the monthly DNR Hydrologic Conditions Report series. This report of DNR monitoring provides general information describing the hydrologic status of various water resources across Minnesota. The report compares monthly precipitation, stream flow, lake level and groundwater levels to historical values. The monthly reports are based on information generated by DNR through long term programs committed to record-

ing and tracking the long term status of the state's water resources. The "network of network" concept provides a useful framework for integrating monitoring efforts for the entire hydrologic cycle across multiple organizational levels and geographic scales.

1.11 - Monitoring a Three-Dimensional System

As discussed in Section 1.5, the rock and sediment beneath the land surface, most of which is saturated with water, have varying properties that allow more or less water to move in or between those materials. In addition, the rock and sediment that are aquifers occur at different depths, thicknesses, and distributions. For example, the southeastern portions of Minnesota, including the Twin Cities Metropolitan Area, are fortunate in being underlain by multiple major water supply aquifers; in contrast, other parts of Minnesota have fewer or limited aquifers. Ongoing geologic mapping using digital geospatial technology is providing enhanced three-dimensional depictions of the occurrence of subsurface materials, including both aquifers and the materials that are not considered aquifers.

The groundwater flow system within the geologic framework is also three dimensional; groundwater level data are needed from wells in multiple locations and from wells drilled to varying depths to better understand the groundwater flow system. This three-dimensional information is critical to fully evaluate the movement of groundwater within aquifers, between aquifers, and from recharge areas to discharge areas. A well nest of two or more wells at a single location allows for water level measurements that indicate the hydraulic relationship between two depths; this is known as vertical gradient. Water levels from wells distributed laterally throughout an aquifer provide the data to establish the hydraulic relationship between wells at different locations or horizontal gradient. Both vertical and horizontal gradient data are needed to more fully understand groundwater flow and the impacts of water use and other changes on the groundwater system.

The existing network, as discussed in Section 1.7, has limitations in lateral and vertical data coverage. Due to the costs involved with well installation and management, the capability of the groundwater level monitoring network to collect water levels that adequately describe the three-dimensional groundwater flow system in Minnesota is limited. However, where possible, and with available funding, well nests and additional wells are installed at priority locations to improve lateral and vertical data coverage.

Section 2: Designing the Network and Allocating Wells Within the Network

The approximate number of wells distributed statewide and in varying aquifers to fill our groundwater information needs is 7000, a nearly ten-fold increase from the approximately 750 wells currently monitored. The additional wells will be placed according to a statewide design and installed over time to fulfill long-term groundwater level monitoring needs.

This section introduces the considerations involved in designing a backbone for the long-term Groundwater Level Monitoring Network (GWLMN). Some of the considerations include requirements for adequate coverage, including: number of wells, where they are drilled, how deep they are drilled, and how often they are measured. Adequate coverage at the appropriate locations will help resource managers better understand the response of the groundwater system over space and time; as a result, wells placed in a designed network will support the protection and management of water resources.

Following extensive internal review of the existing GWLM Network, the DNR Groundwater Level Monitoring Work Group determined that approximately 7000 groundwater level monitoring wells are needed to establish long-term trend groundwater levels in Minnesota. This section also outlines the DNR's method of determining well density and distribution based on unit area and the allocation of the groundwater level monitoring well to the various depths with the state to meet long-term information needs.

2.1 - Well Density as a Design Element

Well density is defined as the number of wells per unit area. Groundwater level monitoring well density for a GWLM network such as Minnesota's is not a predetermined number, but may vary considerably depending on the characteristics of a particular area or aquifer resource. The density of wells in an area should be considered flexible, depending upon the following factors:

- Aquifer characteristics: extent, productivity, recharge, leakage, discharge
- Surface water and groundwater interaction zones
- Topography and geology
- Special conditions, such as ecologically-sensitive areas, impacted waters, areas of concern, and other groundwater-related conditions that may be identified in the future.
- Intensity of use, existing water appropriations, and future potential use
- Appropriation permit requirements; potential impacts of use
- Population: water supply use or potential use
- Regional or local importance
- Area dependence on groundwater and alternate source availability

Figure 7 shows the general classes of groundwater level monitoring well network densities established by consensus of the GWLM Work Group. The density classes range from high densities to low densities depending on conditions in or affecting a single groundwater resource. Higher densities are needed, for example, where populations are more concentrated, commercial use is intense, and in locations of regional or local importance. Lower densities are appropriate for less populated areas, areas with lower use, and in locations where groundwater is not a major concern.

The well density ranges listed below are used in the following sections to support the well allocations by resource for the long-term network plan.

Very High	High	Moderate	Low	Very Low
10 per square mile	2 per square mile	1 every 5 square miles	1 per township (36 square miles)	10 for entire state land area (70,400 square miles)
Well density (ρ) and distribution values (d) discussed in Section 2.3				
ρ = 10+	ρ = 2	ρ = 0.2	ρ = 0.028	ρ = 0.00014
d = 0.1	d = 0.5	d = 5	d = 36	d = 7,040

Well Density Class Characteristics	
Very High	High intensity of use, known pumping impacts on other users or supplies, groundwater resources sensitive to change, high potential for impacts on area surface water resources, rapidly declining water levels.
High	High population, high existing or potential use, groundwater system less sensitive to change, possible overlapping well contribution areas, declining water levels and identified potential for pumping impacts
Moderate	A well-known and mapped aquifer with some existing pumping impacts, limited other problems or issues.
Low	A deep, regional confined system with low risk of use impact, low risk of high intensity use
Very Low	Small or limited yield, low population, low intensity of use, limited dependence on groundwater

FIGURE 7. Suggested Groundwater Level Monitoring Well Density Ranges for a Single Groundwater Resource.

2.2 - Unit Areas as Network Design Elements

A unit area is the resource area that is used with well density discussed above to support the allocation of wells for a long-term groundwater monitoring network. Unit area is used in Section 2.1 as the denominator when calculating well density. More commonly-used unit area options are typically based on the following established boundaries:

- County – politically based
- Major basin/ Watershed – topographically based
- Groundwater Province – geologically based
- Aquifer Extent – geologically based

In the context of designing a statewide groundwater level monitoring network, the commonly-used unit area options do not fit the needs of a network that monitors both near surface and deeper groundwater systems. Although familiar and convenient to use, a county-based boundary as a unit area is not a workable unit area for groundwater level monitoring because the extent of aquifers does not follow geopolitical boundaries. Basin/watershed boundaries are defined by topography and since water table elevation in most cases reflects the land surface topography, basin/watershed boundaries are appropriate unit areas for mapping the water table system. The deeper groundwater systems, however, commonly cross basin/watershed boundaries, and are not generally constrained by basin/watershed boundaries; deeper aquifers are geologically defined and are best represented by Groundwater Province and mapped aquifer extent (where known), which are not based on topography. With these considerations, unit area options based only on topography or only on geology or aquifer extent are incomplete, and application of one or the other as the single basis of network unit areas is problematic.

The long-term groundwater level monitoring network requires a flexible unit area that integrates surface conditions related to topography with subsurface conditions of deeper resources that are defined by geology. Therefore, unit areas for network development and the allocation of GWLM wells are defined by basin or watershed for near surface and shallow depths and by Groundwater Province or aquifer extent for aquifers occurring at moderate or deep depths. The division between the two types of unit areas is defined in Figure 8 at about 50 feet beneath the land surface and is identified as the "active hydrologic zone boundary".

Unit Areas		Depth	Hydrologic System	Tritium Residence Time	Hydrologic Condition	Geologic Setting
State Basin (12 State Basins)	State Subregion Watershed (84 DNR Major Watersheds)	Near Surface	Active	Recent	Usually unconfined	Alluvial systems, outwash, till, buried outwash, bedrock
		Shallow		Recent/Mixed		Outwash, till, buried outwash, bedrock
Active Hydrologic System Boundary - approximately 50' below land surface						
Groundwater Province	Aquifer Extent	Moderate	Deep	Mixed/Vintage	Typically confined	Outwash, till, buried outwash, bedrock
		Deep		Vintage		Till, buried outwash, bedrock

Figure 8. Criteria for Defining Unit Areas.

Related criteria included in Figure 8 that will assist the proper selection of unit area are hydrologic system, tritium residence time, and hydrologic condition. Hydrologic system in this description refers to whether groundwater movement is relatively fast and complex with water actively moving between the surface and subsurface (active hydrologic system), or relatively slow with much less interaction between the surface and subsurface (deep hydrologic system). The active hydrologic system is common at the surface and to shallow depths. The deep hydrologic system is typical of groundwater systems at moderate or deep depths. Tritium residence time of groundwater samples, if data are available, may be used to support a selection of unit area by helping to define a hydrologic system.

Tritium values of 10 or more tritium units (TU), defined as Recent, are commonly observed in the active hydrologic system. Tritium values of less than 10 TU, defined as Mixed and Vintage, are commonly observed in the deep hydrologic system at moderate and deep depths, but Mixed values may also be observed at shallow depths. Tritium values equal to or less than 1 TU, defined as Vintage, are typical of the deep hydrologic system at deep depths. Groundwater with recent and mixed tritium age can be considered part of the active hydrologic system with unit area defined by basin or watershed. Groundwater with mixed and vintage tritium can be considered part of the deep hydrologic system with unit area defined by groundwater province or aquifer extent.

Hydrologic condition describes the groundwater system as either unconfined or confined, and is an additional criterion to assist selection of unit area. Unconfined hydrologic conditions occur at the water table. Confined conditions are typical of aquifers in the deep hydrologic system. The unit area for unconfined conditions is defined by basin/watershed while the unit area for confined conditions is most typically defined by groundwater province or aquifer extent.

In Figure 8, the unit areas are presented in two area scales divided vertically by the active hydrologic zone. The unit areas for the active hydrologic zone are defined as the State region and Sub-region areas. The unit areas for the deep hydrologic zone are defined as the Groundwater Province (see Figure 12, Section 2.4) and Aquifer Extent. Table 3 describes the basis for defining the unit areas. The goal of Table 3 is to help determine the active hydrologic zone and the appropriate unit area.

Selection of the appropriate unit area to support development of the Minnesota GWLM network may require, in addition to the primary basis of unit area, the consideration of several additional criteria as discussed above. The selection of unit area is important in the discussion in Section 2.4, describing allocation of groundwater monitoring wells according to unit area and hydrologic system.

2.3 – Groundwater Level Monitoring Well Density and Distribution Within the Unit Area

The concept of well density was introduced in general in Section 2.1. Once the boundaries of the unit area have been decided (Section 2.2), the next step toward designing a statewide groundwater level monitoring network is to determine how many wells per unit area. The following section presents the factors and criteria for determining how many wells per unit area or square mile are needed to adequately collect data from the groundwater resources. The following section further explains the process used to establish the goal number of 7000 wells for the state network.

Well density can be determined using the following equation:

Well Density as:

$\rho = w/A$ (groundwater level monitoring wells per square mile)

ρ (rho) is the well density

w is the number of groundwater level monitoring wells

A is the unit area in square miles

An alternative way to consider the number of wells needed for a statewide monitoring network is the area coverage per well, which is the inverse of well density. This is defined here as well distribution, and can be determined as follows:

Well Distribution is the inverse of density:

$1/\rho = d = A/w$ (square miles per groundwater level monitoring well)

d is the well distribution = $1/\rho$

Density Class	Very High	High	Moderate	Low	Very Low
Area	10 per square mile or greater	2 per square mile	1 every 5 square miles	1 per township (36,000 square miles)	10 for entire state land area (70,400 square miles)
Density (ρ)	ρ = 10+	ρ = 2	ρ = 0.2	ρ = 0.028	ρ = 0.00014
Distribution (d)	d = 0.1	d = 0.5	d = 5	d = 36	d = 7,040

Figure 9. Suggested groundwater level monitoring well density ranges for a single groundwater resource with corresponding calculated density and distribution values. Density class characteristics were presented in Figure 7.

Figure 9 shows the calculated density and distribution values according to the density ranges presented in Figure 7 in Section 2.1. The calculated density and distribution values in Figure 9 are used in Table 3 to show the corresponding relationship between general density classes and specific density and distribution in the example.

Table 3 presents calculated density and distribution values for a constant 1,000 square mile unit area according to a range of wells from 1 to 500 GWLM wells. This shows the number of wells for a given unit area (1000 square miles), but it does not address the actual ground-level placement of well nests or groups of wells, nor the allocation of wells to a specific aquifer. Both density and distribution values are useful, but for operation of the GWLMN, the distribution value (d) is immediately practical since it indicates the number of square miles per GWLM well that the groundwater level well might be considered to be monitoring. Larger distribution values may be suitable for area or regional data gathering, while smaller distribution values may be considered for more local or detailed data needs.

The right column in Table 3 shows how the calculated density and distribution values corresponds to the general density range classes from Figure 9. If the entire land area of Minnesota is considered the unit area, Minnesota's current GWLM well density is 0.010, as calculated by dividing the number of GWLM wells (750) by state land area (70,400 mi2). The 70,400 square miles of land area is calculated from the area of the state (86,938 mi2) minus the area of surface waters and wetlands (13,968 mi2); this area represents the land area on which a well can actually be constructed. The area to be monitored is the entire state area of 86,938 square miles because aquifers extend beneath surface water and wetlands. According to this calculation, Minnesota's current groundwater level monitoring network is in the Low Well Density Class (Land Management Information Center, 2011).

Table 3. Examples of well distribution and density values by varying number of groundwater level monitoring wells in a unit area.

Unit Area A = Square Miles	GWLM wells (w) w = A/d	Distribution Value d = 1/ρ	Density Value ρ = GWLM Well/Square Mile	Well Density Class
1000	1	1,000	0.001	Low
1000	5	200	0.005	
1000	10	100	0.01	
1000	50	20	0.05	Moderate
1000	100	10	0.1	
1000	200	5	0.2	
1000	300	3.3	0.3	
1000	400	2.5	0.4	
1000	500	2	0.5	

Table 4 shows three different well distribution and density value scenarios for two very different unit areas: statewide and a more local scale (Pope County). In this example, Pope County is used as the smaller unit area because it has an existing local GWLM network. For each unit area, the table shows the current number of GWLM network wells compared to the long-term network buildout goal discussed previously and a theoretical network buildout goal of twice the long-term goal. Although the current well distribution and density values of the state and Pope County differ, for comparison purposes similar well distribution and density values are used for the proposed buildout and theoretical buildout scenarios. The current well density class range (see Figure 9) for both the statewide and Pope County unit area is within the Low range. The proposed statewide long-term network development to about 7,000 wells results in a well density class of Moderate; theoretical expansion of the statewide network to 14,000 does not change the well density class. Even at 14,000 wells the well density class range remains in the Moderate class.

Table 4. Examples ofGWLM well distribution and density using Minnesota total land area and Pope County as unit areas.

Unit Area	Unit Area A = square miles	Number of GWLM Wells (w)	Well Distribution Value $d = 1/\rho = A/w$	Well Density Value $\rho = w/A$	Well Density Class Range (See Figure 7)
MN	70,400	approx. 750 (current)	93.9	0.01	Low
MN	70,400	7,000 (proposed build-out)	10.1	0.1	Moderate
MN	70,400	14,000 (theoretical)	5	0.2	Moderate
Pope County	670	26 (current)	25.8	0.04	Low
Pope County	670	67 (proposed build-out)	10	0.1	Moderate
Pope County	670	135 (theoretical)	5	0.2	Moderate

Pope County is included as an example in Table 4 because various network designs for the county were evaluated by the DNR's Groundwater Level Monitoring Work Group. The evaluation identified many of the difficulties in designing a GWLM network and ultimately assisted in developing the concepts presented in this document. The result of the Pope County evaluation showed a wide range of opinions of monitoring needs identified by DNR staff with an equally wide range of recommended groundwater level monitoring wells needed to adequately monitor the Pope County groundwater system. The differences were mainly due to differing monitoring goals, which very much affected the selection of the appropriate number of GWLM wells needed to adequately monitor multiple aquifers.

Through extensive evaluation, the DNR's Groundwater Level Monitoring Work Group has determined that a reasonable long-term build out for the backbone network should have a goal of approximately 7,000 GWLM wells. Evenly distributed across the state, this number of GWLM wells would result in a density of 0.1 and distribution of 10 or one GWLM well for every ten square miles. Putting these values into a public land survey perspective, using townships for unit areas, a long-term build out to 7,000 GWLM wells would provide three to four wells per township (36 square mile area) statewide. Seven thousand wells is a limited number when considering that the geologic framework and the groundwater system are three dimensional. Commonly, multiple aquifers need to be monitored for long-term trend data in most areas.

Because Minnesota's groundwater systems demonstrate great variations, with multiple aquifers at varying depths, this report recommends that statewide values for GWLM well densities should be considered as variable, ranging from 0.05 to 0.2, or a corresponding distribution value of one GWLM well per 20 to 5 square miles. This range will provide more operation and management flexibility to install and monitor needed wells based upon review of the specific hydrologic conditions and concerns for a particular unit area.

2.4 - Allocation of Groundwater Level Monitoring Wells

Groundwater level information needs, as discussed in Section 1.7, can be satisfied by increasing the number of groundwater level monitoring (GWLM) wells in the backbone network from approximately 750 to 7,000. With the long-term build out goal identified, the long-range number of groundwater monitoring wells needs to be assigned to Minnesota's aquifers and groundwater systems at different depths to maximize information while limiting costs. This section describes the process of assigning network wells to aquifers and groundwater systems, a process that is called allocation. Allocation is defined here as:

> A plan to assign the appropriate numbers of GWLM wells among Minnesota's groundwater resources to acquire the necessary groundwater level data to describe the groundwater resource condition and trends.

This report recommends that the allocation of network wells to aquifers in groundwater systems should be based on a percentage method. After considering other groundwater network plans (e.g., SOWG's network) related to groundwater level monitoring needs, this report concludes that other network plans are too generalized and do not address the criteria for assigning new wells to Minnesota's varying aquifers and groundwater systems; the well assignments are critical to provide the information needed by the network plan. No directly usable method was identified that could form the basis of the needed well allocation. Therefore, a new method has been developed that combines allocation methods for two different unit area concepts. One unit area concept is based on topography, which defines watersheds, and is applied to the shallow near surface systems (active hydrologic zone). The second unit area concept is based on aquifer extent and is applied to deeper aquifer systems. This approach has the benefit of organizing shallow wells around watersheds and deep wells around deeper aquifer systems.

The following discussion presents several examples of how the process of allocation and network development is intended to proceed at the state level. In order to develop a statewide backbone network that satisfied the state's current data needs, DNR staff will be responsible for reviewing available information needed to formulate a preliminary allocation plan. Figures 10-13 show examples of the available information resources that will help DNR staff and others identify areas where backbone network development is needed.

Figure 13 shows a map that was created by DNR staff to demonstrate areas where population density, water consumption, and major utility intersections are located.

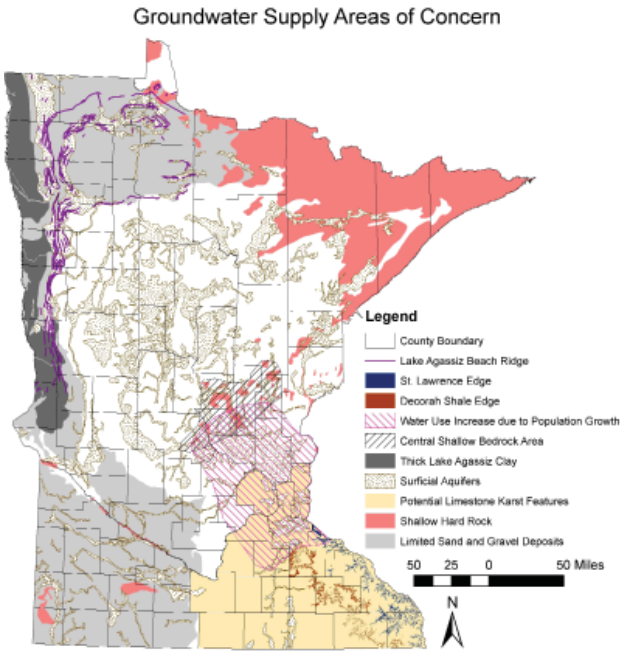


Figure 10. Groundwater Supply Areas of Concern. The Groundwater Supply Areas of Concern map identifies areas where geological and water use aspects lead to groundwater concerns.

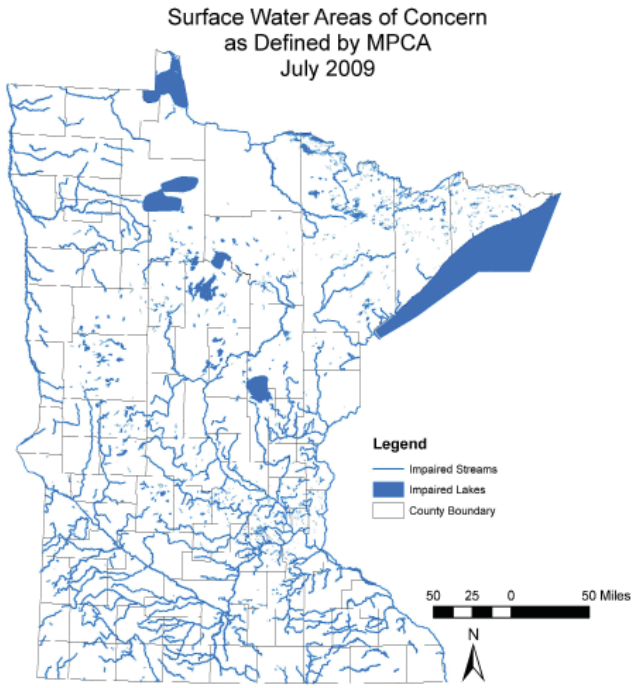


Figure 11. Surface Water Areas of Concern. The MPCA Surface Water Areas of Concern map identifies the location of impaired waters of the State.

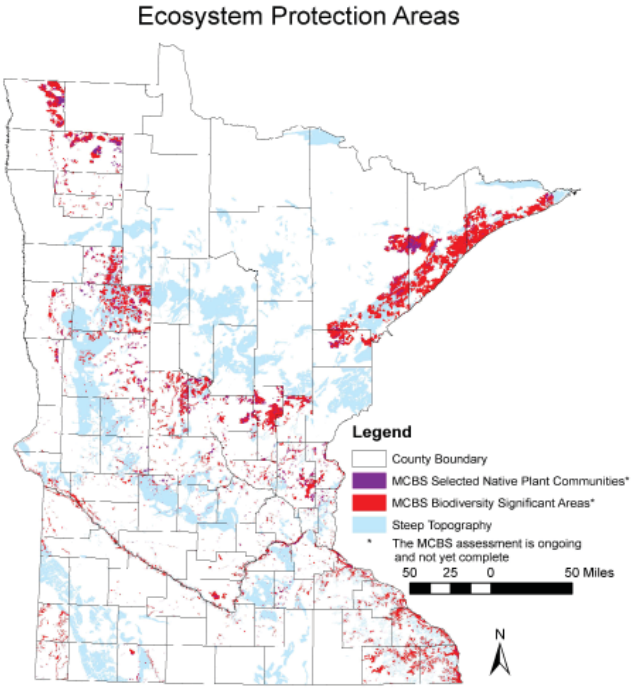


Figure 12. Ecosystem Protection Areas. The Ecosystem Protection Areas map identifies the areas in the state where the Minnesota County Biological Survey has located native plant communities and rare species. This survey is ongoing and has not been completed for the entire State.

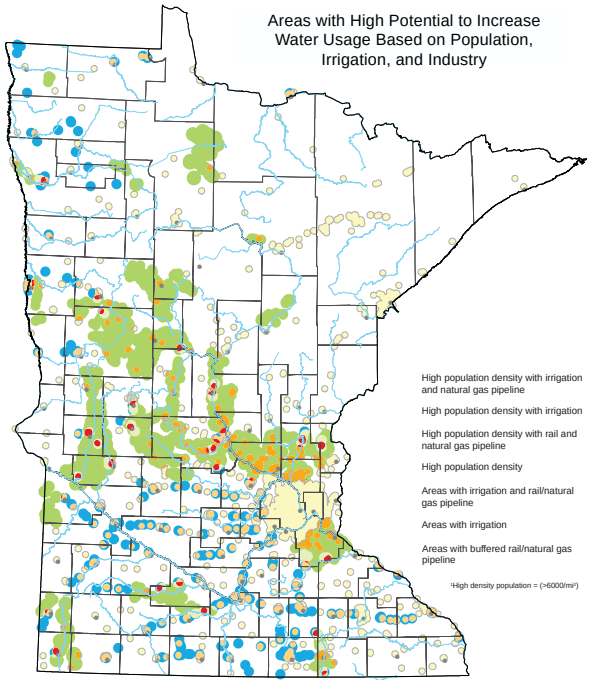


Figure 13. Optimum Density Rankings. The Optimum Density Ranking map shows areas with high potential to increase water usage.

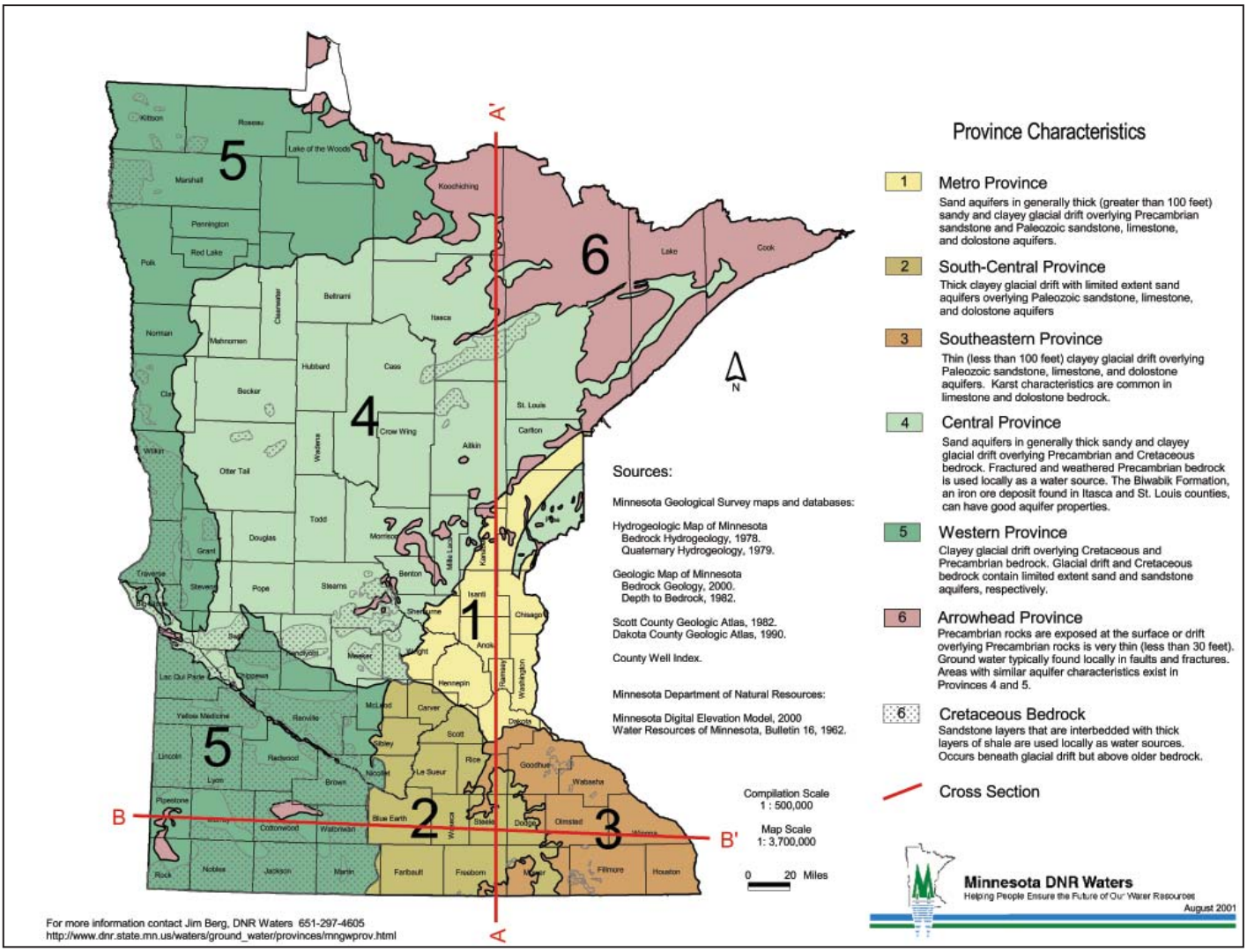


Figure 14. Map of the groundwater provinces.

Figure 14 shows the groundwater provinces map. This map is an important reference for the allocation process since it shows the major hydrologic regions within the state.

Table 5. Selected aquifer parameters for groundwater provinces.

Groundwater Province	Specific Capacity	Transmissivity (T) T = K*Thickness*7.48	Average Hydraulic Conductivity (K)	Comments
Province 6				
Glacial Drift	Variable	Variable	150 feet/day	Generally too thin for high capacity use
Precambrian Bedrock	<1 gpm/ft	<100 to 500 gpd/ft	0.1 feet/day	Highly dependent on fractures
Province 5				
Glacial Drift	<10 to >50 gpm/ft	< 20,000 to >100,000 gpd/ft	150 feet/day	Best yields in buried channel deposits
Cretaceous Bedrock	<1 to 17 gpm/ft	<200 to 30,000 gpd/ft	20 feet/day	
Precambrian Bedrock	<1 to 5 gpm/ft	<100 to 5000 gpd/ft	0.1 feet/day	Dependent on fractures
Province 4				
Surficial and Buried Aquifers	<10 to >40 gpm/ft	<10,000 to >80,000 gpd/ft	150 feet/day	
Cretaceous Bedrock	<1 to 17 gpm/ft	<200 to 30,000 gpd/ft	20 feet/day	
Precambrian Bedrock	<1 gpm/ft	<100 to 500 gpd/ft	0.1 feet/day	Dependent on fractures
Biwabik Iron Formation	<1 to 10 gpm/ft	<1000 to 20,000 gpd/ft	2 feet/day	
Province 3				
Glacial Drift	Variable	Variable	150 feet/day	Generally too thin for high capacity use
Upper Carbonate	5 to 90 gpm/ft	8000 to 175,000 gpd/ft	25 feet/day	
St. Peter	1 to 10 gpm/ft	2500 to 37,000 gpd/ft	10 feet/day	
Prairie du Chien-Jordan	3 to >100 gpm/ft	7000 to 250,000 gpd/ft	45 feet/day	
Tunnel City-Wonewoc	2 to 35 gpm/ft	4000 to 80,000 gpd/ft	25 feet/day	
Mt. Simon-Hinckley	1 to 33 gpm/ft	2000 to 70,000 gpd/ft	25 feet/day	
Province 2				
Glacial Drift	<10 to >30 gpm/ft	<10,000 to >50,000 gpd/ft	150 feet/day	Best yields in buried channel deposits
Upper Carbonate	5 to 90 gpm/ft	8000 to 175,000 gpd/ft	25 feet/day	
St. Peter	1 to 10 gpm/ft	2500 to 37,000 gpd/ft	10 feet/day	
Prairie du Chien-Jordan	3 to >100 gpm/ft	7000 to 250,000 gpd/ft	45 feet/day	
Tunnel City-Wonewoc	2 to 35 gpm/ft	4000 to 80,000 gpd/ft	25 feet/day	SC near low end in southern metro
Mt. Simon-Hinckley	1 to 33 gpm/ft	2000 to 70,000 gpd/ft	25 feet/day	
Province 1				
Surficial and Buried Aquifers	<10 to >40 gpm/ft	<10,000 to >80,000 gpd/ft	150 feet/day	
St. Peter	1 to 10 gpm/ft	2500 to 37,000 gpd/ft	10 feet/day	
Prairie du Chien-Jordan	3 to >100 gpm/ft	7000 to 250,000 gpd/ft	45 feet/day	
Tunnel City-Wonewoc	2 to 35 gpm/ft	4000 to 80,000 gpd/ft	25 feet/day	SC near low end in southern metro
Mt. Simon-Hinckley	1 to 33 gpm/ft	2000 to 70,000 gpd/ft	25 feet/day	

Table 5 shows the selected aquifer parameters for groundwater provinces. The table presents a range of generalized estimates of aquifer characteristics for each of the groundwater provinces.

Figures 10-14 and Table 5 are based on recent data and offer information that is important to building a groundwater level monitoring network from a regional perspective. This information is sufficient to make some general recommendations regarding network development needs, but other information will be needed to address specific or problem areas. Water supply studies, municipal investigations, environmental studies, and other reports are all sources of more localized information on groundwater.

DNR staff will review all the available resource information to determine the appropriate unit area and the associated distribution value of the wells. Using that information, the preliminary goal number of wells to meet network needs is calculated by dividing unit area by the distribution value. Once the goal number of wells per unit area is determined, the preliminary allocation percentages are then used with the goal number to determine the allocation number of wells by groundwater resource.

Table 6 shows a simplified example of how the allocation of groundwater level monitoring wells could be accomplished for a unit area with three groundwater resources.

Table 6. Example allocation of GWLM wells to principal aquifers.

Hydrologic System	Unit Area (square miles)	Distribution Value (d)	Goal Number of GWLM Wells
	1000	10	100
	Groundwater Resource	Allocation %	Allocation Number of GWLM Wells
Active	Water Table	60%	60
Active or Deep	Buried Drift	30%	30
Deep	Bedrock	10%	10
		100%	100

The allocation number of network wells generated by this process should be reviewed and agreed upon by the DNR Groundwater Level Monitoring Work Group.

The allocation percentage should be adjusted to create the best possible utilization of the goal numbers for the unit area. In most areas, the active hydrologic system should receive the larger allocation of wells with a generally decreasing number of wells with depth, unless the unit area conditions observed suggest otherwise. The active hydrologic system should have a greater well density than the deep hydrologic system because the shallower resources are often the first to show responses to changing conditions and have greater spatial variability. Fewer wells are needed for deeper groundwater resources because they tend to respond more slowly, and have similar characteristics over larger distances, therefore granting more time for reaction and response to significant changes in water levels.

During the network development of the GWLMN, the concept of incremental development or iterative phases should become part of the development program. The construction of groundwater level monitoring wells, for each unit area, should occur over the course of two or more phases.

A period of time of at least several years is needed following initial well installations to allow for data collection and analysis. Subsequent iterative phases will then benefit and perhaps lead to redefining a suitable groundwater level monitoring well distribution and allocation. Table 7 demonstrates the same example used in Table 6 with consideration for existing GWLM wells and two phases of network development.

Table 7. Example allocation of GWLM wells with consideration for existing GWLM wells with two iterative phases of development

Unit Area (square miles)	Distribution Value (d)	Goal Number of GWLM Wells	Existing Number of Observation Wells	Iterative Phase 1	Iterative Phase 2
1000	10	100	10		
Groundwater Resource	**Allocation %**	**Allocation Number of GWLM wells**			
Water Table	60%	60	5	28	28
Buried Drift	30%	30	4	12	12
Bedrock	10%	10	1	5	5
	100%	100		45	45

Tables 6 and 7 are general examples that show the concept for determining the goal number of wells and then allocating them to groundwater resources. In addition, Table 7 shows the iterative process for network development that is an extension of Table 7. They are not meant to serve as examples for any specific area in Minnesota.

The next example uses the basic elements of Table 7 with Minnesota's six Groundwater Provinces as unit areas. Unit areas based on Groundwater Provinces are appropriate as an example because 1) they provide statewide coverage, 2) they are geologically defined, and 3) selected aquifers parameters have been organized by Groundwater Province and groundwater resource (Table 5). The Groundwater Provinces are based on geology, and not by watershed. The development of well allocation for the active hydrologic system, which is watershed based, has not yet been completed. The statewide goal number for the active hydrologic system needs to redistributed by watershed sometime in the future.

Table 8 was created as a statewide estimate of the goal number of groundwater level monitoring wells based on Minnesota Groundwater Provinces (Figure 13) as the unit area. The development of Table 8 required assigning allocation percentages for each groundwater system by province. The estimate of the distribution value of GWLM wells per square mile for the provinces was selected to range from 10 to 20 square miles per well (Tables 3 and 4). The allocation percentages are based on the review of conditions for the groundwater resources for each unit area. The groundwater resources shown in Table 8 according to province are generalized, and do not fully reflect the local complexities in the groundwater system. For example, some bedrock resources that are generally regarded here as part of the deep system, may also include part of the active hydrologic system, which is part of the water table system.

Table 8. Well numbers and allocation for Minnesota's groundwater provinces.

Groundwater Resources	Unit Area (A) (square miles)	Density (ρ) / Distribution (d)	Allocation %	Goal Number of GWLM Wells (w) GWLM Wells
Province 1	**5349**	**0.10 / 10**		**(535)**
water table			40%	214
Buried Aquifers			15%	80
St. Peter			5%	27
Prairie du Chien-Jordan			25%	134
Tunnel City - Wonewoc			10%	53
Mt. Simon Hinckley			5%	27
Total			**100%**	**535**
Province 2	**3011**	**0.10 / 10**		**(301)**
water table			25%	75
Buried Aquifers			15%	45
Upper Carbonate			15%	45
St. Peter			5%	15
Prairie du Chien-Jordan			25%	75
Tunnel City - Wonewoc			10%	30
Mt. Simon-Hinckley			5%	15
Total			**100%**	**301**
Province 3	**7404**	**0.07 / 10**		**(740)**
water table			20%	148
Buried Aquifers			10%	74
Upper Carbonate			30%	222
St. Peter			10%	74
Prairie du Chien-Jordan			15%	111
Tunnel City - Wonewoc			10%	74
Mt. Simon-Hinckley			5%	37
Total			**100%**	**740**

Table 8. Well numbers and allocation for Minnesota's groundwater provinces. (continued)

Groundwater Resources	Unit Area (square miles)	Density (ρ) / Distribution (d)	Allocation %	Goal Number of GWLM Wells (w) / GWLM Wells
Province 4	**29985**	**0.15 / 15**		**(1999)**
water table			67%	1339
Buried Aquifers			27%	540
Cretaceous Bedrock			2%	40
Precambrian Bedrock			2%	40
Biwabik Iron Formation			2%	40
Total			**100%**	**1999**
Province 5	**26893**	**0.10 / 10**		**(2689)**
water table			65%	1748
Buried Aquifers			22%	592
Cretaceous Bedrock			10%	269
Precambrian Bedrock			3%	81
Total			**100%**	**2689**
Province 6	**11404**	**0.05 / 20**		**(570)**
water table			50%	285
Buried Aquifers			10%	57
Precambrian Bedrock			40%	228
Total			**100%**	**570**

Table 8 shows how approximately 7,000 groundwater level monitoring wells could be distributed and allocated to provide a cost estimate as discussed in Section 4. Section 3 will describe how to manage this network as it is developed over the next 30 years.

Section 3: Network Operations

The projected network development is intended to fulfill groundwater level monitoring data needs for long-term trend monitoring. In addition to the phased installation of GWLM Network wells, operations capability will be built gradually. Upon completion of each well, the cycle of long-term water level monitoring of the backbone condition begins. This long-term monitoring cycle includes water level data collection, scientific analysis, sharing among government agencies, and distribution of groundwater level information for public use.This section discusses how water level measurements are acquired as electronic data, reviewed for accuracy, and processed for public distribution.

3.1 - Instrumentation

Historically, water levels were obtained manually. A person visited the well, lowered a measuring device to the water surface, read depth to water, and recorded the well number, the date and time, and the depth to water measurements. Some wells are now equipped with electronic equipment to automatically record measurements at specified intervals over a period of weeks to months. Regardless of new electronic devices, manual water level measurements are always needed to provide precision, confirmation, and backup measurements in case of equipment failure.

Manual water level measurements at DNR groundwater level monitoring wells (Figure 13) are measured using steel surveyor's tapes. The steel tape method currently provides the most accurate and precise way of measuring water levels in wells. Other methods, such as electronic tapes or transducers may also be used, but each of those methods is confirmed periodically using a steel tape. The steel tape method provides a backup in case electronic methods fail. Each measurement requires someone who is trained to visit the GWLM well and measure the water level in the well. Personnel and travel costs have limited the frequency of manual water level readings to one reading per month. Increased deployment of electronic measurement equipment will increase measurement frequency while reducing personnel and travel costs. DNR policy and criteria documents regarding electronic instruments are included Appendices 5.4 and 5.5. Technical guidance for water level measurements are included in Appendix 6.

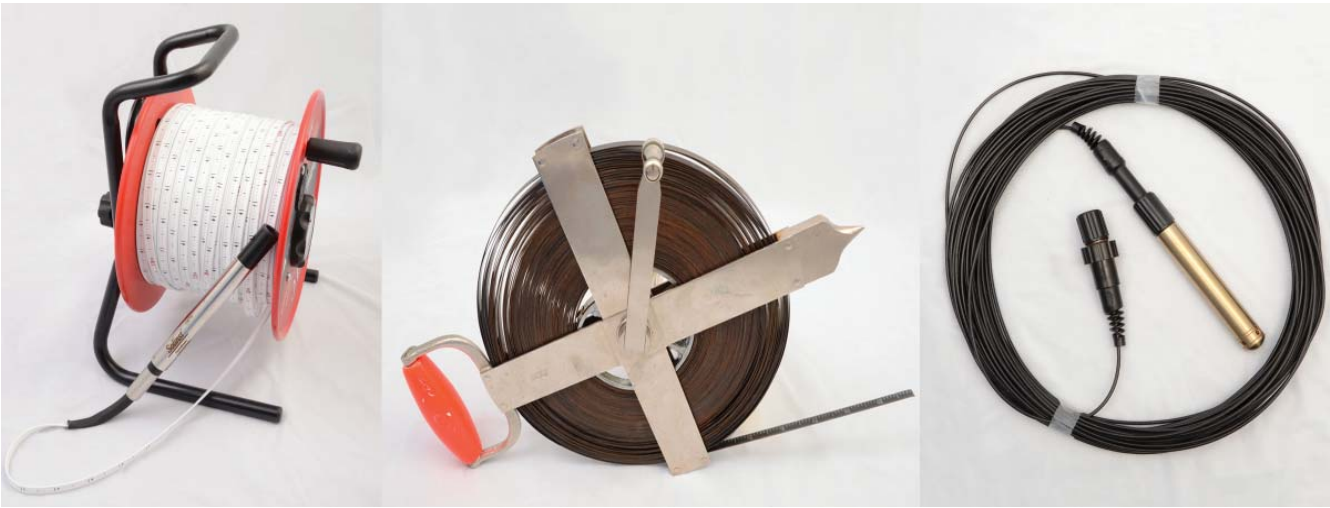


FIGURE 15. Common tools used for groundwater level monitoring (left to right): electronic tape, steel tape, data logger.

3.2 - Monitoring Length of Record and Continuity

Long-term water resources management efforts need long-term resource monitoring data that are collected in a time-series format. A series of measurements periodically on a regular schedule are called a time-series data set. Long-term time-series data are especially important for groundwater because groundwater levels may have a response lag of many years following climatic or pumping changes. For example, climate cycles in the Midwest occur over tens of years, so groundwater level monitoring data must also extend decades to track groundwater system response to climatic and other system changes.

While single water level measurements reported on well construction records are valuable, they are only one measurement in time. The value of the data increases as the length of water level records increases over time. Figure 15 shows how water level records increase in value to managers, researchers, and others who need groundwater level data.

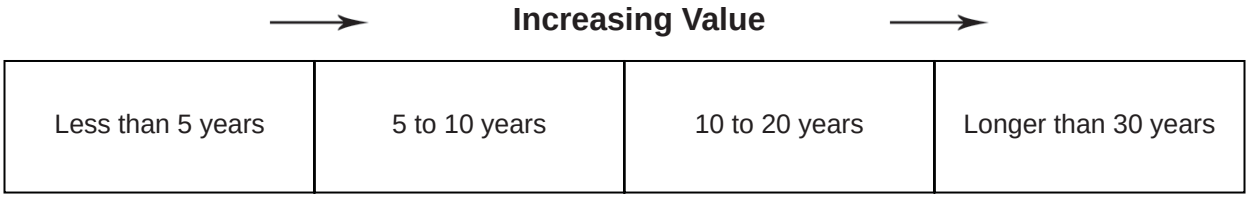


FIGURE 15. Length of well record and its value for long-term trend analysis and resource management.

Data continuity is a critical element to the development of this network. It is important to obtain regular scheduled measurements so that significant changes or events are identified and not missed due to breaks in the data record.

3.3 – Monitoring Frequency

Monitoring frequency refers to how often groundwater level measurements are collected over time and recorded. Selection of a measurement frequency for a site will depend on the network and site, aquifer, purpose, intensity of use, site specific or local situations, and other factors. The frequency of measurement can vary depending on the particular purpose of the data being collected. For example, general groundwater system tracking at a GWLM Network site through multiple annual cycles may yield adequate information with monthly measurements. Daily or more frequent measurements may be required to track aquifer response in a heavy use area. Recharge studies are an example of data needs that require high measurement frequencies to fully assess system response to recharge processes.

The frequency of water level measurements affects the value of the water level records. Figure 16 shows how greater frequency of water level measurements increases their value. The DNR's minimum criteria for inclusion of existing wells in the network should be water level measurements collected at least monthly. The decision to collect hourly or more frequent readings depends on the need for backbone data from a specific location.

FIGURE 16. Frequency of measurement and its value forlong-term trend analysis and resource management.

Most modern databases can handle large volumes of time-series data, thus reducing the limitations that previously hampered the collection of high-frequency data. As mentioned previously, most groundwater level network data is measured at a monthly frequency. If funding would allow, more frequent measurement would be desirable. At selected locations, pressure transducer data loggers are deployed in the DNR network of GWLM wells to record groundwater level measurements once every hour. Periodically, manual measurements are collected to provide water level reference data and to confirm the accuracy of the automated data collected by the pressure transducer. Based upon review of the collected pressure transducer data to date, hourly measuring frequency appears to be adequate for long term trend level monitoring purposes at sites with data logger instrumentation.

3.4 - Data Post-processing and Hydrographs

After being collected from the field, groundwater level data from data loggers undergoes post-processing, which is defined here as a series of data compilation steps where data files are checked for accuracy, configured, and prepared to be loaded into the database. After the data are loaded into the database, the user can evaluate a graph of the data. The manually-collected water level measurements are included as separate data values plotted with the pressure transducer data to verify the accuracy of the automated data.

During post-processing, it may be discovered that the old and new data sets may not perfectly match. If this should occur, staff make changes to the data during post-processing, and the computer software tracks and records these changes. A supervisor then reviews the changes and validates (approves) the post processed data. The DNR saves both the unaltered data and corrected data sets.

Hydrographs are line charts of time-series water level data (Fig. 17) that can illustrate and compress a large amount of data that can be easily read, compared, and interpreted. A hydrograph provides a visual aid that is used during post-processing to assist joining recent data with older data.

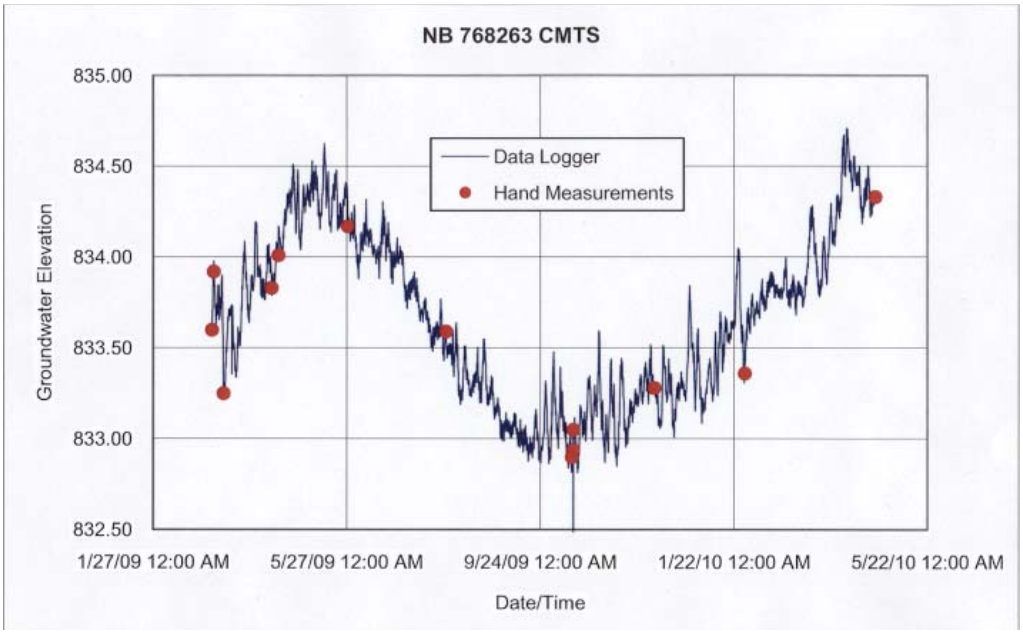


FIGURE 17. Hydrograph of water levels in a GWLM well with manual readings (shown as red points) and electronic data logger readings (blue continuous line).

3.5 - Data Uses and Limitations

The primary purpose of groundwater level monitoring is to protect the resource by informing and providing supporting scientific information for policy decisions and management actions. However, groundwater level information alone cannot prevent or solve problems. A statewide backbone network is extremely important because it provides information on resource trends, data for modeling, and assistance with problem identification. Efforts to address specific concerns will usually require that more detailed information be collected than can be obtained from the existing GWLMN database. A typical example of addressing specific concers is when DNR responds to well interference complaints and resource conflicts; in such cases, more frequent monitoring may be required because the problem is local and needs additional monitoring to identify the issues and successfully resolve the problem.

A regulatory framework is in place that allows managers to suspend (for a seasonal impact) or terminate (for a permanent impact) water withdrawals that will potentially impair ecosystem services. If adequate monitoring of both surface and groundwater resources is in place, regulators will be better able to manage water use or prevent unintended impacts.

While the state GWLM Network as it currently exists provides valuable resource data, not all water level data needs have been met. Many times, monitoring sites may not be in the ideal locations or of sufficient density. Sometimes the available data is fragmentary, or only available for a few years. At many sites in the network the data record may be incomplete because measurements were only taken during the irrigation season. For many wells in the existing backbone network, measurements are only collected from March to October because winter conditions prevent site access. At some locations, the monitoring frequency may be inadequate; finally, data may be limited because wells at some monitoring sites are not properly maintained or need replacement.

3.6 - Database Management and Protocols

The DNR's groundwater level monitoring well database adheres to generally accepted industry standards as well as to the standards developed by the DNR's Management Information Services and the State of Minnesota Office of Enterprise Technology. The most recent version of the database uses an open source data system called PostgreSQL. Any changes to the database will be done so that they conform to State of Minnesota and industry standards.

The current database uses the Minnesota Department of Health's (MDH) Unique well numbering system as the primary key to identify specific wells. There is a secondary key in the database called the groundwater level monitoring well number, which is a well-specific number created by the DNR. It uses the widely used two digit Minnesota County code and a three digit incremental number. This well-specific identifier is useful as it immediately identifies the county in which the well is located; it is mostly used for internal DNR analysis.

The database provides the well location and well construction data and stores water level measurements associated with the well. Information about the database fields including the field attributes are specified in a database data dictionary which is available, but not included in this document.

3.7 - Data Availability and Access

Data from the groundwater level monitoring well network is currently available to anyone through the DNR's website. The information provided includes well location and construction information, aquifer designation, and all of the water level measurements for the well. A hydrograph for the well is also presented that includes a graph of precipitation data for the area near the well.

The data can be accessed by using a map on the DNR website to select a well location. The website also provides the option of choosing a well by MDH Unique number or the DNR groundwater level monitoring well number, if known. A list is presented of all measured and unmeasured wells in the groundwater level monitoring well database from which to choose. The data is also available directly from the DNR's groundwater level monitoring well database administrator.

The internet is currently the primary resource tool used by the DNR for providing groundwater level data and related resources to the public. Groundwater level monitoring well information with hydrographs and precipitation information are all currently available via the web at http://climate.umn.edu/ground_water_level/.

The DNR also produces interpretive products such as a monthly report of the State's hydrologic conditions. This report includes maps that provide general information on the status of water resources across the state. These interpretive reports provide recent information on the condition of principal components of the hydrologic cycle, including:

- Stream Flow
- Groundwater
- Lake Levels
- Precipitation and drought conditions

These reports can be found on the DNR's website at http://www.dnr.state.mn.us/current_conditions/hydro_conditions.html.

The monthly summary of groundwater conditions uses selected indicator wells located throughout the state with percentile ranking based on the last reported reading for the current month compared to all historical reported levels for that month. A version of the monthly summary conditions map showing groundwater levels and groundwater provinces (Fig. 18) was included in the 2010 DNR Ecological and Water Resources Water Availability and Assessment Report.

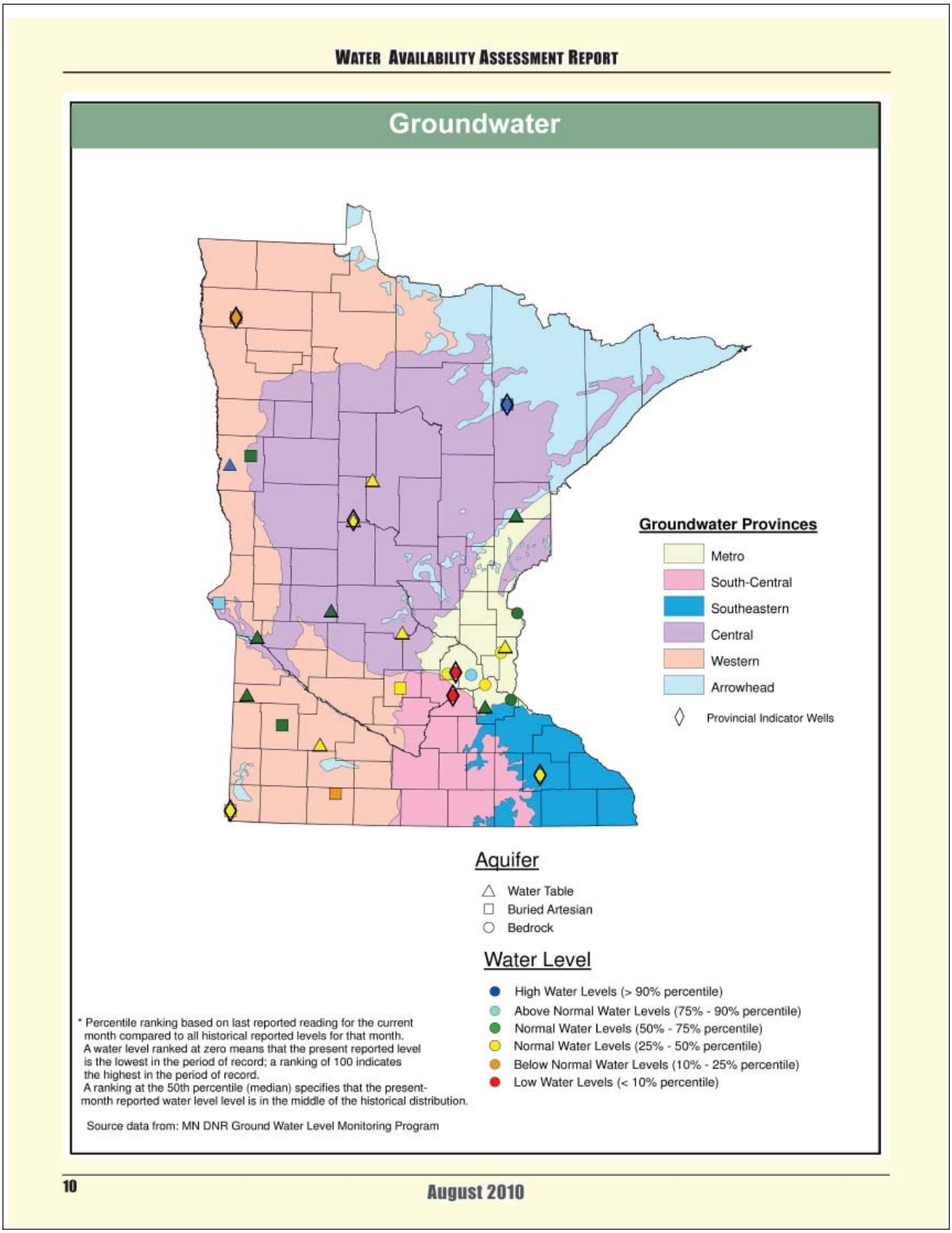


FIGURE 18. Groundwater Level Historical Rankings.

The DNR requires most holders of groundwater appropriation permits to provide water level data from pumping wells or associated monitoring wells. The water levels are collected by the permit holders and submitted to the DNR. The well and water level information are stored in a Microsoft Access® database. Access to this information is currently limited to Division of Waters staff because of security concerns associated with public water supply wells. It is the intent of the Department to use this data for aquifer analysis and to assist the permit holders in managing the resource.

The DNR is moving to a more integrated website which will allow users to obtain data from the various water monitoring activities conducted by the department. These areas are stream flow, groundwater levels, and lake levels. Currently, a user must visit three different web sources to access each data set.

The vision for future web applications is full of opportunities. For example, the indicator well map could become an interactive map with links to related information fields. Irrigators and other high capacity water users could access a web based resource to assist with water management decisions, thus promoting better management practices to conserve Minnesota's groundwater resources.

A recognized need exists to improve shared access to water data across state agencies. Improved shared access will provide more data integration and allow for better access to the data by external users. The DNR/MPCA's Cooperative Stream Gaging Project is an example of joint management of a water resource database; this site provides access to near real-time and historical streamflow and water quality data. In time, the agencies plan to develop data systems that connect the data collected and stored by the various agencies so that it is accessible to the public. The idea of a data portal is attractive since it would allow will allow the different agencies to continue to collect and store the agency data and through the portal make the data available to anyone in a usable format. The startup and ongoing operation costs of such a portal are considerable and would require ongoing funding by multiple agencies to be successful.

Section 4: Estimated Cost to Develop a Statewide Backbone Groundwater Level Monitoring Network

The distribution of about 750 groundwater level monitoring wells in Minnesota's current measured network has limited coverage across the state (Section 1.7). The well distribution maps by aquifer discussed in that section and the evaluation of monitoring needs by resource presented in Section 2.4 supports the need for nearly 7,000 groundwater level monitoring wells in the backbone network for long-term trend monitoring. The long-range goal of about 7,000 groundwater level monitoring wells for the backbone network is nearly ten times the number of existing measured network wells. Given the scope of the network development that is needed, achieving the build-out goal for the backbone network will require a continuing investment over several decades. This section presents the cost estimate for this proposed network build-out to nearly 7,000 wells over a period of 30 years. The network build-out will vastly improve the state's ability to provide the necessary information to describe the quantity of groundwater in Minnesota, which will help ensure its availability and sustainability for future generations.

Table 6 in Section 2.4 presents the estimated long-range goal for the total number of GWLM wells needed by groundwater province to adequately monitor aquifers and groundwater resources in the backbone GWLM network. In Table 9, the estimated long-range goal for the total number of wells for the backbone network is summarized by aquifer or resource. Table 9 also summarizes the number of wells needed by resource to meet the long-range monitoring goal. If the number of existing wells in the backbone network is considered, a total of 6,078 additional wells are needed. The number of additional wells needed by resource in Table 9 was used in Table 10 to estimate the cost to construct the number of wells needed to meet the monitoring goal. Table 9 is organized by resource because there is a general cost variation to construct wells among the resources listed. For example, installing a well in a shallow water table resource is expected to cost less than installing a well in a deeper resource, such as the Mt. Simon Hinckley aquifer. Drilling costs can be expected to vary by groundwater resource based upon the drilling method used, number of sites to be drilled, drilling time required, fuel costs, type of construction materials, and other cost considerations.

Table 9. Statewide groundwater level monitoring well allocation by groundwater resource.

Groundwater Resource	Goal Number of Groundwater Level Monitoring Wells	Organized By	Percent of Statewide Buildout	Existing Number of Wells	Number of Wells Needed to Reach Goal Number
Water table	3,810	Watershed	55.7	341	3469
Quaternary - Buried Aquifers	1,388	Varies	20.3	243	1145
Cretaceous Bedrock	309	Province or Aquifer Extent (if mapped)	4.5	10	299
Upper Carbonate	267		3.9	6	261
St. Peter	116		1.7	5	111
Prairie du Chien-Jordan	320		4.7	6.3	257
Tunnel City - Wonewoc (formerly Franconia Ironton Galesville)	158		2.3	25	133
Mt. Simon Hinckley	79		1.2	61	18
Precambrian Bedrock	349		5.1	2	347
Biwabik Iron Formation	40		0.6	2	38
Total	**6,835**		**100%**	**758**	**6078**

Table 10 shows that most of the wells needed for the statewide build-out are for monitoring the water table resource and Quaternary buried aquifers. Fewer wells are needed to complete the backbone network goal for bedrock aquifers. The water table and shallow Quaternary resources are assigned a greater proportion of wells because the shallower resources are often the first to respond to changing conditions and also have greater spatial variability (Section 2.4). Deeper groundwater resources, unless immediately affected by pumping stress, respond more slowly to change and tend to be more uniform over more extensive areas; therefore, fewer deeper wells are needed to meet the desired monitoring goal for the backbone network.

Table 10 was developed to show the cost estimate for a 30-year plan to achieve a backbone GWLM network of about 7,000 wells. Under this plan approximately 1,015 wells would be built every five years or approximately 203 new groundwater level monitoring wells would be installed per year. The costs are based on 2010 cost estimates. The estimated cost for the first five years of network development, for the fiscal years 2011 to 2015, is $13,900,753 or approximately $2,800,000 per year.

Table 10. Minnesota Groundwater Level Monitoring Network Build-Out Timeline and Estimated Cost (30-Year Plan)

Year	2010	2010-2015	2015-2020	2020-2025	2025-2030	2030-2035	2035-2040	Total Cost of Network Buildout	Operation End Maintenance Costs for Each Subsequent Year
Total Wells in Network	750 (existing)	1765	2780	3795	4810	5825	6840		
Drilling, Instrumentation, and Easements		$12,666,550	$12,666,550	$12,666,550	$12,666,550	$12,666,550	$12,666,550	$75,999,300	$300,000
Operations and Maintenance, Technical Support, and Quality control		$950,182	$1,652,145	$2,198,109	$2,744,073	$3,290,036	$3,680,000	$14,514,545	$736,000
Data Management, Groundwater Analysis, and Data Access		$284,022	$447,217	$610,413	$773,609	$936,804	$1,100,000	$4,152,065	$220,000
Total		$13,900,753	$14,765,913	$15,475,072	$16,184,231	$16,893, 391	$17,446,550	**$94,665,910**	$1,256,000

The costs in Table 10 include well installation and instrumentation, operations and maintenance, and data management and access. Well installation and instrumentation costs include those expenses to physically install monitoring sites. In addition to the drilling costs, each well includes the initial cost of a downloadable data logger and the cost of replacement after five years of operation. These well installation and instrumentation costs represent more than 90 percent of the expense to expand the existing network. Once installed, each site has additional ongoing expenses to periodically collect data, maintain the site for proper operation, and verify new data. As new sites are added to the network and greater volumes of data are generated, additional expenses for data management and access are incorporated into the cost estimate. The following lists, in general, the costs considered in the development of the Table 10 cost estimate for the network build-out:

Well installation and instrumentation

- Well drilling and construction
- Easements and site clearance
- Instrumentation with electronic water level recording equipment
- Agency staff oversight of drilling operations

Operations and maintenance, technical support, quality control

- Manual water level measurements
- Periodic down loading of electronic water level recording equipment
- Well inspections and maintenance
- Slug testing
- Equipment repair
- Verifying new data for accuracy
- Assisting data managers with data processing

Data management, groundwater level analysis, data access

- Post processing of downloaded data
- Barometric data correction
- Data upload into data base
- Data base management
- Provide data access to Web
- Analyze water level trends
- Respond to data requests and assist data users

Well installation costs can vary considerably depending on the depth of the well and other site considerations. A shallow well requires less time and lower-cost material to drill and construct than deep wells. For example, a shallow surficial sand aquifer well can be installed by a certified Minnesota water well contractor at a cost of about $5,000 while a deeper bedrock well can cost $70,000 or more. The DNR owns and operates water well drilling equipment and has trained personnel who are capable of installing water wells to a depth of about 50 feet at much lower cost. Based on anticipated depths of new wells to be installed for the network, the estimates presented in Table 11 are based on the use of DNR drilling equipment and crews of DNR staff. It is expected that DNR equipment and crews would install about 57 percent of the proposed network wells. The remaining 43 percent of the wells will require the use of more expensive equipment and materials suitable for wells of greater depth. The cost estimate for each well includes the cost of installing data logger instrumentation to measure water levels automatically. The cost of the data logger instrumentation is currently $750 per well.

Some expenses were intentionally not included in the cost calculation as they may be applicable to limited or specific sites. These expenses include borehole geophysical logging, water chemistry analysis or age-dating; monitoring well fees for water sampling; and easement or parcel purchase costs.

Advanced technology exists that can provide real-time data communication and well operational information via telemetry. This technology can send information via radio, cell phone, or by satellite. The

cost of equipping one nested groundwater level monitoring well site with telemetry is currently estimated at about $15,000. Because of the cost, installation of telemetry capability was not included in the Table 11 expenses. This additional expense could be considered for high-priority sites where immediate data access is required and if additional funding were available.

The installation of more than 6,000 groundwater level monitoring wells for the statewide backbone network over a period of 30 years is a massive undertaking. The work will need to be prioritized and directed to logically build out from the existing network and link with specialized networks that are part of additional, permit-mandated monitoring locations or perhaps shorter-term investigations. The buildout priorities must also evaluate and acknowledge groundwater level data generated by other data collection efforts for other purposes. The primary focus of the buildout plan is, and should remain, long-term groundwater level data acquisition with the goal for the backbone network sites of minimum 30-year data records.

In addition to the logical extension from existing sites to areas currently unmonitored or under monitored, other priorities will guide future network development. Priorities may include sites that support long-term investigations or monitoring of groundwater management areas or, more generally, water resource management areas. Possible priority areas for this purpose could include the Buffalo aquifer near Moorhead, the Bonanza valley area east of Glenwood, the Pineland Sands Aquifer near Park Rapids, the Woodbury area, and the expansion of the northwest corridor between the Metro Area and St. Cloud. Other priority areas include portions of Minnesota undergoing development pressure with associated water needs, existing aquifer use areas that lack adequate backbone monitoring, and areas of significant hydrologic and ecologic importance that lack adequate backbone monitoring. Identification of priorities and the necessary design to meet identified priorities must be part of an ongoing review of existing network coverage as the backbone network develops over time. The review of priorities should also identify and address monitoring limitations in other parts of the hydrologic cycle such as stream flow, lake levels, and spring discharge.

The network development is a long-term, large-scale statewide effort resulting in new monitoring sites each year. The GWLM network wells, while intended for primary use as part of the statewide backbone groundwater level monitoring network, will be constructed so others may use the wells to collect other types of data, including water quality data. This type of construction adds to the initial cost of a well, but allows greater flexibility for future use.

If the long-term buildout concept is funded, an initial development plan that covers at least two fiscal biennia will need to be developed in coordination with the annual or biennial work plans of the existing network. The long-term plan will also need to be developed in cooperation with existing monitoring efforts by state agencies, research institutions, and other stakeholders.

Coordination with network partners, data users, and stakeholders will require considerable investment in time. Some of these partners may be public organizations who may be approached with a request to install wells on their property. Installation of wells on public property is desirable since the land use is less likely to change and interfere with the operation of the well as a monitoring site. A good working relationship with partners and stakeholders and, over time, the delivery of desired data to those partners will be the key to the success of the network build-out.

Section 5: Recommendations

This section summarizes the recommendations identified in this document as needed to achieve the long-term goal of a fully realized statewide backbone groundwater level monitoring network. The realized statewide backbone network will provide greatly expanded data and the related interpretations needed to support sustainable management of the state's water resources.

5.1 Technical Recommendations

Expand the statewide backbone GWLM network. This unprecedented network expansion from approximately 750 wells to 7,000 wells would increase the state's ability to understand, respond to, and plan for groundwater changes over time.

Install GWLM network wells with the intention of obtaining long-term records. The value of the data record increases with length of time. The backbone network should be developed over time to increase the number of wells with a data record of 20 years or more. Installed wells should be considered permanent and located to avoid disturbance.

Install at priority sites, if funding allows, electronic data loggers to collect near-continuous water level data. Near-continuous water level data has greater value but is more expensive to acquire and manage. Each GWLM network well should be evaluated for installation of data logger equipment, such as wells located in priority resource management areas.

Install well nests to determine vertical hydraulic gradients. Installing two or more groundwater level monitoring wells to different depths at a single location allows better characterization of aquifer vertical hydraulic gradients and the potential for water movement between aquifers.

Organize groundwater level monitoring efforts based on watersheds for shallow groundwater systems and on aquifer extent for deep groundwater resources. Adopting the watershed as the organizational unit for monitoring the shallow groundwater system achieves a natural coordination between the shallow groundwater system and surface water monitoring. The deep groundwater resource would continue to be organized by aquifer or resource extent.

Incorporate active hydrologic zone concepts into the long-term network design. The active hydrologic zone is that portion of the groundwater system that readily interacts with surface water and closely tracks changes in precipitation. The long-term network design should include wells that monitor groundwater conditions in the active hydrologic zone and which are coordinated with surface water monitoring. Linking the two systems benefits understanding shallow groundwater systems and supports the development of ecologically-based watershed management.

Incorporate the well distribution and resource allocation method into the long-term network design. The method outlines the steps to determine groundwater level monitoring well needs by unit area and groundwater resource. The distribution and allocation method does not generate the final network design, but rather is intended to guide further discussions on specific network design at the regional and local level to meet specific monitoring needs.

Develop and operate the backbone GWLM network as part of a network of networks. The backbone network should be considered a component of a more comprehensive network of networks devoted to monitoring the entire hydrologic cycle. As part of the network of networks, the backbone GWLM network would more effectively share and coordinate groundwater monitoring efforts and assets.

Build out the backbone GWLM network in phases. The long-term development of the network should be approached as an iterative, phased process. A period of time is needed for data collection and analysis between phases. The data collected during each phase will inform the GWLM network development plan of subsequent phases.

The cost of both network build out and operation must be considered. The estimated build-out cost, while largely for the installation of new wells, must also include expenses for data collection, data management, data analysis, and monitoring site maintenance. On-going operation and maintenance costs will increase as the network is developed.

5.2 Implementation Recommendations

Build consensus among professionals and stakeholders. Share and discuss the guidelines in this document with internal and external groups of professionals. Use existing agency and stakeholder groups to inform the process of distributing and allocating groundwater level monitoring wells based on unit area and groundwater resource, and establish priorities for the build out process.

Develop a short-term implementation proposal. An initial, small-scale version of the 30-year plan should be developed, and if funded, implemented to evaluate and confirm the processes outlined in this document. Opportunities for collaborative network development and operation should be identified and pursued as part of the initial project implementation.

Develop a plan to build out the GWLM network in phases. Each year the proposed plan would install approximately 210 new groundwater level monitoring wells. The network development is intended to be accomplished in iterative phases of approximately five years in length. The five-year period is intended to provide an opportunity to evaluate the network development process and make necessary adjustments to the plan for the next five-year phase.

Operate and maintain the GWLM network for the long term. Sufficient funding support must be maintained to assure high-quality data are collected over many years. Long-term funding support must include the costs to repair or replace wells and equipment as needed.

Utilize the most efficient and effective methods to manage, analyze, interpret, and distribute the data. Expand current efforts to provide data to users online. Interactive web applications should be further developed to enhance interpretation, improve access, and increase usability of the data. It is expected that over time data delivery and electronic communication pathways will change; future network data operations should be flexible and adaptable to expected changes in electronic communications.

The statewide GWLM network requires continuing commitment. Once the 30-year network build out project is complete, continuing funding for network operation and maintenance, as well as data management, analysis, distribution will be necessary.

Section 6: Conclusions

The primary purpose of the DNR GWLM Network development described in this guidance document is to assure long-term sustainable water supplies. This guidance document presents a plan for expanding the current Groundwater Level Monitoring Network to fulfill the need for more complete information on the condition of groundwater resources throughout the state. At present, the current groundwater level monitoring network is limited in the areas and resources monitored; it does not provide the information needed to adequately manage Minnesota's resources. While Minnesota's current network compares favorably to other states, there are large areas of the state and groundwater systems that are not adequately monitored.

The existing DNR GWLM Network includes about 750 wells distributed throughout the state, but the ability to adequately monitor the groundwater system with the current network is limited. The previous work by DNR staff summarized in this document concluded that a network goal of about 7000 groundwater level monitoring wells is needed to meet long-term monitoring needs. This document describes a process of allocating network wells by groundwater province and groundwater resource, with more than half of the wells allocated to the water table and shallow groundwater resources. The remaining wells are allocated to deeper aquifer resources.

Building on the existing GWLM Network, and based on the long-term network goal, this document describes in general a network development plan spanning 30 years to completion. The installation of more than 6000 groundwater level monitoring wells will cost approximately $94.7 million in 2010 dollars, including operations, maintenance, and data management. Ongoing operation and management cost for each subsequent year in 2010 dollars is estimated to be $1.23 million. Ongoing support from multiple stakeholders and a commitment to long-term funding will be needed to achieve the network development goal.

The long-term network development as conceived will provide expanded data from both the surficial and deeper resources to enhance understanding of the three-dimensional groundwater system. As a result, water resource managers will have much-improved information for:

- Understanding status and response to change of the groundwater water system,
- Formulating appropriate management responses to changing water levels,
- Planning for the future by making decisions based on scientific data.

Current and future groundwater quantity concerns include groundwater system response to climate change, increased water consumption, and changes in hydrologic and ecologic systems. The new organizational concept for groundwater level monitoring presented in this document incorporates both watershed and aquifer will better integrate and support other monitoring efforts, such as surface water monitoring. The scope of the GWLM Network expansion is unprecedented. The successful implementation of the network build-out is dependent on an ongoing and appropriate funding commitment.

References

Advisory Committee on Water Information, Subcommittee on Ground Water, 2009, National Framework for Groundwater Monitoring in the United States, accessed at <http://acwi.gov/sogw/pubs/tr/sogw_tr1_Framework_june_2009_Final.pdf>.

Association of American State Geologists, Ground Water Protection Council, Interstate Council on Water Policy and National Ground Water Association, 2007, State/Regional groundwater monitoring networks – results of 2007 survey [Appendix 2], accessed at <http://acwi.gov/sogw/pubs/tr/nfw-dec08/Apdx2_final_state-regional-report_010909.pdf>.

Johnson, G, Cosgrove, D., and Lovell, M., Idaho Water Resources Research Institute, 1998, Glossary [Snake River Basin Surface-Ground Water Interaction—from Snake 3 River Project], accessed at <http://www.if.uidaho.edu/~johnson/ifiwrri/sr3/home.html>.

Land Management Information Center, 2011. Datanet. Accessed at <http://www.lmic.state.mn.us/data netweb/>.

Minnesota Department of Resources, 2010, Groundwater: Plan to develop a groundwater level monitoring network for the 11-county metropolitan area, accessed at <http://files.dnr.state.mn.us/pub lications/waters/groundwater_level_monitoring_report_october_2009.pdf>.

Minnesota Department of Natural Resources, 2010, Long-term protection of the state's surface and groundwater resources, accessed at <http://files.dnr.state.mn.us/publications/waters/long-term_pro tection_surface_ground_water_201001.pdf>.

Peterson, T., 2010, Minnesota Department of Natural Resources, 2010, Todd County Geologic Atlas, Part B, accessed at <http://www.dnr.state.mn.us/waters/programs/gw_section/mapping/platesum/tod dcga.html>.

Minnesota Department of Natural Resources, 2010, Water Availability and Assessment Report, accessed at <http://files.dnr.state.mn.us/aboutdnr/reports/legislative/2010_water_availablity.pdf>.

Minnesota Rules, part 4725.1830; MINN. R 4725.1830 (2008).

Norvitch, R.F., about 1975, The scope of the groundwater monitoring program in Minnesota: U.S. Geo logical Survey, St. Paul, MN. Unpublished.

Taylor, C.J., and Alley, W.M., 2001, Groundwater-level monitoring and the importance of long-term water-level data [Circular 1217]: U.S. Geological Survey, accessed at http://pubs.usgs.gov/circ/circ1217>.

Glossary

Appropriation – Water consumption. In Minnesota, an water appropriation permit is required for withdrawal of 1 million gallons per year or 10,000 gallons per day.

Aquiclude – A saturated geologic unit that is not capable of transmitting significant quantities of water under ordinary hydraulic gradients.

Aquifer – A saturated permeable geologic unit that can transmit significant quantities of water under ordinary hydraulic gradients. Aquifers are broadly classified into two categories, unconfined and confined. When an aquifer is separated from the ground surface and atmosphere by a material of low permeability, the aquifer is confined.

Artesian Aquifer – When water levels in an aquifer exhibit pressure; e.g., when a well is installed in a confined aquifer and the water level in the well casing rises above the top of the aquifer due to pressure.

Aquitard – A less permeable geologic unit within a saturated stratigraphic sequence. These geologic units may be permeable enough to transmit modest quantities of water, but are generally considered aquifers. Aquitards play significant roles in the study of regional groundwater flow, but are not productive enough to allow the completion of high yielding production wells.

Bedrock Aquifers – Bedrock aquifers are consolidated geologic rock units (bedrock) that have porosity and permeability such that they meet the definition of an aquifer (able to release water in quantities sufficient to supply reasonable amounts to wells). Water in these units is located in the spaces between the rock grains (such as sand grains) or in the fractures within the more solid rock.

Buried Aquifers – Are comprised of glacially-deposited sands and gravels, over which a confining layer of clay or clay till was deposited. Their areal extent and hydraulic connections beneath the ground surface are often unknown.

Climate Change – Any change in global temperatures and precipitation over time due to natural variability or to human activities.

Confined Aquifer – Are separated from the atmosphere by a very slowly permeable or rock (aquitard) called a confining layer. Water in these aquifers is under pressure and, in a well, the water level will rise above the top of the aquifer. See Unconfined Aquifer.

Data Logger – An instrument that records electronic data from an electronic sensor. Historically, data loggers were separate instruments externally connected to electronic sensors. Today, micro-technologies allow union of the sensor and data recorder into a single device.

Groundwater – Water located within the soils and rocks located beneath the surface of the earth.

GWLM – DNR acronym used generically for groundwater level monitoring, but sometimes referring to a specific work group.

GWLM – DNR acronym for Groundwater Level Monitoring.

Hydraulic Connection – A condition that exists between apparently separated units where water is either gained, or lost to the other.

Hydraulic Conductivity (“K”) – Hydraulic conductivity is the rate at which water moves through material.

Hydraulic Gradient – The gradient or slope of a water table or piezometric surface.

Hydrograph – A time series graph showing changes in water level on the Y-axis versus time on the X-axis.

Hydrology – The scientific study of the properties, distribution, and effects of water on the earth's surface, in the soil and underlying rocks, and in the atmosphere.

MPCA – Minnesota Pollution Control Agency.

Network – A system of interrelated items.

Groundwater level monitoring well – A water well that is used is to measure water levels.

Obwell – A DNR internal informal reference that means the same as groundwater level monitoring well.

Pressure Transducer - An electronic sensor that measures pressure. Pressure transducers are placed in GWLM wells to measure water pressure which is then converted to water level in the well.

Recharge - Mechanisms of water inflow to the aquifer. Typical sources of recharge are precipitation, applied irrigation water, underflow from tributary basins and seepage from surface water bodies.

Specific Capacity – A hydrologic ratio determined by well discharge divided by water level drawdown during a pumping test. These measurements are made during a pumping test to determine the approximate well yield.

Surface Water – Water located at the earth’s surface, occurring as lakes, rivers, wetlands, and oceans.

Sustainability: The condition of where groundwater can be withdrawn from an aquifer without harming ecosystems, degrading water quality, or compromising the ability of future generations to meet their needs.

Transmissivity - The rate of flow of water through a vertical strip of aquifer which is one unit wide extending the full saturated depth of the aquifer and under a unit hydraulic gradient. Transmissivity is used characterize aquifer conditions.

Unconfined Aquifer - An aquifer in which the top of the saturated zone (the water table) is at atmospheric pressure.

Water Table – Water beneath the land surface occurs in two principal zones: the unsaturated zone and the saturated zone. The upper surface of the saturated zone is referred to as the water table.

Appendix 1

AGREEMENT FOR INSTALLATION, MAINTENANCE AND USE OF A TEST HOLE OR WATER LEVEL OBSERVATION WELL ON PRIVATE OR PUBLIC LAND

THIS AGREEMENT is entered into this ____ day of _____ 20___, by John and Joan Smith, hereinafter referred to as the "Grantor", and by the State of Minnesota, acting by and through the Commissioner of Natural Resources, hereinafter referred to as the "Grantee".

WITNESSETH:

WHEREAS, the Grantee desires to expand the observation well network throughout the state for the purpose of obtaining geologic and hydrologic information; and

WHEREAS, the Grantor is the owner of property, as described below, on which the Grantee has deter mined it would be beneficial to gather geological and hydrologic information; and

WHEREAS, the Commissioner of Natural Resources has the authority to conduct surveys, investigations, and studies of waters of the state in order to implement the Commissioner's duties under Minnesota Statutes 103G.121,

NOW THEREFORE, it is agreed between the parties hereto:
1. The Grantor, for and in consideration of the faithful performance by the Grantee of all covenants and conditions herein contained, hereby grants a perpetual Agreement to the Grantee to establish, operate and maintain an water level observation well on the following described premises in _____County, Minnesota to wit:

NW ¼, SE ¼, Se ¼ Sec __, T___, R__W

together with the right of ingress and egress over the following described premises to wit:

NW ¼, SE ¼, Se ¼ Sec__, T___N, R__W

as depicted on the map attached hereto and made a part thereof. Grantee agrees to use existing access roads whenever possible.

This Agreement is for the purpose of drilling or augering a test hole or water level observation well on the above described premises in accordance with M.S. 103I and for measuring the water level on a regular basis. The test hole will extend in the earth to depths which will enable the Grantee to obtain geologic and hydrologic information. If hydrologic conditions are favorable, casing will be installed and the test hole will become a water level observation well for the purpose of taking water level measure ments throughout the term of this Agreement. In addition to the hole as outlined above, the water level observation well will consist of the following physical characteristics and appurtenances, collective ly hereinafter called the "Structure": A 2 " diameter PVC casing extending approximately 3 feet above the land surface protected by a 6-inch steel protective casing.

2. Excavation and/or installation of the Structure shall begin within 30 days or at a mutually agreeable time after the effective date of this Agreement. The Structure shall be installed and maintained in a safe and workmanlike manner.

3. The Structure and all equipment and tools for the maintenance and use thereof placed in or upon

said described property shall remain the property of the Grantee and shall be removed, filled and/or sealed by the Grantee at its own cost and expense within a reasonable time after the termination of this Agreement. Upon removal, filling and/or sealing of the Structure, the Grantee shall restore the above described premises as close as possible to the same state and condition existing prior to the excavation, and/or installation of the Structure and its appurtenances.

4. The Grantee agrees to cooperate, to the extent allowed by law, in the submittal of all claims for alleged loss, injuries, or damages to persons or property arising from the acts of the Grantee's employees, acting within the scope of their employment, or contractors in the excavation, installation, use, maintenance, and/or removal of said Structure, appurtenances, equipment and tools as authorized and limited by the Minnesota Torts Act, M. S. 3.736.

5. Results of the water level observations will be available to the Grantor.

6. This Agreement shall become effective when all signatures required have been obtained and shall continue in full force and effect until terminated by the Grantee at any time with 30 days' written notice. However, if the Structure prevents or in any way interferes with the Grantor, the Grantor's heirs, successors or assigns' ability to sell, finance, develop or otherwise use the premises for any purpose, the Grantor may terminate this Agreement by giving 60 days' written notice to the Grantee.

7. This Agreement shall run with the land and bind all of Grantor's successors, heirs and assigns.

8. To the best of Grantor's knowledge the vicinity of the proposed water level observation well is free from contamination.

9. The Grantee assumes no liability for any contamination or other damages that may have occurred on the property prior to the effective date of this Agreement.

10. Contamination which occurs after the construction of the water level observation well, and is introduced into the aquifer because of the existence of the water level observation well, will be the responsibility of the Grantee.

GRANTOR:
By:_____Title:_____
By:_____Title:_____

This instrument was drafted by:
Minnesota Department of Natural Resources
Division of Waters
500 Lafayette Road
St. Paul MN 55155-4032

May 2011 / File date

Appendix 2

DNR OB Well
Field Check List

Date _____
DNR OB Well No. _____
Unique Well No. _____
County _____

		Yes	No	Notes
1	Well Site Found			
2	Well in place			
3	Well Type/Use			
4	Site Photographs			From a distance & close up + Misc.
5	Used metal detector			found: Yes maybe No
6	Nested Site			names:
7	Site Description			
8	Well condition	Good	Fair	Poor
9	Bollards			number material
10	Bollard condition	Good	Fair	Poor
11	Protective Casing			diameter
12	Reflective tape			
13	DNR OB ID Sticker			cross out phone add number
14	MN Unique Well ID Tag			
15	Well Cap	outer	inner	
16	Other Access	pitless	vent	
17	Lock			Condition: Good Fair Poor
18	Type of lock			key code color
19	~~Well Diameter~~			ID OD (circle)
20	Casing Material	Steel	PVC	
21	Stick up			slope flat hard soft
22	MP Marked at TOC			
23	Pump in well			submersible turbine
24	Decontaminate Steel Tape			
25	Well Depth from TOC			
26	Well bottom	Hard	soft	other
27	GPS: Trimble Garmin	N		E
28	Elevation	GL:		MP:
29	Depth to water from TOC solinst			time
30	Depth to water from TOC steel	H	C	D time
31	Slug tested			Fast Moderate Slow (circle)
32	data logger used			
33	data logger installed (long term)			
34	Decontaminate Steel Tape			
35	Well locked B4 leaving?			

Appendix 3

Bid No.0000

SOLICITATION FOR CONTRACT WORK PRIME CONTRACTOR
SCHEDULE OF ITEMS

BIDS WILL BE AWARDED TO THE CONTRACTOR WHO SUBMITS THE LOWEST BID, MEETING ALL TERMS, CONDITIONS AND SPECIFICATIONS, FOR EACH LOCATION.

THIS IS A UNIT PRICE BID. ACTUAL QUANTITIES WILL BE MEASURED FOR PAYMENT. SUBMIT BID FOR ALL ITEMS. FAILURE TO DO SO WILL PRECLUDE CONSIDERATION OF THE BID. IN CASE OF ERROR IN THE EXTENSION OF PRICES, THE UNIT PRICE SHALL GOVERN. IN CASE OF ERROR IN SUMMATION, THE TOTAL OF THE CORRECTED BID AMOUNTS SHALL GOVERN.

Item No	Description – Dual Rotary Reverse Circulation (w/surface sampling every 5 ft) 4-inch diameter casing 1 of 2 in well nest Name of Location	Est Qty	Pay Unit	Unit Price	Amount Bid
1	Mobilization/demobilization	1	Job	$_____	$_____
2	Drill & Sample Hole (Unconsolidated material)	200	Foot	$_____	$_____
3	Drill & Sample Hole (Bedrock)	100	Foot	$_____	$_____
4	10” Steel Casing	200	Foot	$_____	$_____
5	4” Steel Casing	250	Foot	$_____	$_____
6	Grout (Furnish & Install)	3	Cu Yd	$_____	$_____
7	Develop 4” Well	1	Job	$_____	$_____
8	Protective outer casing w/locking cap (Furnish & Install)	1	Each	$_____	$_____
9	4” Diameter Protective Steel Posts (Furnish & Install)	3	Each	$_____	$_____
10	**Total: Dual Rotary Reverse Circulation Name of Location**				$_____

BY: _____
(Signature) *(Please Print Name)*

Title: _____

DATE: _____

Bid No.0000

SOLICITATION FOR CONTRACT WORK PRIME CONTRACTOR
SCHEDULE OF ITEMS

BIDS WILL BE AWARDED TO THE CONTRACTOR WHO SUBMITS THE LOWEST BID, MEETING ALL TERMS, CONDITIONS AND SPECIFICATIONS, FOR EACH LOCATION.

THIS IS A UNIT PRICE BID. ACTUAL QUANTITIES WILL BE MEASURED FOR PAYMENT. SUBMIT BID FOR ALL ITEMS. FAILURE TO DO SO WILL PRECLUDE CONSIDERATION OF THE BID. IN CASE OF ERROR IN THE EXTENSION OF PRICES, THE UNIT PRICE SHALL GOVERN. IN CASE OF ERROR IN SUMMATION, THE TOTAL OF THE CORRECTED BID AMOUNTS SHALL GOVERN.

Item No	Description – Dual Rotary Reverse Circulation (w/surface sampling every 5 ft) 4-inch diameter casing 1 of 2 in well nest Name of Location	Est Qty	Pay Unit	Unit Price	Amount Bid
1	Mobilization/demobilization	1	Job	$_____	$_____
2	Drill & Sample Hole (Unconsolidated material)	200	Foot	$_____	$_____
3	Drill & Sample Hole (Bedrock)	100	Foot	$_____	$_____
4	10” Steel Casing	200	Foot	$_____	$_____
5	4” Steel Casing	250	Foot	$_____	$_____
6	Grout (Furnish & Install)	3	Cu Yd	$_____	$_____
7	Develop 4” Well	1	Job	$_____	$_____
8	Protective outer casing w/locking cap (Furnish & Install)	1	Each	$_____	$_____
9	4” Diameter Protective Steel Posts (Furnish & Install)	3	Each	$_____	$_____
10	**Total: Dual Rotary Reverse Circulation Name of Location**				$_____

BY: _____
(Signature) *(Please Print Name)*

Title: _____

DATE: _____

SPECIAL TERMS, CONDITIONS, AND SPECIFICATIONS
PROJECT SPECIFICATIONS

Bid 0000

DNR Central Region Observation Well Drilling Name of Project Locations

Scope of Work
The contractor will furnish all labor, tools, materials, equipment, and all else necessary to legally and correctly install and complete monitoring wells by dual rotary reverse circulation method and conventional mud rotary method, as specified (with surface sampling every 5 feet), and seal bore holes, if necessary. The contractor must be registered with the Minnesota Department of Health as a Well Contractor.

The project consists of installing a two-well monitoring nest at each location. Each nest will include a well completed in the Mt. Simon sandstone. The primary goal for drilling boreholes into the Mt Simon Sandstone is to complete a monitoring well at each location. The second goal is to learn the total thickness of the Mt. Simon Sandstone at each location by drilling to the base of the formation where feasible.

All contract work shall be completed on/or before the Project Completion Date of: September 30, 2010. Site locations are listed on page 33 of this document.

Location of the Monitoring Wells
Locations are as specified in this bid document. All work performed shall conform with the Water Well Construction Code, Minnesota Statutes, Chapter 1031, and Minnesota Rules, Chapter 4725, administered by the Minnesota Department of Health (MDH). The DNR Project Supervisor will state the exact location prior to the commencement of the actual drilling.

Quality of Work
The work to be done, as defined in this document, shall consist of furnishing all labor, tools, materials, equipment, and all else necessary to legally and correctly drill and seal bore holes, if necessary, and install and complete monitoring wells in the State of Minnesota. This includes any and all reports that may need to be filed with the MDH. Copies of any reports filed shall be sent to the appropriate MDH representative & and Project Supervisor.

Contractors' Licenses
All work pertaining to the drilling of bore holes and installation of well materials must be done by contractors licensed in accordance with the Water Well Construction Code as specified in Minnesota Statutes, Chapter 103-I.

Award
Contractors must provide a price for each itemized line for each location they are bidding. Bids will be awarded to the Contractor who submits the lowest bid, meeting all terms, conditions and specifications, for each well nest location as specified. The State reserves the right to make multiple awards on this contract if deemed to be in the best interest of the State. The State also reserves the right to reduce the number of locations awarded based on available funding at the time of the award.

Payments
The Contractor will be required to submit an itemized invoice for payment for each monitoring well which has been installed. In all instances the contractor shall recommend and bill the State using the lowest cost alternative for completing a service item. Invoices are to be sent to the Project Supervisor. Payment will not be made until borehole records have been submitted to the MDH and Project Supervisor receives copies. Separate payment requests can be made, to the Project Supervisor, for each monitoring well after the monitoring well has been installed and all other related work (geophysical logging, well development, site clean-up, and appropriate record submittal) has been completed.

Retainage
The State, in making partial payments, will retain five (5) percent of the duly approved value of the work performed under the contract documents until final completion and acceptance of work at each location by the Project Supervisor.

Coordination of Work
Within 7 days of receiving the Notice to Proceed the contractor shall prepare a work schedule. No work shall begin until the Project Supervisor has approved the work schedule. All work must be completed within 30 days of receiving approval by the Project Supervisor unless written permission has been received from the State allowing a later completion date. Failure to do so will result in work being giving to another Contractor unless delays were caused by unforeseeable conditions as discussed in the section "Changes". Once the project is started, work is to proceed on a continuous basis. Interruptions in finishing a project must be approved by the State. The State may stop work at any time and the Contractor will be paid for all work that has been completed prior to being asked to stop work.

Changes
The work shall be bid assuming some unknown difficulties of a nature typical for work of this type will be experienced. Changes to the contract time period or the contract amount will be considered only if conditions vary substantially from those likely to occur or are reasonably unforeseeable.

Drilling Permits, Licenses, and Permission to Drill
The Project Supervisor will obtain permission to drill. The Contractor will be responsible for obtaining any and all necessary State and local permits and licenses that may be required by law to perform the work defined in these specifications. Permits required by local authorities shall be secured and paid for by the Contractor. The Contractor is required to be licensed in accordance with the Water Well Construction Code. The Project Supervisor will notify Gopher-One-Call prior to drilling.

Drilling Mud
Only commercially prepared drilling mud shall be used. Natural clay from outside sources or recovered from previous well cuttings shall not be used. The use of organic mud will only be allowed with the prior approval of the Project Supervisor. Drilling mud shall be changed every 150 feet (or as appears necessary by DNR Project Supervisor) so that a more accurate description of the cuttings can be made.

Working Schedule
All drilling and other work for which there will be payment shall be done during the daylight hours of a 5-day work week (Monday through Friday), except as specified below. Unless approved by the Project Supervisor, no drilling shall be done on official state holidays or nonworking days. The Contractor and the Project Supervisor, at the beginning of the work, shall mutually agree on a schedule of work hours to be followed. If certain phases of work on a test hole must be continued into the hours of darkness, the Contractor shall provide sufficient lighting so that work may be carried out in a safe and efficient manner. If the schedule of work hours is to be changed, the Project Supervisor and the Contractor shall mutually agree to such change 24 hours in advance of such change.

General Bidding Instructions
The quantities shown here are estimates for bid tabulation. In all cases the State will pay the Contractor for the actual quantities used for work approved by the Project Supervisor. No bore hole will be started without additional permission from the Project Supervisor if the estimated cost for the bore hole will put the cost of work performed over the cost stated on the contract. Boreholes to be drilled under these specifications are to be used by the State in the investigation of stratigraphy and hydrology of sites in Minnesota. The anticipated drilling depth will generally be between 100 and 1000 feet. It may be necessary to install surface casing in the borehole to maintain circulation of drilling fluids or to control flowing conditions. Each borehole will have a protective casing/cap installed by Contractor.

Drilling Site
The drilling site is defined as the general location of the drilling, being an area no larger than 500' x 500'. More than one monitoring well may be installed at a site, or it may be necessary to reset the drill rig should an unexpected obstruction or other problem be encountered. The cost of relocating the drill rig within the drilling site will be paid as Idle Time. The Contractor shall provide all equipment and experienced personnel, including the specified drilling equipment; all tools, accessories, power, lighting; and all other items necessary to conduct efficient drilling operations. The Contractor shall arrive at the site with sufficient supplies, and well materials to complete the anticipated project in order not to delay the drilling. If it is anticipated that the project will require a surface casing, such materials shall be on-site at the start of the project. If the well/bore must be sealed/abandoned, the Contractor shall also have sufficient supplies and materials to complete this task.

The drill rig shall be in good condition and of sufficient capacity as to meet the drilling specifications outlined. In the event that the equipment, judged on the basis of work completed to date, is considered unsatisfactory, thus endangering performance under the contract, the DNR shall notify the Contractor of such in writing for corrective action.

General Health & Safety
The Contractor is solely responsible for the protection of property and the health and safety of its employees, subcontractors, suppliers, agents and others on or near the site, including health and safety matters related to the nature of the work and the potential for encountering hazardous substances in air, soil, leachate, and/or condensate during the work. The Contractor's personnel shall maintain safe working conditions, including the wearing of hard hats and steel-toed shoes. Hearing protection is also strongly encouraged.

Delays within contractor's control
Delays in drilling which cause idle time for the Owner (State of MN) shall be deducted from final payment by the State at the same rate as "Idle Time". These delays are those caused by inadequate supplies, failure to bring all equipment necessary to drill, install well materials and seal boreholes, or arrival at the drilling site after the predetermined time without reasonable cause. Only delays in excess of 30 minutes will be charged and idle time will be figured to the nearest quarter hour. Delays due to equipment breakdowns will be handled as described in "Equipment and Personnel to be furnished by Contractor".

Drilling Procedures
For each site the expected sequence is as follows. After setting surface casing, if needed, drilling is to proceed to a depth determined by the Owner, collecting samples as described in "Geologic Samples and Log". The borehole shall be sufficiently

straight and plumb to permit geophysical logging. During the drilling no sand, dirt, rock, old drilling cuttings, or any foreign materials shall be introduced into the borehole except with prior knowledge and consent of the Owner.

The Contractor shall make measurements of the amount of hole drilled or other factors for purposes of payment or testing with his own equipment in the presence of the Owner. In case of dispute or for any other purposes, the Owner will be entitled to make measurements at any time with its own equipment at no extra cost to the State. Explosives shall not be used in connection with any drilling operation except on specific prior written approval.

Geologic Samples and Record
Samples of the materials penetrated shall be collected at intervals of 5 feet, at changes in formation, and at depths determined by the Owner. The driller shall notify the Project Supervisor logging the test hole of such conditions to facilitate in evaluating changes in the formation. The driller shall carefully and accurately keep a log with descriptive notes of everything encountered by the drill and of all difficulties or unusual conditions met in drilling. Within 30 days after completion of the borehole, the invoice for the work and the DNR's copy of the Bore Hole Record and well construction shall be prepared and delivered to the Project Supervisor in accordance with Minnesota Rules, Chapter 4725.

Site Preparation and Clean-up
No fee will be paid to complete minor site preparation and clean up typical for work of this type. Changes to the contract amount will be considered only if conditions vary substantially from those typical for work of this type and must be approved by the Project Supervisor prior to the initiation of work.

Cuttings Containment, Final Clean Up and Restoration
The site shall be left free of waste materials; damaged areas restored, and with the ground surface restored to as near original condition prior to approval by project supervisor for final payment. To expedite the final clean up, the contractor should plan to provide an open container (dumpster or other similar container) for drilling fluid circulation and cuttings containment. Dug mud pits will not be suitable for any of these sites.

Damage to Facilities
The drilling site(s) chosen will be reasonably accessible and have reasonable maneuvering space for the Contractor's trucks and equipment. The Contractor shall be responsible for the cost of completing any repairs/replacement of any damaged structure, cover soils, vegetation, personal or real property caused by drilling activities both on and off the site. It is the responsibility of the Contractor to maintain the integrity of any site structure by taking appropriate measures to protect it from accidental damage, e.g., rutting. The Contractor shall immediately notify the Project Supervisor of any damage. The Project Supervisor will have the utilities located. If, upon inspection of the site, the Contractor determines that there is not sufficient cleared area for efficient operations, the Contractor shall notify the Project Supervisor who will arrange for an alternative site or for further site preparation.

Mobilization
Mobilization shall include moving all personnel, tools, equipment and vehicles to the site and removing the same from the site when drilling is completed. It shall also include the preparation of required submittals including the provision of insurance certificates and site preparation if any, setup, demobilization and final clean up and restoration. The Contractor shall arrive at the site with sufficient supplies to complete the anticipated project in order not to delay drilling. If it is anticipated that the project will require a surface casing, such materials shall be on-site at the start of the project.

Drilling
The price per foot of drilling shall include drilling, assisting in collection of geologic samples, recording a log of all materials and drilling conditions encountered, and filing a well log record.

Sealing Bore Hole
If a borehole cannot be completed as a monitoring well, upon completion of drilling and after the Project Supervisor has completed any testing deemed necessary, the borehole shall be sealed according to the Minnesota Rules, Chapter 4725. The quantity of grout required to seal a well will vary depending on type of formation. If the quantity of grout exceeds the well volume by 30 percent, the Project Supervisor must approve any further grout placement. While grouting in bedrock the Contractor shall be prepared to use stone aggregate to reduce the grout volume in accordance with Minnesota Rules, Chapter 5 4725.

Idle Time
During the progress of drilling operations under these specifications, it may be necessary for the Project Supervisor to perform work not directly involving drilling, such as geophysical logging that will require the services of the drilling crew and drilling equipment to stand idle during normal working hours. In such an event, the Owner shall request that the Contractor furnish such assistance and/or cease operations and shall state the anticipated extent or duration thereof. The Contractor shall promptly furnish such assistance and/or cease operations and shall receive reimbursement, therefore, according to the bid item for idle time. Idle time of the drilling crew and equipment, during normal working hours, not ordered by the Owner shall not be reimbursable under this contract. Also, time spent for circulation of drilling fluid for collecting samples or drill cuttings as called for under "Geologic Samples and Log" shall not be separately reimbursable; it is to be included in unit drilling cost. Idle time shall be figured to the nearest quarter hour.

Observation well locations Hennepin, Isanti and Anoka Counties

County	T R SEC QQ	Name	Owner	Nearest Intersection	Aquifer	Est. Well Depth
Isanti	35 25 33 NE NW	Crooked Road WMA	DNR/FAW	Dolphin St. NW, 285th Ave NW	Mt. Simon Sandstone	300
Isanti	35 25 33 NE NW	Crooked Road WMA	DNR/FAW	Dolphin St. NW, 285th Ave NW	Unconsolidated sand	100
Isanti	36 25 35 SE SE	Spectacle WMA	DNR/FAW	325th Ave NW, Helium St. NW	Mt. Simon Sandstone	350
Isanti	36 25 35 SE SE	Spectacle WMA	DNR/FAW	325th Ave NW, Helium St. NW	Unconsolidated sand	100
Isanti	37 24 2 SW SW	Stanchfield WMA	DNR/FAW	Flamingo St. NW, 413th Ave	Mt. Simon Sandstone	250
Isanti	37 24 2 SW SW	Stanchfield WMA	DNR/FAW	Flamingo St. NW, 413th Ave	Unconsolidated sand	60
Anoka	33 25 22 NE SW	Pickerel Lake WA	DNR/TAW	Jasper St., Old Viking Blvd NW	Mt. Simon Sandstone	400
Anoka	33 25 22 NE SW	Pickerel Lake WA	DNR/TAW	Jasper St., Old Viking Blvd NW	Unconsolidated sand	100
Hennepin	118 24 8 SW SW	Robina WMA	DNR/FAW	Lake Haughey Rd and Hwy 12	Mt. Simon Sandstone	600
Hennepin	118 24 8 SW SW	Robina WMA	DNR/FAW	Lake Haughey Rd and Hwy 12	Unconsolidated sand	100

Appendix 4

DOW SITE SPECIFIC DRILLING OPERATIONS SAFETY PLAN

Projected Date(s) of Field Work:

Site Address or Coordinates:

Approvals		
	Initials	Date
Prepared By		
Approved By		

☐ Site Map Attached

Work Planned at this site: LCCMR SC drilling and ob well installation. Site activities will include over-site of drilling procedures and sample collection. Follow-up site activities will include installation of long term water level monitoring equipment and water quality sample collection.

KEY CONTACTS

DNR Project Leader:	(project manager) _____	Phone:	Cell:	☐ CPR/F.Aid
Site Contact (WMA, etc.):	(on-site geologist) _____	Phone:	Cell:	☐ CPR/F.Aid
Drilling Staff	Well Company drilling crew _____	Phone:	Cell:	☐ CPR/F.Aid
	_____	Phone:	Cell:	☐ CPR/F.Aid
	_____	Phone:	Cell:	☐ CPR/F.Aid
	_____	Phone:	Cell:	☐ CPR/F.Aid
	_____	Phone:	Cell:	☐ CPR/F.Aid

Other: Unit Supervisor Phone: Cell:

Administrator Phone:

Closest Emergency Medical Facility (Name):

Phone Number (general):
☐ Emergency Medical Facility Confirmed
☐ 911 Service Confirmed

Phone Number (emergency):
☐ Map with Route to Hospital Attached

Police: 911 Fire: 911 Paramedic/Ambulance: 911

EMERGENCY PROCEDURES

Medical Emergencies

1. Remove injured or exposed person(s) from immediate danger if possible.
2. Evacuate other on-site personnel to a safe place in an upwind direction.
3. If serious injury or life-threatening condition exists, call 911 - Clearly describe location, injury and conditions to dispatcher/hospital. Designate a person to direct emergency equipment to the injured person(s).
4. Provide first aid if necessary. Be aware that shock is a threat for all persons at the site.
5. Call the DNR project leader and supervisor.
6. Immediately implement steps to prevent recurrence of the accident.

General Emergencies

In the case of fire, flood (uncontrolled flow of water), explosion, or other hazard, stop work, evacuate, and call the local police/fire department by calling 911 as appropriate.

Emergency Equipment Onsite
☐ First Aid Kit; ☐ Fire Extinguisher; ☐ Other: _____

PHYSICAL HAZARDS:

☐ Heat Stress ☐ Cold Stress ☐ Wet ☐ Noise
☐ Slip, Trip, & Fall ☐ Heavy Equipment ☐ Electrical Hazards
☐ Underground Hazards: One Call Ticket # _____ Date Called: _____
☐ Overhead Hazards ☐ Traffic ☐ Excavations/Trenching ☐ Confined Space
☐ Other: _____

SITE CONTROLS: Good Housekeeping measures minimize slip and fall hazards (and control erosion). Identified hazards should be flagged, fenced off or staked, etc. _____
_____

PERSONAL PROTECTIVE EQUIPMENT – R = REQUIRED, A = HAVE AVAILABLE

Serious injuries and deaths have been **prevented** when people working near rigs have worn their protective gear.

_____ Eye Protection _____ Safety Glasses _____ Sun Protection
_____ Hard Hat _____ Steel-Toed Boots _____ Appropriate Clothing
_____ Traffic Safety Vest _____ Hearing Protection _____ Rain Gear
_____ Appropriate Gloves: Neoprene, safety grip; cloth/leather; Other _____
Other: _____

Drillers will follow their own health and safety plans, copies of which must be provided to DNR, and provide their own personal protective equipment.

LIST OF POTENTIAL TOPICS FOR TAILGATE SAFETY MEETING

Drilling Contractor Staff are responsible for all activities related to drilling and drill rig setup and operation. At the tailgate safety meeting, the Drilling will brief DNR staff on critical safety features of the drill rig and point out hazards of working near a drill rig.

Tailgate Safety Briefings

Work for the day should not be started until hazards have been identified discussed. Following is a list of topics to review as appropriate.

- Is everyone wearing proper personal protective equipment? Clothing is snug, jewelry and watches will not snag?
- Are vehicles and machinery in good operating condition? (pre-drilling walk-around completed?)
- Is everyone aware of the safety plan and know what to do in case of an accident?
- Are fire extinguishers present? Are they of the appropriate size and type? Are they in good working condition?
- Is any fuel on the site properly stored?
- Do the conditions require "no smoking"? (and do the drillers observe that caution?)
- Is the work area organized? Would DNR be completely embarrassed if the media stopped by for pictures?
- Has staff been told to 'pick up after themselves' during drilling operations?
- Are any trip hazards present?
- Are all "shut down" devices on the drill rig installed and in good working condition?
- Are tools clean and in good working condition?
- Do the site conditions warrant wheel chocks for vehicles (drill rig/water truck)?
- Is there a working (charged) cell phone on site? Is there cell phone service? Failing that, is an emergency communication source available?
- Have employees been trained in first aid and CPR?
- Is there a properly stocked first aid kit available on-site and in every vehicle?
- Are overhead power lines or any other utility lines present in the area? A minimum distance of fifty or more feet should be observed when setting up in the vicinity of overhead lines. Has the power utility been onsite to install protective measures?
- Have all underground utilities been identified?
- Is there a danger of being struck by other moving vehicles?
- Is there a danger because of possible soil instability due to steep slopes, etc.?
- Is there poison ivy in the area, wild parsnip? Can staff identify these poisonous plants? Hornet nest or bee hives?
- Is there a danger of lightning strikes? This subject must be addressed regardless of time of year or current weather conditions.

TAILGATE SAFETY MEETING DOCUMENTATION FORM

Date:

Site Location:

Lead By:

Name (printed)	Signature

MAP TO HOSPITAL

(copy map and route from mapping program and paste in so it will print out with the safety plan – verify from personal knowledge of drilling site that the program is actually giving you something useful)

Appendix 5.1

Policy and criteria for accepting existing wells into the MN GWLM Network

This policy applies to:

Accepting existing wells from other entities into the Minnesota Ground Water Level Monitoring (GWLM) Network. Ownership of the well may or may not be transferred to the State of Minnesota Division, Department of Natural Resources, Division of Waters, depending on circumstances.

Background

From time to time, an existing well is no longer used by its owner. The reasons that a well is no longer used include the following: the completion of a study, re-purposing of a site property from one function to another, a change of land ownership, and possibly other reasons. Rather than seal the well, and possibly incur considerable expense, the owner of the existing well may approach DNR Waters and propose that the well become part of the GWLM Network. The actual ownership of the well may or may not be transferred to DNR Waters. Potential wells for inclusion in the network may also be identified in other ways, such as surveys of unused or abandoned wells by local governments. Historically, most of the wells in the current network were added to the network through formal or informal access obtained from other entities. In some cases DNR accepted formal ownership of the well from another entity.

Adding an existing well to the Network may be very beneficial in terms of adding valuable data to the network without the expense of actual installation. Existing wells that are added to the Network by access agreement have ownership and future responsibility retained by another entity. However, if the ownership of the well is transferred to DNR, the transfer brings with it a commitment by DNR Waters to maintain the site and, when no longer needed, to seal the well. The potential costs to seal a well can be considerable.

General Policy

The Division of Waters will add existing wells to the GWLM Network to improve the quality and quantity of ground water data and reduce the cost of installing new wells.

General Criteria:

An existing well proposed to be added to the Network:

- Must fulfill a monitoring need;
- Should monitor a known aquifer or system;
- Must be in connection with the aquifer;
- Must be intended for long-term measurement;
- Must meet requirements of the Minnesota Well Code.

Specific Criteria:

Technical Criteria

1. The existing network should be reviewed to identify a specific need. For example, the well fills a gap that exists in the network or an existing well is no longer functioning properly and needs replacing.
2. The existing well should connect with an aquifer of sufficient extent and thickness to have an economic or resource value for a significant area.
3. Other ground water level monitoring networks should be reviewed so the proposed well is not a duplicate of an existing operational well. The proposed well should also support complementary hydrologic cycle networks such as climate and surface water.
4. Wells that are proposed for ownership transfer to DNR Waters should be less than 25 years old and less than six inches in diameter. Proposed wells must meet the requirements of the Minnesota Well Code at the time of transfer.
5. Proposed wells for inclusion in the Network should be at least two inches in diameter to accommodate measurement devices.
6. GWLM Network wells should not be used for pumping. If the proposed well is used for pumping, the effects of the pumping shall be considered prior to accepting the well into the Network.
7. The well must have proper documentation including a well log and/or other construction data that adequately describes the physical setting and construction of the well.
8. Geophysical and video logs should be conducted on all proposed wells to verify the condition of the well and confirm the geology of the area in which the well is installed.
9. Pumping and/or slug tests should be conducted to demonstrate functionality of the well.
10. The condition and safety of the proposed well must be field-verified. The field verification step should also check well location and use, and the presence of pumps or other equipment in the well.
11. Any well that is open to multiple aquifers cannot be accepted into the Network unless provisions have been made to properly refit the well for single aquifer use.

Administrative Criteria

12. The record of ownership of each well proposed for inclusion in the Network should be confirmed. Whether the well is added to the Network by access agreement or transfer, an access agreement or transfer agreement, respectively, will need to be concluded with the well owner.
13. If the proposed well for transfer is not an actively used well, any pumps or structures in the well should be removed prior to accepting the well for transfer into the GWLM Network. This work should be conducted by the previous/existing owner of the well prior to the DNR Waters using the well as part of the Network.
14. For wells that are added to the Network by access agreement, an access arrangement shall be approved between the property owner and the DNR Waters to allow long-term access to the well location for monitoring and maintenance (as defined in the Access Agreement).
15. Existing wells that are proposed for addition to the DNR Waters GWLM Network shall have identification tags and impact protection installed as needed to meet Minnesota Well Code Requirements prior to accepting the well into the Network.

16. If a well is unsuitable for adding to GWLM Network, the information about the well should be stored for possible future review and reconsideration.
17. Each proposed addition to the Network should be carefully reviewed and a review memo and recommendation prepared. The review should be conducted by the Groundwater Monitoring Well Coordinator and should address the criteria (as outlined above) used to determine if a well should be accepted into the GWLM Network as an observation well. The recommendation will be submitted to the Ground Water and Hydrogeology Supervisor for their review and concurrence. The documentation should be kept in the GWLM Network well file and in the remarks section of the GWLM Network database.

FINAL Policy Criteria new obs wells MN GWLM Network 16Jun2010

Appendix 5.2

Policy and criteria for installing new wells to add to the MN GWLM Network

This policy applies to:

Drilling or installing new wells for use in the Minnesota Ground Water Level Monitoring (GWLM) Network. The ownership of the well is expected to be with the State of Minnesota, Department of Natural Resources, Division of Waters (DNR Waters).

Background

When the funding is available, new wells are installed by DNR Waters to add to the GWLM Network. The well is typically located in an area that is under-represented in the existing Network, is placed in an aquifer that was previously not measured, or is associated with a study being conducted in a particular area. DNR Waters will maintain the new well and properly abandon it when it is no longer needed.

Each proposed new well location should be carefully reviewed and a review memo and recommendation prepared. The review should be conducted by the Ground Water Monitoring Well Coordinator and should address the criteria (as outlined below) used to determine if a location would be acceptable for a new well. The documentation should be kept in the GWLM Network well file and in the remarks section of the GWLM Network database.

General Policy

The Division of Waters will install new wells to add to the GWLM Network to improve the quality and quantity of ground water data. These wells would be installed in areas or aquifers that have an insufficient number of GWLM Network wells.

General Criteria

A proposed new well *must* meet the following criteria:

- Must fulfill a monitoring need.
- Must be constructed to be in connection with the aquifer.
- Must be intended for long-term measurement.
- Must meet requirements of the Minnesota Well Code.

Likewise, a proposed new well *should* meet the following criteria:

- Should monitor a known aquifer or system.
- Should be located on public land, preferably State of Minnesota owned property.
- Should be part of a well nest installed in the various aquifers at the location.

Specific Criteria

1. The existing network should be reviewed to identify a specific need. For example, specific needs may include gaps that exist in the network or replacing an existing well that is no longer functioning properly. The location should be within an area identified in long-range or priority plans developed by DNR Waters.
2. The new well should be constructed to connect with an aquifer of sufficient extent and thickness to have an economic or resource value for a significant area.
3. Other ground water level monitoring networks should be reviewed so the proposed well is not a duplicate of an existing operational well. The proposed well should also support complementary hydrologic cycle networks, such as climate and surface water.
4. New wells should be at least two inches in diameter to accommodate measurement devices.
5. New wells will be installed in accordance with all appropriate well installation regulations.
6. Installation procedures for the well shall include proper development before incorporating the well into the network.
7. Upon completion and development, a single-well pump test shall be conducted to determine well hydraulic characteristics.
8. An access arrangement will be approved between the property owner (including those sites owned by units within the DNR) and DNR Waters to allow long-term access to the well location for monitoring and maintenance (as defined in the Access Agreement).

FINAL Policy Criteria new obs wells MN GWLM Network 16Jun2010

Appendix 5.3

Policy and criteria for removing wells from the MN GWLM Network

This policy applies to

Removing existing wells from the Minnesota Ground Water Level Monitoring (GWLM) Network. The well may or may not be owned by the State of Minnesota, Department of Natural Resources, Division of Waters.

Background

Occasionally, a well in the GWLM Network is no longer measured, but has not been sealed. The well might not be measured because the well has been damaged and is no longer a functioning well, tests have indicated that the well is no longer connected to the aquifer, the use of the property has changed, or the property owner does not allow DNR staff on the property.

The well may have been installed by the DNR for either the obwell network or for a special project. It may have been installed for a project by another entity (e.g., the USGS) and use of the well was acquired by the DNR. The well may be an old water supply well or it could be an active water supply or irrigation well. The DNR may or may not own the property where the well is located.

If a well is no longer measured and is not in use for another purpose, it is not considered an active well by the Minnesota Department of Health (MDH) and according to Minnesota well code (Minnesota Statute 103I.301) the well must be sealed.

General Policy

The Division of Waters will seal wells and remove the site from the GWLM Network if they are no longer measured as a part of the GWLM Network and are not used by another entity.

If a well is owned by but is no longer actively measured by DNR Waters, it must be sealed by the DNR Waters in accordance with MDH well code and regulations.

If the well is owned by another entity and is not in use by that entity, the well owner must be notified that the well is no longer in use by the DNR and it should be sealed.

If another entity wishes to continue measuring a well owned by the DNR, the ownership of the well will be transferred to that entity and that entity will be responsible for the maintenance and eventual sealing of the well.

General Criteria

An existing well will be removed from the Network if:

- The well is no longer actively measured but is owned by the DNR.
- The property owner does not want the well on their property.
- Tests indicate that the well is no longer accurately measuring aquifer water levels.
- The well is redundant and is duplicating water level data from a nearby well.
- Well is damaged and can no longer function as a monitoring well.
- Well is damaged and is a threat to human health or the environment.

If the well was acquired from another entity (such as the USGS) and the DNR has actively measured the well for a period of time (at least five years), the DNR will accept responsibility for maintenance and sealing of the well unless other arrangements have been made.

Specific Criteria

Technical Criteria

A GWLM Network well will be sealed and removed from the Network if any of the following criteria are met and the well is owned (specifically or implicitly) by the DNR:

1. A well has been damaged beyond repair.
2. A well is no longer actively measured because it is in a location which does not fit into the needs of the GWLM Network.
3. A well is no longer effectively measuring the aquifer. This maybe indicated by a very slow to no response to a slug test or some other test.
4. Water levels have changed dramatically for no apparent reason. This may indicate the well casing has failed and water from a different part of the subsurface is entering the well.
5. A well is a flowing well with no way to consistently measure the water level.
6. A well has been damaged by the elements and the integrity of the well is in question.
7. The well is located close to another well which is measuring the same aquifer. Generally, the newer well should be retained in the Network as it is expected to have a longer remaining life span.
8. Property owner no longer wants the well on the property.
9. Property owner will not allow DNR or its contractors on the property to measure the well.

Administrative Criteria

1. If the well is sealed by the DNR, the well will be sealed in accordance with MDH well sealing requirements.
2. If the well is sealed for the DNR by a contractor, the well must be sealed in accordance with MDH well sealing requirements.
3. If the well was acquired from another entity and the DNR has actively measured the well for more than five (5) years, the DNR will continue or provide maintenance and will seal the well when necessary unless another agreement has been made.
4. When the well is sealed, the well sealing records must be kept by DNR with other data from the well.
5. If the well is owned by another entity, that entity must be notified by the DNR that the well will no longer be measured as a part of the GWLM Network and if the owner is not using the well, that the owner should seal the well in accordance with MDH well sealing requirements.

6. If the DNR plans to seal an obwell and is not certain that other entities measure the well, a warning sticker will be placed on the well stating the well will be sealed in six months (specify date on label) and if the measuring entity has concerns, it must contact the DNR within the six months. The DNR's Area and Regional Hydrologist and the local Soil and Water Conservation District and/or Waters.
7. Management District should be contacted at least 60 days before the well is sealed. If these individuals or organizations are measuring the well, arrangements must be made to outline the responsibility of the other individual or organization related to the maintenance and ownership of the well.
8. If the DNR finds a well that was formerly used as a DNR obwell, is no longer measured, and appears to not be actively used, the DNR will notify both the property/well owner and the MDH about the well and indicate that the well does not appear to be in use.

Appendix 5.4

Policy and Criteria for Installation and Use of Electronic Data Logging and Telemetry in the MN GWLM Network

This policy applies to:

The installation and use of electronic water level sensors (transducers), electronic data loggers, and telemetry equipment for automatically recording water levels in wells and automatically or semi-automatically acquiring the recorded electronic data for the Minnesota Ground Water Level Monitoring (GWLM) Network. The MN GWLM Network is operated by the State of Minnesota Department of Natural Resources, Division of Waters (DNR Waters).-

Background

Electronic water level measurement and data logging

Water levels in ground water monitoring wells rise and fall in response to variations in long-term climate, seasonal recharge, weather events, pumping from the aquifer or related resource, and other hydrologic system changes. The water level changes in the well are measured periodically to track the response of the ground water system to those variations. Generally, water levels in Network wells are measured once a month from April to November and are not measured the other months.

The data are manually recorded and later provided to the Network database. In order to obtain accurate measurements to 0.01 foot, the preferred traditional equipment for the MN GWLM Network is a specially constructed steel tape. Currently, wells are measured manually once a month by SWCD staff. The SWCDs are paid a set amount per well measurement.

Electronic sensors called transducers can respond to water pressure changes that can be interpreted as water level changes. The electronic signal can be stored in another electronic device called a data logger for later retrieval. Transducers and data loggers are standard technology and have been used for many years by DNR Waters staff, especially for aquifer tests and special studies. They have not, however, been used for routine measurement of GWLM Network wells mainly because of cost. Newer designs have features (size, data capacity, data download procedures, required routine service) that may be more cost effective than manual measurements in certain locations. In this document, unless otherwise stated, datalogger means an integrated transducer and datalogger system.

Telemetry

Telemetry means remote communication and data acquisition by telephone lines, cell phones, radio, or satellite systems. Telemetry from sites instrumented with the necessary electronics is not new in Minnesota. The technology is used at about 150 stream gages in Minnesota (see Appendix A). The USGS uses telemetry at selected ground water level monitoring locations in Minnesota.

For the MN GWLM Network, using telemetry would allow remotely evaluating the status of the monitoring sites and downloading the water level measurements without traveling to the location. After the downloaded data is reviewed, it would be transferred to the GWLM database. Optimally, the data can be acquired and provided to users in near real time.

General Policy

Use of Transducers and Dataloggers

To reduce the costs of manual measurements, provide for more frequent measurements, and increase data management efficiency; the use of electronics for measuring and recording water levels in the MN GWLM Network should be employed. The dataloggers should be installed when and where it is cost effective and their use should be expanded over time. The long-term goal is to instrument all suitable Network wells with dataloggers.

Use of Telemetry

The purpose of telemetry is to reduce costs of manual measurements, provide for more frequent measurements, increase data management efficiency, and make data more immediately available; the use of telemetry in the GWLM Network should be considered at priority sites when and where it is cost effective. The use of telemetry may be expanded over time. DNR Waters should work with other agencies to install telemetry sites if such sites will improve information about the resource and there is sufficient support between the agencies.

General Criteria

Transducer and Datalogger Equipment

Transducer and datalogger equipment should be placed in all suitable obwells in the Network. Unsuitable wells are typically irrigation wells or other actively pumped wells or wells with limited access. This equipment should not be placed into actively pumping wells because of the potential for damage to the transducer, datalogger, or the pump. Adding electronic monitoring equipment to unsuitable wells should be assessed on a well-by-well basis.

Currently, there are a limited number of dedicated transducers and dataloggers installed in the Network. As funding becomes available dedicated Network dataloggers will be purchased and installed. The factors that need to be considered when evaluating where the dataloggers should be installed include the following:

- Wells in areas that currently or historically have had ground water supply issues, (i.e., Brooten/ Belgrade or the Buffalo Aquifer area) should be given priority consideration. This would be a continuation or expansion of the existing practice to deploy dataloggers in areas requiring close observation because of water supply issues, drought, well interference, and resource conflicts. There are generally 10 to 20 dataloggers deployed for such purposes at any time.
- At the county level, factors to consider include:
    - Distances between obwells – wells that are far apart are better suited to have dataloggers. The amount of travel time and travel expense is reduced if someone visits the well

quarterly rather than monthly.
    - Local support – participation by SWCD, watershed districts, area hydrologists, local agencies, etc. A goal is to establish partnerships for downloading data and conducting site checks.
    - Nested well systems -- if a monitoring location is a nested well cluster, all of the wells in the nest should be instrumented.
- Ability for DNR personnel to visit the wells on a timely basis to download the datalogger and ensure equipment is functioning properly.

Details about the transducer equipment requirements and data collection are presented in Appendix B.

Telemetry Equipment

At this time, DNR Waters is not actively pursuing adding telemetry to any of the new or existing wells in the network. Because of the cost of installation, the on-going maintenance required for a telemetry system, and the relatively slow change in ground water levels, the use of telemetry for communicating ground water levels is not considered a priority use of limited resources.

5.4 - Appendix A

Minnesota Cooperative Stream Gaging Program

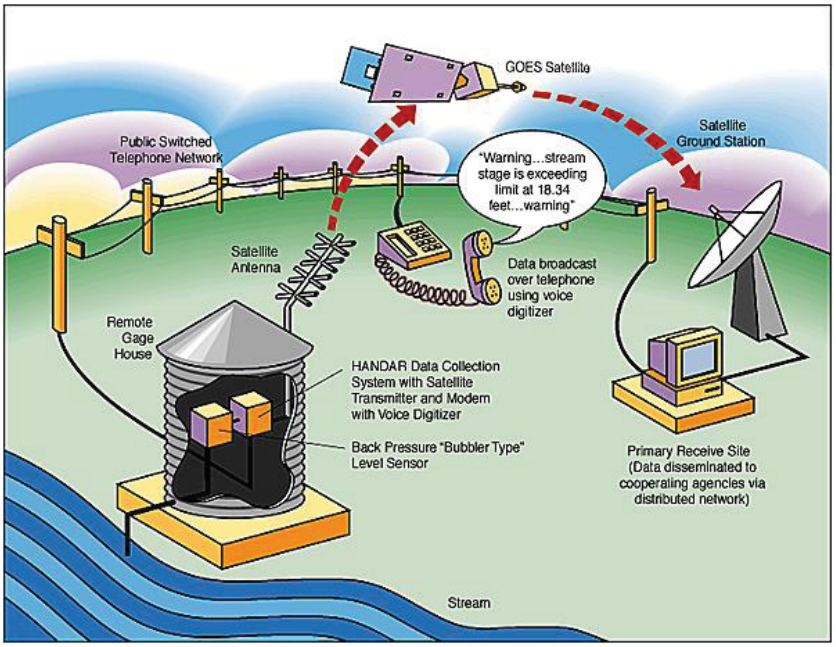
Telemetry Overview for Stream Gaging

The diagram below gives a general outline of how the Minnesota Cooperative Stream Gaging Program telemetry system is organized. There are two common ways to remotely communicate with the data loggers: telephone and satellite. Other options include cell phone and radio communication.

First, the telephone line, which is hooked up by the telephone company and is maintained just like any residential phone line. Program personal can call the logger, make programming changes, and get a measurement reading. With certain loggers, the phone can also be used as a warning if certain criteria are exceeded as shown in the diagram. This method can sometimes be difficult in more remote areas where a phone network can be far away from the site.

The second type of telemetry is through a Geostationary Operational Environmental Satellite (GOES). Like other forms of satellite communication, this allows a direct real-time feed of information from the logger to a computer. For flood warning gages, data is routed directly into the data system where it is analyzed by the software and then immediately put onto the website and stored in the database. The equipment required for this arrangement is a Data Collection Platform (DCP) transmitter, which is attached to an antenna on location. This transmitter is then able to communicate with the GOES satellite, which relays the data to a ground station and routes the data to an assigned computer. This method does not depend on remoteness of the site, but does require a relatively open space to transmit a satellite signal from the DCP to the satellite.

One of the biggest benefits of real time access to data is accurate and prompt response to changing situations in the field. Another benefit is efficiency: saving time and expense on data downloading visits, and the ability to check current conditions and equipment status when planning a site visit.



5.4 - Appendix B

Transducer and datalogger equipment requirements

The transducer and datalogger equipment must be able to measure ground water levels and temperature. They need to be a self-contained unit, which must include the transducer, the datalogger, the power supply, and the ability to be easily downloaded in the field. If possible, they should all be from the same manufacturer so there is consistency in the equipment and downloading software. The dataloggers should be able to withstand the conditions of the well they are installed, which include temperature and water pressures. Prior to installation, the expected range of the water levels needs to be considered. Initially, it is expected that a datalogger with a pressure range of 15 feet will be sufficient for most of the network wells. However, the record of each well needs to be examined prior to datalogger installation to insure that the resolution of the datalogger is appropriate to the conditions of that particular well.

Because these dataloggers are typically non-vented units, meaning that they do not take atmospheric barometric changes into account when recording the water level, a barometric datalogger will also need to be installed. This type of datalogger will allow the barometric changes to be removed from the water level data. A barometric data logger covers a 20-mile radius from the barometric logger location. The barometric datalogger can be installed in one of the obwells in the area, along with the water level datalogger. The barometric datalogger should be downloaded at the same time as the nearby water level dataloggers. The water levels from the surrounding wells can be compensated to reflect the change to due barometric changes. It is estimated six or eight barometric data loggers are needed for complete coverage of the state.

Transducer and datalogger data collection

In general, the dataloggers should measure ground water levels on an hourly basis and should be downloaded on a quarterly basis. This schedule can be revised to match the requirements for a particular area but daily readings should be the minimum measurement interval. DNR field staff will download the dataloggers. At this time, it is expected that the DNR water monitoring and survey unit personnel will download and the dataloggers while they are in the area conducting other monitoring. If needed, the field staff will also provide certain operational maintenance required by the equipment.

During the transition from manual measurements to electronic measurements with dataloggers, a local agency may be contacted and encouraged to take responsibility for routine downloads of the dataloggers in their area. If they are interested in participating, DNR staff would provide training and on-going support.

Appendix 5.5

Policy and Criteria for Vibrating Wire Transducer Use and Installation in Wells of the MN GWLM Network

This policy applies to

The installation and use of vibrating wire technology (vibe wires) in wells in the Minnesota Ground Water Level Monitoring (GWLM) Network. The network is the responsibility of and managed by the State of Minnesota, Department of Natural Resources, Division of Waters (DNR Waters).

Background

DNR Waters first identified vibrating wire (vibe wire) technology for possible application in ground water level monitoring wells of the GWLM Network in 1999, when a need developed for instrumentation that could be permanently emplaced in a well that was due to be sealed. Vibe wires are commonly used in engineering applications that require emplaced or buried instrumentation with long-term stability and reliability. A vibe wire is designed to measure fluid pressures such as ground water elevations when buried directly in embankments, fills, etc. Appendix A presents a description of how vibrating wire technology works.

Vibe wire installations in Minnesota

Since 1999, 33 vibe wire installations at nine sites have been emplaced and are currently in use in sealed wells in Minnesota. Most of the installations are located in the Twin Cities metropolitan area. There are three in Minneapolis, three in St. Paul, four in Brooklyn Park, three in Caledonia (Houston County), three in Cambridge, three in Savage, three in Afton, one in Bayport, and nine in Castle Rock (Chub Lake study area).

As typified by these installations, vibe wire transducers were typically installed in deep wells (greater than 200 feet deep) that were being sealed by the well owner. The wells were being sealed for a number of reasons, including reduction of liability from a well no longer in use or redevelopment of a property. Because the number of deep observation wells in the state is limited, having the ability to continue monitoring these wells extends the period of record for the well, thereby increasing the data's value over the long term.

Vibe wire transducers do need to be sealed in place to be used. They can be used to measure water levels in open hole wells on a temporary or permanent basis. Vibe wires have been used in a number of open hole wells in the Twin Cities metropolitan area in association with various ground water studies.

Vibe wire data collection

Currently, none of the wells in which vibe wire are installed have dedicated dataloggers associated with them. At these locations, measurements are collected monthly using a data logger and a computer. The data is collected and the values recorded in a field book. This information is added to an Excel spreadsheet, which contains the initial ground water levels and the height of the measuring point above ground surface. The water level is calculated by subtracting the reading from the initial water level and multiplying it by a factor of 1 or –1 to adjust for the sign of the reading. These values are then entered into the GWLM Network database.

Dedicated dataloggers could be added to any of the current or future vibe wires. The limiting factor for having a datalogger at a well is the ability to house the datalogger at the ground surface. The vibe wire manufacturer has a number of different datalogger systems, all of which would require housing at or near the wellhead.

When a dedicated data logger is installed, the water levels should be collected on a daily basis and the data should be downloaded on a quarterly basis. The data collection rate and period between downloads can be varied as needed.

The DNR in cooperation with the USGS formerly established a telemetry system for collecting data from the Chub Lake vibe wires. Measurements were collected hourly and then transmitted to the USGS, which processed and presented the data as part of the USGS's real-time groundwater level network.

The water level data collected from these sites are currently stored in the Obwell database and are accessible through the Ground Water Level Data Retrieval page on the DNR website. The available Chub Lake data is available on the USGS groundwater website

<u>Experience and issues with vibe wire installations in Minnesota to date</u>

1. Experience with installing a vibe wire transducer as part of well sealing procedures has shown that a high level of care is needed to avoid damage to the transducer during emplacement, especially as these installations are in deep wells, typically at a depth of hundreds of feet. Handling the transducer cable itself during installation can be difficult and the transducer or cable can be damaged during sand pack or grout placement.
2. Once sealed, an independent method check of vibe wire transducer data is not possible. The measurements reflect relative change from the time of installation but it is difficult to establish accuracy, precision, or error. For some sites, relative change following installation may be acceptable.

General Policy

To maintain or improve the water level data of deep aquifers in Minnesota, DNR Waters will install vibe wires in select wells that are being sealed and that match the general criteria for site selection and installation as outlined in this document.

General Criteria
Site selection and installation

Site selection criteria
The current installed vibe wire transducers were emplaced in wells that were previously being monitored by DNR Waters for ground water levels, except for the Chub Lake wells. The vibe wire transducers were installed because the well owner planned to seal the well and vibe wire technology was the only way available which allowed data collection to continue at these locations. Because vibe wire transducers are permanently sealed into the well and do not allow access for calibration or servicing, vibe wire transducers should be considered only if no other option is available and continuation of the data record is a high priority.

Wells that are to be sealed and that have not been previously measured by DNR Waters should be considered for vibe wire installation if the well is located so that it fills a gap in the GWLM Network. This gap maybe related to the physical location or the aquifer that could be measured. In these instances, the well will need to be assessed as outlined in the Policy and Criteria for Accepting Existing Sites document.

Independent method check requirement
When possible, existing vibe wire sites shall be paired with a comparable site to obtain an independent method check of water level. This assures that the data collected are of high quality and identifies any instrument drift or failure.

Vibe wire resolution
When the vibe wires are installed in deep wells, the initial water pressure will typically be high. Because of the high initial water pressure, the range of pressures that the vibe wire can measure must be large to prevent damage to the vibe wire. This reduces the ability of the transducer to measure small changes in water levels.

For example, a vibe wire installed in a four inch well with 235 feet of head will have a pressure of 102 PSI exerted upon it. To insure that this pressure does not damage the vibe wire, the vibe wire will have a resolution of approximately six feet. Thus the water level may change six feet before the vibe wire will measure a change. This equipment resolution must be taken into account when selecting a site for vibe wire installation. The resolution must be noted in the data record and the users should be advised.

Vibe wire installation

A complete description of the steps and procedures for installing vibe wires is presented in Appendix B.

There is no technical limit to the number of vibe wires that could be installed in a well. Generally, the casing size dictates the number of vibe wires installed. The smaller the casing size, the fewer wires that should be installed because it is more likely that the tremie pipe used to place the sealing grout will damage the vibe wires during the installation/abandonment activities.

In many of the existing vibe wire installations in the GWLM Network, multiple wires have been placed in the same aquifer. This was to provide redundancy in case one of the instruments failed. In some wells there maybe multiple zones of ground water flow through the formation. In these locations, multiple vibe wires might be installed to collect data on the different zones.

A Minnesota Well Code variance is required for vibe wire installation. Sealing vibe wires into a borehole presents a challenge to the Minnesota Well Code as it is a relatively new technique and therefore it is not addressed in the code. The Minnesota Health Department (MDH) has been very cooperative in reviewing plans for each proposed installation and has issued variances, which allow them to address their concerns regarding proper installation. The DNR has installed vibe wires at a number of locations in the state and the MDH has provided a variance for each installation. The DNR will need a variance for any additional vibe wire installation and the well sealing activities will not begin before the variance is approved by the MDH.

The ownership of the sealed well with the installed vibe wires does not transfer to the DNR. An access agreement will be developed between the DNR and the land owner for access to the site to collect water levels.

Vibe wire abandonment

While no vibe wires have been abandoned, it maybe necessary to end the use of the vibe wires. The reasons to end measuring the vibe wires might include failure of the equipment, changes in land use, or DNR Waters no longer has well access. Unless otherwise directed by the MDH, the wires shall be cut off at the top of the grout and a minimum four inches of concrete shall be placed over the cut wires. The MDH shall be notified in the change of status of the well.

APPENDIX A
How Vibrating Wire Transducers Work

How vibrating wire transducers work

Vibe wire technology (vibe wires) has been around for many years, having evolved from engineering application where strain gages were buried in embankments or placed within structures. This long history has proven them to be stable and operative over many years of service, a necessary feature if they are going to be used in a sealed-well situation.

The vibrating wire unit consists of a pressure transducer containing the actual vibrating wire and a multi-wire cable that connects the transducer to the controlling and reading apparatus. This latter apparatus can be a data logger, a single readout device, or a computer with appropriate software.

Figure 1 schematically represents the pressure transducer. The heart of this device is the vibrating wire. Steel piano wire is secured, at the cable end, to the body of the transducer; the other end is welded to the center of a pressure sensitive diaphragm. The diaphragm has access to the pore water pressure through a porous filter. An electronic coil assembly is located near the midpoint of and close to the wire. This coil, upon receiving electronic signals from the control apparatus on the other end of the cable, electronically "plucks" the wire. This is accomplished when the activated coil varies the magnetic field, causing the gage wire to vibrate at its resonant frequency. While the wire vibrates, the coil picks up the vibrating signal and transmits it back via the cable to the reading apparatus where it is processed.

Pressure changes on the diaphragm change the tension in the gage wire, causing the wire to vibrate at a different frequency just as a plucked guitar string changes pitch as it is tightened or loosened. At the time of manufacture, each vibe wire transducer is calibrated for its resonant frequencies over a range of pressures.

When vibe wires are placed into an actual application, they are initialized for the ambient water level pressure at that time. Readings taken at a later date reflect the change from that initial water level.

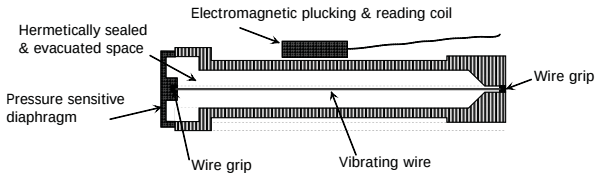


Figure 1. Schematic of vibrating wire transducer.

Appendix B
Specific procedures for vibe wire installation

Installation of the vibe wires transducers
The vibe wire transducer will be placed within a column of sand in that selected section of the borehole. The sand column is isolated within the borehole by neat cement grout below (if necessary) and above The sand column will extend at least five feet below the transducer and five feet above it.

A well variance from the Minnesota Department of Health (MDH) must be obtained prior sealing any vibe wire(s) in a well.

Figure 1 presents a diagram of a typical multiple vibe wire installation. A single vibe wire install would have a similar design. Multiple vibe wires may also be placed in a single aquifer as shown in Figure 2.

Placing the vibe wires requires the following steps:

- If the vibe wire is to be installed near or above the bottom of the well and there is no need to place grout in the bottom of the well, sand should be placed from the bottom of the hole to the level of the first (or deepest) vibe wire depth.
- If grout is necessary in the bottom portion of the well, it should be pumped into the borehole up to the point representing the bottom of the sand column, in which the first vibe wire is to be employed. That grout is allowed to set up solid.
- If the grout is installed, then at least five feet of sand will be placed from the top of the solid grout to the depth of the vibe wire.
- The vibe wire transducer is placed in a cloth bag that is then filled with sand. This gives the transducer weight to help it settle into the well and it protects the transducer from damage during the installation of the sand.
- Holding on to the cable, the vibe wire is suspended in the borehole at the desired depth.
- The vibe wire is calibrated, zeroed, and secured to prevent movement during the remaining work on site.
- Sand is placed into the borehole using a tremie pipe (to avoid abrasion of the vibe wire cables), where the sand will surround the transducer and rise to the planned depth, at least five feet above the vibe wire.
- After the sand has settled, neat cement grout is pumped into the borehole via a tremie pipe.
- If multiple vibe wires are being installed, grout is tremied to the depth of bottom of the next sand layer and allowed to set. The sand and vibe wire at the next interval above will be installed as outlined above. If the distance between the vibe wires is large, (100--150 feet or more), consider placing a five to ten foot cap of grout on the sand, allow that to set up, and then place the remaining grout. This

prevents the excessive pressure of a large column of grout from forcing cement into the sand and ruining the transducer. This continues until the last vibe wire is installed.

- If there is only one vibe wire to be installed, after the sand has settled, neat cement grout is pumped into the borehole via a tremie pipe. If the column of grout to be placed is quite large (100--150 feet or more), consider placing a five to ten foot cap of grout on the sand, allow that to set up, and then place the remaining grout. This prevents the excessive pressure of a large column of grout from forcing cement into the sand and ruining the transducer.

Vibe Wire Calibration

1. Prior to going into the field attach the vibe wire to a datalogger and insure that the transducer works. The pressure and temperature readings should register on the datalogger. If both readings are not present or do not seem correct, there may be a problem with the transducer. Contact the manufacturer for assistance.

2. At the site, unreel the vibe wire and mark every 100 feet on the wire using electrical tape. Mark the final installation depth as well.

3. Open the end of the transducer and fill the space with distilled water. This aids saturation of transducer.

4. Place transducer in bag and fill with sand. Place sand bag and transducer into bucket of water until ready for installation.

5. Measure depth to static water level (SWL) in the well.

6. Measuring from transducer, mark a point on vibe wire cable equal to SWL.

7. Mark a point on the vibe wire cable, e.g. (SWL+15 ft) to suspend the transducer 10 to 15 feet below the SLW.

8. Place transducer into borehole and suspend in 5--10 feet of water for 20--30 minutes (to allow sensor temperature to equilibrate with water temp; this also aids saturation of the transducer).

9. Pull transducer up until it is out of water.

10. Using supplied Linear Gage Factor, set a “field zero”. Identify this config file as “PreInstall” plus a site identifier.

11. Lower transducer into water down to first mark (e.g., SWL+15 ft) and obtain a reading: is it –15.0?

12. Continue to lower transducer to its proper borehole position; take a reading – is it equal to the transducer depth minus the SWL? Configure transducer as normal, getting a new zero reading. Save this new configuration file according to standard naming conventions. The naming convention for vibe wires is:

> The well's MDH Unique number_the transducer's serial number_ the depth of the transducer. For example the name for obwell 62041 which is located in the Ironton-Galesville aquifer on the University of Minnesota St. Paul campus would be: 249803_55218_752 (unique number_transducer serial number_depth of transducer).

13. After the well has been sealed and the vibe wires are activated, staff will return to the site with appropriate survey equipment to determine the ground elevation at the site.

In some installations the vibe wires are installed at different depths within a thicker sand layer in a single aquifer. The procedures and installation steps would be the same for such an installation as outlined above. This installation style could be used to provide redundancy in the equipment to provide long-term data collection in the event one of the vibe wires failed or was damaged during installation. A diagram of such an installation is presented in Figure 2.

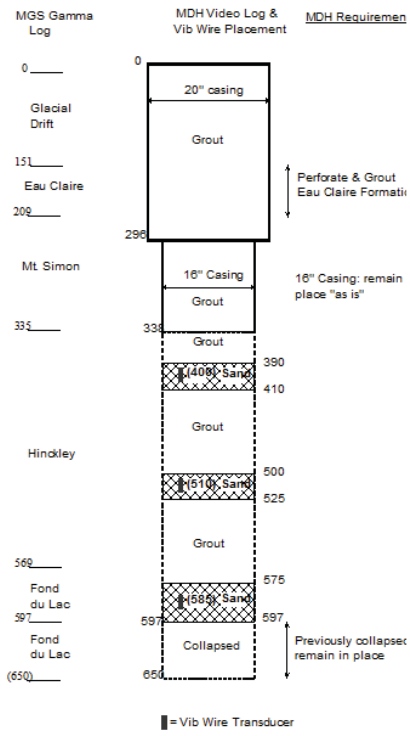


Figure 1. Placement of Vibe Wire Transducers in borehole or well

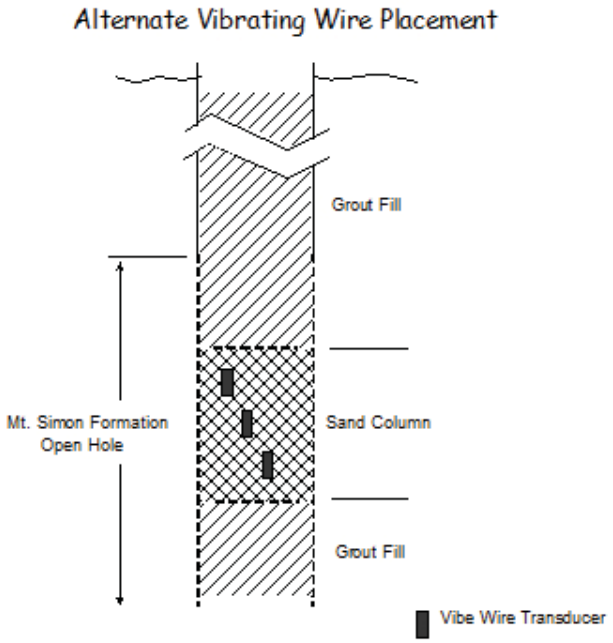


Figure 2. Alternative Placement of Vibe Wire Transducers in borehole or well

Appendix 6.1

DNR Waters Groundwater Level Monitoring Program
Technical Guide
July 14, 2010

Well Construction Methods and Materials

All well construction shall be done in accordance to the current rules and regulations. A qualified professional geologist (PG) should be on-site to supervise all field activities from mobilization through site cleanup. The role of an onsite geologist is multi-faceted; the range of duties varies from a project representative available to answer visitor and stakeholder questions, scientifically observing and recording hydrogeological aspects, and project manager providing on-site recommendations and comments during various stages of drilling and construction.

Numerous drilling methods are available to install obwells. In Minnesota, mud rotary drilling methods are the most common. However, there are a variety of technologies available that offer a variety of options depending upon the geologic conditions and depths anticipated. The selection of drilling methods and materials can be somewhat flexible and can be based upon the borehole depth, aquifer conditions, and other factors as indicated in Table 1:

Table 1 – Well Depth, Methods, and Materials

Observation Well Depth	Drilling Method	Well Diameter	Casing Material
Shallow (< 50 feet)	Hollow Stem Auger, Mud Rotary, Rotary Sonic	2 to 4 inch	PVC or Steel
Mid Drift (50-150 feet)	Hollow Stem Auger, Cable Tool, Mud Rotary, Rotary Sonic, Dual Rotary	2 to 4 inch	Steel
Basal Drift (150 -350 +feet)	Cable Tool, Mud Rotary, Dual Rotary, Rotary Sonic	4 inch or larger	Steel
Bedrock (variable feet)	Cable Tool, Mud Rotary, Dual Rotary, Rotary Sonic	4 inch or larger	Steel

Other drilling methods are also available. However, sample quality and geophysical logging requirements are also very important considerations when selecting the best drilling method. Steel well casing is the preferred material for deeper well installations due to the strength of the materials during well construction, and according to the well code steel casing is required for wells over 50 feet deep and in bedrock in Minnesota.
While a two-inch diameter observation well is often an industry standard for pizeometers, future needs that involve larger monitoring and collection devices should also be considered.

Generally speaking, larger diameter wells are more suitable for collecting water quality samples and for accommodating the variety of devices including pumps; smaller diameter well casings limit the size of instruments that can be installed. Historically, multiple-size well casings have been used for deep drilling by reducing the casing diameter with depth. Also, larger diameter wells generally accommodate and can respond more favorably to well maintenance procedures.

Once the well has been installed, well development procedures are conducted to clear the well of construction fluids and solids. During this development, well contractors make an estimate of specific capacity or well yield by measuring static level, rate of water withdrawal and water level drawdown. Recovery or the rate of water level rise within the well following well development can provide useful hydraulic information.

Each well should be protected. Three steel bollards should surround the well equally distant and 2 feet from the well. Additionally, an outer protective casing should be installed and fitted with a lockable cap. Each well should be completed with a water-tight well cap.

Above ground level well finishing measurements include the following:

Obwell	2 feet above ground level
Pro-top	3 feet above ground level
Bollards	4 feet above ground level

Bidding contracts should include site restoration as a project requirement, including removal of cuttings and other debris and site grading the site to re-establish the original surfaces. Reseeding is generally not done by the drilling contractors, due to the issue of introducing unknown species to the landscape. It is important to review the site restoration aspects with the land managers and other stakeholders so that everyone knows what to expect. Final site closure procedures for the contractor should include re-grading the surface to original slope and drainage, generally smoothing the ruts and bumps. A final site inspection should be conducted during site closure prior to approving final payments.

Appendix 6.2

July 14, 2010
DNR Waters Groundwater Level Monitoring Program Technical Guide
Observation Well Siting

The process of siting an observation well refers to determining the most suitable observation well location. This technical guide will describe how to proceed with a site review and mark an intended drilling site. This process deserves attention to the following details; mistakes made here can be hazardous, upsetting and costly.

Siting practices have changed over time. Many years ago, small diameter pizeometers were installed by a federal government agency to conduct groundwater investigations. These wells were generally 1.25 inch steel pipe fitted with drive point screens. A smaller drill rig could easily drive into a road right-of-way (ditch) and quickly drill and install a well to the water table (< 30 feet). These wells did not require permission. Unfortunately, many of these wells have simply vanished. Information from site inspections suggests that many were snapped off at ground level by being bent-over, suggesting they were either accidentally hit or intentionally pushed over.

The best observation well locations are near entrances or field approaches to open spaces where impacts to the land can be minimized and the well can be easily seen. For most drilling equipment, about one-quarter acre of open space is adequate to move in, set up and do the drilling and construction work. Publically owned land should be used for observation well sites. Public lands provide a greater likelihood that that the well will stay in place allowing for long-term data collection. Currently, the well siting process is less often placing obwells on private land, unless it is absolutely necessary.

Listed below are a few examples of publicly-owned properties: Wildlife Management Areas, Lake Accesses, Parks, Landfills, Offices, Schools, Garages, Storage areas, and Undeveloped lots.

Once an observation well site or sites that show good potential are selected for consideration, an office review followed by a site visit is needed confirm that the site conforms to the following site details:

- **Ownership**

  Confirm that the ownership status will remain unchanged for the forseeable future and that a complete written access agreement and associated documents are provided, if applicable.

- **Property boundaries**

  Confirm that the site is located within the intended property boundaries. Review property resources and attempt to locate property corners and lines near intended well sites. Positioning of observation well sites needs to consider the current well construction and set back rules. The size of the work area should include consideration of the personnel and equipment anticipated.

- **Well Location**

  The actual spot where the borehole is drilled is marked with a white stake and flagging prior to the utility locate. This location may be refined based upon site conditions and comments from the drilling crew based upon moving their equipment to do the work. The location should be in plain sight and easily seen during entry to the location. Observation wells should not be hidden from plain sight where vandalism could more easily be done. Each site should be clearly marked with a six-foot high white flagged pole as a marker for each intended borehole location. A white marker is the accepted utility indicator for an intended excavation.

- **Site Access**

  Personnel and equipment need to safely enter and exit the site. Contractors should be allowed to make temporary roadway and drilling site modifications. In Minnesota, the frozen ground during winter makes for ideal access into areas where the soils are soft.

- **Target potential**

Existing information resources need to be reviewed to confirm that the desired target formations are present. A contingency plan should be in place to identify alternate targets, should the targeted formation not be present. This is mainly an issue for glacial targets where formational variations can occur over short distances.

- **Site conditions**

Utilities must be located and marked prior to beginning work. However, completing a utility clearance is not a guarantee that the location is safe to drill. Other potential hazards may be present that are not covered by a standard utility check. Review of the site history may reveal potential unknown obstacles. This includes former buildings, tile lines and privately own utilities. Drilling contractors are required to contact "Gopher One Call" to have utilities located at least 48 hours prior to beginning drilling.

- **Site Safety**

Site Safety plans must be prepared for each drilling site. Each plan needs to identify potential hazards and clearly indicate emergency response plans. Weather can often affect outdoor work; close attention needs to be paid at any time of the year. Depending on the season, various animals, insects, and vermin may be present or on the prowl. Dress appropriately, and be aware of your surroundings in case you encounter unexpected visits from animals.

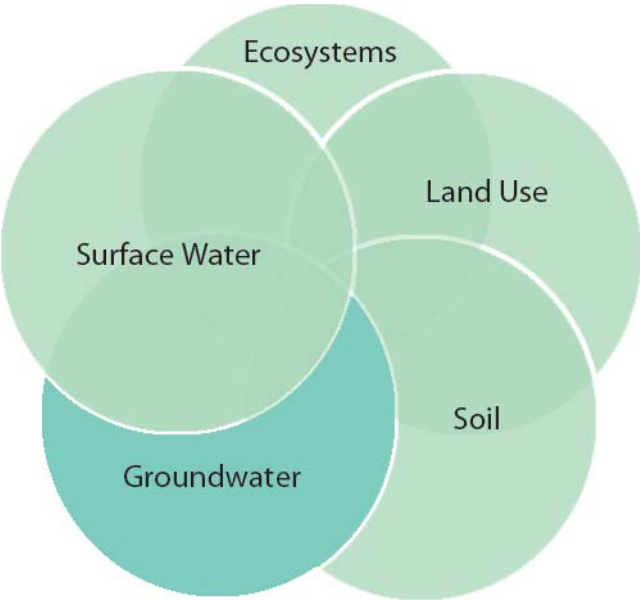
- **Neighbors & Visitors**

Maintaining good public relations is a must. If a site has neighbors, make an extra effort to talk to them and inform them about the project. Be sure to plan for visitors by having extra safety equipment (e.g., hard hats and safety vests) available onsite for curious people. Sometimes visitors can provide local information that can help hydrologists better understand the history of the site. If a high volume of visitors is expected, fence off a safety zone; however curious they may be, visitors should never be allowed near active on-site equipment. When appropriate, publishing a press release prior to siting events and start of drilling operations can encourage positive relations with the public and program efforts.

As Murphy's Law suggests, it's often the unexpected situation or unplanned-for problem that often happens. The site should be thoroughly walked and inspected. The preparation of site maps using air photos and hand sketch drawings are helpful tools for communication purposes. Detailed site photographs taken from similar perspectives before, during and after construction procedures can provide important documentation of the changes made before and after well construction.

South-Central Minnesota Groundwater Monitoring of the Mt. Simon Aquifer

James A. Berg and Scott R. Pearson
Minnesota Department of Natural Resources
Ecological and Water Resources Division
St. Paul, Minnesota



Minnesota Department of Natural Resources

ENVIRONMENT AND NATURAL RESOURCES TRUST FUND

June 2011

Funding for this project was provided by the Minnesota Environment and Natural Resources Trust Fund as recommended by the Legislative-Citizen Commission on Minnesota Resources (LCCMR).

This is the final report of the LCCMR project “South-Central Groundwater Monitoring and County Geologic Atlases” (M.L. 2008 Chap. 367, Sec. 2 Subd. 4 (h)).

Authors
James A. Berg
Scott R. Pearson

Contributors and Reviewers
Jennie Leete
Neil Cunningham
Bob Tipping
Tony Runkel
John Mossler

Version 1.3, June 2011

If you have questions or would like additional information, please contact James Berg at 651-259-5680.

Minnesota Department of Natural Resources
500 Layfayette Road North | Saint Paul, MN 55155-4040 | www.dnr.state.mn.us | 651-296-6157
Toll free 888-MINNDNR | TTY 651-296-5484

This report is available in additional formats upon request, and online at www.dnr.state.mn.us

Contents

Abstract.....6

Introduction and Purpose.....7

Geology of South-Central Minnesota.....8

Investigation Methods.....9
- Site selection
- Drilling methods and well construction
- Aquifer interval selection for monitoring
- Geophysical well logging
- Well development
- Groundwater sample collection
- Specific capacity procedures and results
- Continuous water level measurements

Thickness of the Mt. Simon Aquifer Near the Western Subcrop.....13

Groundwater Movement and Potentiometric Surface - Mt. Simon Aquifer.....13

Geochemistry.....14
- Groundwater Residence Time
- Stable isotopes, ^{18}O and deuterium
- Source water temperature and mixing
- Evaporation of source water
- Major ions
- Trace elements

Hydrogeology Illustrated by Cross Sections and Hydrographs from Observation Well Nests.....18
- Cross section A-A' and Severence Lake WMA hydrograph
- Cross section B-B' and Sibley County landfill property hydrograph
- Cross section C-C' and Norwegian Grove WMA hydrograph
- Cross section D-D' and Peterson unit hydrograph
- Cross section E-E' and Courtland West/Nicollet Bay hydrographs
- Cross section F-F' and Helget-Braulick WMA hydrograph
- Cross section G-G' and Bergdahl WMA hydrograph
- Cross section H-H' and Case WMA hydrograph
- Cross section I-I' and Madelia WMA hydrograph
- Cross section J-J 'and Long Lake WA hydrograph
- Cross section K-K' and Exceder WMA hydrograph
- Cross section L-L' and Rooney Run WMA hydrograph

Paleohydrology and recharge estimates.....22
- Southern area recharge
- Northern area recharge

2009 Groundwater Appropriation.....23
Southern area appropriation
Northern area appropriation

Conclusions.....24

References.....25

Attachments Section

Tables.....28
1: Well summary
2: Specific capacity and water level data summary
3: Field sample collection and handling
4: Residence time indicators, stable isotopes, and selected trace elements
5: Selected anion and cation data

Figures.....33
1: Mt. Simon observation well nest locations
2: Cambrian and older stratigraphy in study area
3: County and state Paleozoic bedrock map
4: Mt. Simon Sandstone thickness
5: Mt. Simon potentiometric surface and groundwater flow directions
6: Cross section Z-Z', Mt. Simon potentiometric surface
7: Carbon-14 residence time data from the shallower aquifers at each observation well nest
8: Mt. Simon carbon-14 residence time, potentiometric surface, and groundwater flow directions
9: Stable isotope data compared with North American meteoric line
10: Ternary diagram-relative abundances of major cations and anions
11: Mt. Simon sulfate concentrations (mg/l), and groundwater flow directions
12: Mt. Simon chloride concentrations (mg/l), and groundwater flow directions
13: Mt. Simon arsenic concentrations (mg/l), and groundwater flow directions
14: Precipitation departure from normal October 2009-September 2010
15a: Cross section A-A'
15b: Severance Lake WMA hydrograph
16a: Cross section B-B'
16b: Sibley County landfill hydrograph
17a: Cross section C-C'
17b: Norwegian Grove WMA hydrograph
18a: Cross section D-D'
18b: Peterson Unit hydrograph
19a: Cross section E-E'
19b: Courtland West Unit hydrograph
19c: Nicollet Bay Unit hydrograph
20a: Cross section F-F'

20b: Helget Braulick WMA hydrograph
21a: Cross section G-G’
21b: Bergdahl WMA hydrograph
22a: Cross section H-H’
22b: Case WMA hydrograph
23a: Cross section I-I’
23b: Madelia WMA hydrograph
24a: Cross section J-J’
24b: Long Lake WA hydrograph
25a: Cross section K-K’
25b: Exceder WMA hydrograph
26a: Cross section L-L’
26b: Rooney Run WMA hydrograph
27: Mt. Simon recharge interpretation
28: Generalized cross section Z-Z’ and geochemical data
29: Cross section Z-Z’, Mt. Simon recharge and discharge
30: Mt. Simon observation well nest locations and 2009 groundwater appropriation

Appendix A: Geological/Geophysical Logs and Well Construction Diagrams.....76

.

Abstract

The deepest bedrock aquifer of south central/southeastern Minnesota, including the Minneapolis/St. Paul metro area, is the thick (50 to 200 feet) Cambrian sandstone Mt. Simon aquifer. It supplies all or some of the water used by over one million Minnesotans. The few water level measurements available from this aquifer in the Mankato and Minneapolis/St. Paul metro area indicate declining water levels in areas where water is being withdrawn for municipal and industrial use. To better understand the recharge dynamics of the Mt. Simon aquifer the western and northern edge of the Mt. Simon aquifer was investigated and characterized through observation well installations, water level monitoring, groundwater chemical analysis, and aquifer capacity testing. Most data collected for this study are derived from the wells installed at 14 locations by contracted drilling companies.

The combination of chemical residence time indictors, continuous water level data from nested well locations, and a general knowledge of the regional hydrostratigraphy, show an aquifer with a very slow recharge rate from a large source area located south of the Minnesota River and a smaller source area located in the northern portion of the study area. The younger ^{14}C residence time values of Mt. Simon groundwater (7,000-8,000 years) from this project roughly correspond to a time after the last ice sheet had receded from southern Minnesota suggesting groundwater in the Mt. Simon aquifer in this region began as precipitation that inf ltrated during the post-glacial period. The stable isotope data of oxygen and hydrogen support this conclusion. A recharge estimate of the Mt. Simon aquifer south of the Minnesota River based on these minimum residence time data suggest an inf ltration rate of approximately 2 cm/year. The resulting 5 billion gallons/year of recharge from the southern source area is less than the amount of groundwater used from the most recent year for which data are available (2009) but approximately equal to permitted volumes (i.e., the volume of water that the users are allowed to pump) for appropriators in this area. At current groundwater extraction rates, the region's groundwater supply appears to be in a steady state. The effect of future increases in groundwater appropriation from the Mt. Simon due to population growth, industrial development, or drought might push this resource beyond this steady state.

A major accomplishment of this project is the creation of a network of observation well nests along the western margin of this aquifer system. Long term water level data and geochemistry from these wells will enable future hydrologists to evaluate the local and regional effects of any future expansion of Mt. Simon groundwater pumping in the region beyond current volumes.

Introduction and Purpose

The 2008 and 2009 legislatures allocated funding from the Environment and Natural Resources Trust Fund for an aquifer investigation, mapping, and monitoring project in south-central and east-central Minnesota (Figure 1). The 2008/2009 allocations provide $4,295,000 for a 4-year project. The allocation is being shared by the DNR ($2,769,000) and the Minnesota Geological Survey (MGS, $1,526,000) to evaluate the Mt. Simon aquifer and produce geologic atlases. The purpose of this report is to compile, summarize, and interpret data collected from the f rst phase of the DNR portion of this project as required by the statute (ML 2008, Chap. 367, Sec. 2, Subd. 4 (h)). A report summarizing the second phase of the project west and northwest of the Twin Cities Metropolitan area is scheduled for completion June 30, 2012.

The deepest bedrock aquifer of south central/southeastern Minnesota, including the Minneapolis/St. Paul metro area, is the thick (50 to 200 feet) Cambrian sandstone Mt. Simon aquifer. and it supplies all or some of the water used by over one million Minnesotans. The few water level measurements available from this aquifer in the Mankato and Minneapolis/St. Paul metro area indicate declining water levels in some parts of these areas where water is being withdrawn for municipal and commercial use. While efforts currently are underway through other agency and additional Minnesota Department of Natural Resources projects to locally map and understand these depressed Mt. Simon water level areas, we believed a project to regionally understand the recharge dynamics of the Mt. Simon aquifer was needed. The western and northern edge of the Mt. Simon aquifer (Figure 1), where it is not overlain by relatively impermeable Paleozoic shale formations, was considered the most likely area for aquifer recharge. This edge of the Mt. Simon aquifer also was investigated and characterized through observation well installations, water level monitoring, groundwater chemical analysis, and aquifer capacity testing to help determine recharge pathways and sustainable limits for this aquifer. These data will help determine aquifer recharge characteristics and potential limitations for future use.

Most data collected for this study are derived from the wells installed at 14 locations by contracted drilling companies. Staff from the DNR Ecological and Water Resource Division coordinated the installation of these wells, which are known among groundwater professionals also as observation wells. Drilling in the northern portion of the investigation area (Phase 2) began in the fall of 2009 to complete well nests (two or more observation wells completed at the same location but at different depths) at an additional 10 locations. The wells are completed in the Mt. Simon aquifer and shallower aquifers on public property in the project area to depths of 70 feet to 680 feet (Table 1). The wells were sampled for chemical constituents such as tritium and carbon-14 that will help determine the residence time or age of the groundwater in this aquifer and overlying aquifers. The wells were also instrumented with equipment to continuously record groundwater levels.

Geology of South-Central Minnesota

The focus of this investigation was the Cambrian Mt. Simon Sandstone (Figure 2) which is located at the base of a thick sequence of marine Paleozoic carbonate, shale, and sandstone formations that underlie central and southeastern Minnesota in a broad structural basin known as the Hollandale embayment (Figure 3). The Mt. Simon Sandstone is generally a medium to coarse-grained quartzose sandstone (Mossler, 2008). The Mt. Simon formation cuttings observed from drill holes for this project generally indicated the unit is dominated by thick beds of gray, white silty, very f ne to medium-grained quartzose to feldspathic sandstones with thin white-grey and light green shale beds. The basal portion of the Mt. Simon Sandstone has somewhat thicker shale beds and coarse yellowish quartz grains ranging from very coarse sand to medium pebble size.

Various Precambrian rocks underlie the Mt. Simon Sandstone due to a complicated geologic history prior to the deposition of the Paleozoic rocks. These older underlying rocks include Middle Proterozoic sedimentary rocks, such as the Hinckley Sandstone and the Fond du Lac, Early Proterozoic igneous and metamorphic rocks, and in some southern areas, the Lower Proterozoic Sioux Quartzite. None of these underlying rocks have desirable aquifer properties for most purposes. Therefore, the Mt. Simon Sandstone is the deepest bedrock aquifer in the region. Furthermore, along the western edge of the Hollandale embayment (Figure 3), the Mt. Simon is commonly the only aquifer available for large capacity (i.e., municipal and industrial) use.

Following the deposition of sand and other sediments that would become the Mt. Simon Sandstone and overlying formations, there was a long period of exposure and non-deposition of rock materials. During the Late Cretaceous period marine and non-marine sedimentary rocks (mostly shale and sandstone) were deposited along the western edge of the Hollandale embayment in south-central Minnesota. During this period a shallow epicontinental (inland) sea covered the western interior of North America. Relatively thick sections of these types are rocks are common in the southern portion of the investigation area.

Following another long period of exposure and non-deposition of rock materials after the Cretaceous period, the region was affected by repeated continental glaciations during the Quaternary period. These glaciations deposited thick alternating layers of glacial outwash (sand and gravel), glacial till (dense mixture of silt, sand, and clay), and other types of deposits. Thus the depositional history for most of southeastern and south-central Minnesota has left a legacy of both bedrock and glacial aquifer systems.

Investigation methods

Site selection

The wells for this investigation were drilled on public land to help ensure the longevity of these monitoring locations. With the exception of one location, all the wells are on state land managed by the Department of Natural Resources, on either wildlife management areas (WMAs) or at water access (WA) locations. One well site in Sibley County is owned by the county. At that location Special access permission for that location was obtained from the County Board of Commissioners.

Site locations were chosen in suspected recharge areas for the Mt. Simon aquifer near the western edge of the Hollandale embayment at location where the Mt. Simon Sandstone was likely to be the uppermost bedrock to be found beneath the surf cial glacial deposits or Cretaceous shale and sandstone. A shallow and deep well were drilled at most locations to provide data on the vertical hydraulic head gradients, changes in groundwater chemistry, and residence time with depth. These sites were evenly spaced as evenly as much as possible given the existing distribution of public land in the region. The well nest locations are typically near existing roads and parking lots for easy access and to minimize disturbance of undeveloped parts of these properties.

Drilling methods and well construction

Two different kinds of drilling methods were used to install wells for this project (Table 1). Mud rotary (MR) is a commonly used and widely available method for drilling and completing water wells. Typically a hollow tricone drilling bit is attached to hollow drilling rods that are turned by the drilling rig. During the drilling process, a drilling mud mixture is pumped through the interior of the hollow rod and bit assembly which pushes the ground rock and sediment upward through the annular space between the drilling rods and the larger diameter borehole to the surface. The drilling mud f ows into an open tank at the surface and is subsequently recirculated back down the inside of the drill bit/rod assembly to the bottom of the borehole. The advantage of this method is that it is relatively fast and inexpensive. The disadvantage of this method is that the ground-up bits of rock and sediment (also known as “cuttings”) that the driller and geologist use to identify drilling progress become diff cult or impossible to identify below a depth of a couple hundred feet because of mixing and mechanical degradation of the cuttings on their way to the surface.

Another type of drilling method was used in selected areas called dual rotary/ reverse circulation (DR/RC). During DR/RC drilling, the drill cuttings are returned to surface inside the rods. Reverse circulation is achieved by pumping air down the outer tube of the rods with a large compressor. The differential pressure at the drill bit creates suction that pulls the water and cuttings up the “inner tube” which is inside the rod. Once the water and cuttings reach the surface, the cuttings move through a sample hose and are collected in a sample pail. RC drilling produces discrete and easily identif able rock chips from all depths and is therefore ideal for drilling in unknown areas where the geologist does not know exactly what to expect at depth. DR/ RC drilling is slower and more expensive than mud rotary.

Aquifer interval selection for monitoring

Methods for well construction were somewhat different for boreholes drilled with the two methods. For the dual rotary holes, an 8- inch or 10-inch diameter temporary steel surface casing was driven simultaneously during drilling to the base of the unconsolidated or poorly consolidated Quaternary and Cretaceous layers. Once solid bedrock was reached, the remainder of the hole was drilled without casing because the hole was unlikely to collapse. Drilling continued until Precambrian bedrock was encountered beneath the Mt. Simon Sandstone. A geophysical log of the hole was then made by the Minnesota Geological Survey at which time the depth of the permanent 4-inch diameter casing was decided based on the gamma log characteristics of the Mt. Simon Sandstone. The relatively shale-free portions of the formation were typically left as open hole. The casing was then constructed by the drilling crew and grouted in place and the temporary casing was removed. The advantage of this procedure was that the depth of the permanent casing could be chosen based on the cuttings and the geophysical log ensuring that the open-hole portion of the well was in the correct depth range such as the most transmissive portion of the Mt. Simon sandstone.

Drilling with the mud rotary method followed a different sequence. A seven-inch diameter borehole was drilled into the top of the Mt. Simon Sandstone and a four-inch steel casing was grouted in place. Once the grout had set, the drilling crew would drill inside the four-inch casing with a smaller drill bit and rod assembly until they had drilled through the Mt. Simon Sandstone into the underlying Precambrian bedrock. The depth at which the Mt. Simon is encountered is estimated by reference to logs of nearby wells and carful observation of changes in the cuttings that come to the surface with the drilling mud. The main disadvantage of this method is that if the top of the Mt. Simon Sandstone is misidentif ed, the base of the permanent casing might not be placed at an ideal depth.

Once the deep Mt. Simon well was completed and logged with geophysical tools, the aquifer for the shallower well in the nest was chosen based on gamma log and cuttings characteristics. These shallow wells were completed in the discontinuous sand and sandstone layers of the Quaternary and Cretaceous units at a relatively wide range of depths. In general, we were seeking the shallowest aquifer that might be used for domestic or larger capacity purposes.

Geophysical well logging

Well logging, also known as borehole logging, is the practice of making a detailed record (a well log) of the geologic formations penetrated by a borehole. The log may be based either on visual inspection of samples brought to the surface (geological logs) or on physical measurements made by instruments lowered into the hole (geophysical logs). The geophysical well log is a record of formation properties with an electrically powered instrument. Both types of logs are used to infer properties and make decisions about drilling and production operations. The geophysical log types collected for this project include passive nuclear measurements (natural gamma rays), resistivity, and spontaneous potential. After the borehole has been completed, but before the permanent casing has been grouted in the borehole, the logging tool (or probe) is lowered into the open wellbore on a multiple conductor, armored wireline. Once lowered to the bottom of the interval of interest, the measurements are taken on the way out of the wellbore. Measurements are recorded continuously while the probe is moving.

Gamma ray logging is a method of measuring naturally occurring gamma radiation to characterize the rock or sediment in a borehole. Different types of rock emit different amounts and different spectra of natural gamma radiation. In particular, shales and clay usually emit more gamma rays than other sedimentary rocks, such as sandstone, or sand and gravel because radioactive potassium is a common component in their clay content, and because the cation exchange capacity of clay causes them to adsorb uranium and thorium. This difference in radioactivity between shales and sandstones/carbonate rocks (or clay-rich, non-clay rich sediments) allows the gamma tool to distinguish between shales (or clay-rich and non-clay-rich sediments).

Resistivity is a fundamental material property which represents how strongly a material opposes the f ow of electric current. This log is run in holes containing electrically conductive mud or water. Sand and sandstone tend to be insulators (high resistivity), and clay and shale tend to be conductors (low resistivity). Similar to the gamma log, this difference in resistivity between shale (or clay-rich sediments) and sandstones/carbonate rocks (or non-clay rich sediments) allows the resistivity tool to distinguish between the two general categories of sediments or sedimentary rocks.

Generalized versions of the gamma logs completed by the Minnesota Geological Survey (MGS) are shown with the lithologic logs for each of the project well nests in Appendix A. The lithologic descriptions on each of these logs is summarized from MGS interpretations of cuttings.

Well development

After the borehole is drilled and the permanent well casing is grouted in the well, the well is purged for one to two hours to remove sediment that may have accumulated at the base of the well. This well development is designed to ensure that all or most of the open hole portion of the well unclogged and water level measurements from the well are representative of water levels in the aquifer at that location.

Groundwater sample collection

Protocols commonly employed for the collection of groundwater samples generally require the removal of much of the standing water in the borehole prior to the collection of groundwater samples. This is done so that the sample represents fresh groundwater and is representative of the resource. Removing groundwater from a well can be completed through the use of many mechanical methods; including bailers, air injection and pumping. An electric submersible well pump was selected for this project because it is capable of removing hundreds of gallons of water from depths greater than 150 feet in a relatively short period of time and because well performance testing information can be collected during the same f eld event. Therefore, the collection of water samples was organized to complete two tasks; the collection of groundwater samples and a short duration well performance test.

To accomplish these two tasks, a submersible water well pump was temporarily installed and operated by a State-certif ed water well contractor. An electric generator was used to provide power to the pump and a combination of piping and f exible hose were installed to deliver the groundwater to the surface. During the course of the f eld sampling events two different pumps were used. The f rst pump had a capacity of eight gallons per minute which proved too low to pump out the required volumes of water at an acceptable rate. To speed up the f eld pace, a pump capable of producing pumping rates of 25 gallons per minute was used. Table 2 presents the basic information collected during these procedures.

Groundwater was pumped through a hose from the f ow meter to a clean, white f ve gallon bucket that allowed f eld observations of color and odor. The bucket was also used as a f ow through chamber into which the probes of several instruments were suspended. Sequential measurements of temperature, pH and specif c conductance were made. The wells were pre-pumped until constant values of pH, temperature and specif c conductance were observed. The sample was collected after the values of these parameters remained stable and at least one well volume of water had been removed from the well.

The sampling consisted of f lling prepared and labeled containers with groundwater from the hose discharge at the stabilization bucket. The carbon-14 (^{14}C) sample size was approximately 30 gallons and required special handling and containers. Analytes and sampling protocol are summarized in Table 3. Samples were sent to the University of Minnesota Hydrochemistry Laboratory (U of M) and the University of Waterloo Laboratory (Waterloo).

Specific capacity procedures and results

Specif c capacity provides an estimate of the potential yield from a water well. It can be calculated from the results of a short duration pumping test. Specif c capacity is the pumping rate (gallons per minute) divided by the measured drawdown (feet) and is reported in units of gallons per minute per foot of drawdown (gpm/ft). In Minnesota's principal aquifers, the observed specif c capacities (Selected Aquifer Parameters for Ground Water Provinces, 2004 DNR) range from less than 1.0 gpm/ft. to values greater than 100 gpm/ft. Specif c capacities for the Mt. Simon- Hinckley wells typically range from 1 to 33 gpm/ft; specif c capacities for glacial drift wells show greater variability from less than 1 to greater than 50 gpm/ft. As shown in Table 2, the observed specif c capacities for the Mt. Simon wells ranged from 13 gpm/ft at Exceder WMA to less than 1 gpm/ft at Helget-Braulick WMA.

The depths to groundwater were measured from dedicated measuring points located at the top of the well casings. For this project the measuring points elevations were measured using engineering grade global positioning systems (GPS) that use the Minnesota Department of Transportation Continuously Operating Reference Station (CORS) network. The measuring point at each well is on the north side of the top of the four-inch diameter steel well casing (top of casing or TOC). Groundwater depth measurements were collected before, during and after pumping using electronic tapes and electronic pressure transducer instruments.

A f ow meter was used to measure rate and a f ow totalizer was used to measure total water discharge in gallons. The f ow rate from the well was controlled with the well head check valve. At the start of each pumping test the valve was opened to allow the full pumping rate. Some of the wells were pumped at rates lower than the capacity of the pump to maintain water levels above the pump intake. DNR observation well 83012 and Flandrau State Park campground well was not accessible for instrumentation and is not represented in Appendix B with a hydrograph.

Continuous water level measurements

Unattended continuous water level measurements can be made with pressure transducers – instruments that respond to changes in pressure created by the water column above the instrument. A data logger can record the measurements taken by a pressure transducer at specif c intervals set by the user. Improvements in technology over the last decade have resulted in combined data logger/pressure transducer units that are about the size of a small f ashlight.

Sealed data logger/pressure transducer units were submerged in each well to a depth of 20 to 25 feet below the water surface. Sealed units record changes in total pressure including barometric pressure.

To sort out changes in pressure reading that are related to barometric pressure from real water level changes, a record of barometric pressure must also be made. Three data logger/barometer units were deployed across the study area for this purpose. All of the instruments were programmed to collect and store hourly readings.

Data are stored in the data logger until the quarterly site visit occurs. Communication cables connected to the instruments are accessible from the top of each well. The data are downloaded from the instruments, a water level measurement is taken with a measuring tape, and computer software calibrates the data stream to the actual measurements and adjusts for changes in barometric pressure.

Thickness of the Mt. Simon aquifer near the western subcrop

One of the objectives of the project was to better def ne the physical boundaries of the Mt. Simon aquifer in the study area to help with future water resource evaluations. With the exception of the well at the Nicollet Bay unit, all the Mt. Simon wells drilled for this project penetrated to the base of the formation. Most existing wells in this area (Figure 4) provide a minimum thickness value since most of the wells are domestic and are only drilled into the top of the aquifer to provide relatively small quantities of water.

Across the study area thicknesses of the Mt. Simon aquifer increase toward the east over a short distance with the exception of an apparently broad and thin (0-50 feet) area in eastern Brown county. East of the western aquifer edge the Mt. Simon aquifer is commonly 200 feet thick or greater (Mossler, 1992).

Groundwater movement and potentiometric surface – Mt. Simon aquifer

A key aspect of understanding the hydrogeology of any area is to develop a basic understanding of the groundwater f ow pathways. Aquifers and systems of aquifers are rarely static or unchangeable. Water is usually moving into the aquifers (recharge), through the aquifers, and out of the aquifers (discharge) in complicated but def nable patterns. Three primary types of data are used by investigators to understand these relationships: chemical data from collected samples, aquifer test data gathered by pumping wells under controlled conditions, and static (non-pumping) data measured from wells and surface water bodies. Static water-level data and potentiometric surfaces are the primary focus of this section.

A potentiometric surface is def ned as “a surface that represents the level to which water will rise in a tightly cased well (Fetter, 1988). The potentiometric surface of a conf ned aquifer (aquifer under pressure) occurs above the top of an aquifer where an overlying conf ning (low-permeability) layer exists. Static (non-pumping) water-level data from the County Well Index and measurements by personnel from the Department of Natural Resources were plotted and contoured to create the potentiometric contour map (Figure 5). Additional wells in fractured Precambrian crystalline aquifers beyond the

extent of the Mt. Simon aquifer are included to show the hydraulic head conditions near the boundary of the aquifer. The contour lines illustrate the potentiometric surface much like the contour lines of a topographic map represent a visual model of the ground surface. The potentiometric surface is generally not the physical top of the water table, but is a representation of the potential energy that is available to move the ground- water in a conf ned aquifer. Low-elevation areas on the potentiometric surface that could be above the coincident surface-water bodies may indicate discharge areas; when combined with other information sources, high-elevation areas on the potentiometric surface can be identif ed as important recharge areas. Groundwater moves from higher to lower potentiometric elevations perpendicular to the potentiometric elevation contours (f ow directions shown as arrows).

Groundwater f ow pathways from recharge areas through the aquifer to discharge locations operate on a wide continuum of depth, distance, and time. Flow into, through, and out of shallow aquifers can occur relatively quickly in days or weeks over short distances of less than a mile, whereas f ow through deeper aquifers across dozens of miles may take centuries or millennia.

Figure 5 shows northeasterly groundwater f ow directions toward the Minnesota River in the southern portion of the study area. In the northern portion of the study area f ow is southeasterly in Sibley County and then diverges toward the Minnesota River in Nicollet County at a very low gradient. This map and Figure 6 (cross section Z-Z') the potentiometric contours bend toward the Minnesota River indicating that it is a discharge feature for the Mt. Simon aquifer. Even though the potentiometric contours indicate discharge to the Minnesota River, the previously mentioned low gradient in the northern portion of the study area could indicate low f ow to the river.

Geochemistry

All the wells constructed for this project and two additional wells in the area were sampled for analysis of common ions, trace constituents, residence time indicators (tritium and ^{14}C), and stable isotopes (^{18}O and deuterium). The results of all these analyses (Tables 4 and 5) assist in the interpretation of the recharge characteristics of the Mt. Simon aquifer.

Groundwater Residence Time

Two residence time indicators were used in this project: tritium and carbon-14 (^{14}C). Residence time is the approximate time that has elapsed from when the water inf ltrated the land surface to when it was pumped from the aquifer for these investigations. In general, short residence time suggests high recharge rates, whereas long residence time suggests low recharge rates.

Tritium (^{3}H) is a naturally occurring isotope of hydrogen. Concentrations of this isotope in the atmosphere were greatly increased from 1953 through 1963 by above ground detonation of hydrogen bombs (Alexander and Alexander, 1989). This isotope decays at a known rate, with a half-life of 12.43 years. Groundwater samples with concentrations of tritium equal to or greater than 10 tritium units (TU) are considered recent water (mostly recharged in the past 60 years). Concentrations equal to or less than 1 TU are considered vintage water (recharged prior to 1953). Concentrations between these two limits are considered a mixture of recent and vintage water and are referred to as mixed water).

The carbon-14 (^{14}C) isotope, which also occurs naturally, has a much longer half-life than tritium (5730 years). Carbon-14 is used to estimate groundwater residence in a time span from about 100 years to 40,000 years (Alexander and Alexander, 1989).

With one exception, none of the groundwater samples contained detectable tritium concentrations (Table 4) and therefore, the residence time for these samples is greater than approximately 60 years. This is consistent with the generally high depths of the sampled aquifers and general lack of thick surf cial sand and gravel in the study area. The one mixed tritium sample was from the shallow well at the Long Lake WA that was screened in a sand and gravel aquifer at a depth of 128 feet.

Figure 7 shows the distribution of ^{14}C residence time values from the shallow wells constructed for this project. These values represent data from aquifers with a wide depth range (70 to 444 feet). This map, therefore, is not intended to show any regional trends or tendencies but is shown to illustrate the wide range of values in these settings. These values are more interesting in comparison to the values discussed below and shown in Figure 8 from the underlying Mt. Simon aquifer.

Figure 8 shows the distribution of ^{14}C residence time values from the Mt. Simon wells constructed for this project, two additional Mt. Simon wells sampled for this project, and Mt. Simon data from other studies (Lively and others, 1992; Alexander, personal communication). Values in the southern portion of the study area range from 7,000 – 8,000 years in central Watonwan County to 30,000 years near the Minnesota River following a pattern of increasing age away from central Watonwan County. The youngest values (8,000-10,000 years) in the northern portion of the study area occur in northeastern Sibley County and also increase in age toward the Minnesota River to the south and east.

The younger ^{14}C residence time values (7,000-8,000 years) roughly correspond to a time not only after the last ice sheet had receded from southern Minnesota, but also after the time when the modern day Minnesota River Valley (Glacial River Warren) ceased to be the main discharge route for the glacial melt water (9,500 years) that was stored in Glacial Lake Agassiz (Wright, 1987). These ^{14}C values and the unique glacial history of the region suggest groundwater in the Mt. Simon aquifer in this region began as precipitation that inf ltrated during the post-glacial period. The stable isotope data described in the following section provided important corroborating evidence for this conclusion.

Stable Isotopes, ^{18}O and Deuterium

All groundwater samples collected from the study area were analyzed for stable isotopes of oxygen and hydrogen, the two atoms found in water. Analysis of the results provides an additional tool for characterizing the area groundwater. Isotopes of a particular element have the same number of protons but different numbers of neutrons. Stable isotopes are not involved in any natural radioactive decay. They are used to understand water sources or the processes affecting them (Kendall, 2003). Commonly used isotopes for these purposes include oxygen isotopes ^{16}O and ^{18}O and hydrogen isotopes ^{1}H and ^{2}H. The heavy hydrogen (^{2}H) is called deuterium. The mass differences between ^{16}O and ^{18}O or ^{1}H and ^{2}H result in water molecules that evaporate or condense at different rates. Thus the concentrations of these isotopes in water changes (fractionates) during evaporation and precipitation, resulting in different $^{16}O/^{18}O$ and $^{1}H/^{2}H$ ratios in rain, snow, rivers, and lakes. The values are expressed as del^{2}H and del^{18}O. The abbreviation "del" denotes the relative difference from standard mean ocean water and express the relative abundance or the rarer heavy isotopes, del^{2}H and del^{18}O. These values from precipitation water generally plot close to a straight line known as the meteoric water line (Figure 9). The departure of ^{18}O and ^{2}H values from the meteoric water line can indicate evaporation or mixing of water from different sources.

Figure 9 shows a plot of del^{18}O and del^{2}H values from groundwater samples collected in the study area compared to the meteoric water line. Three types of information regarding the origin and history of these water samples can be interpreted from this graph: relative atmospheric temperature during source water precipitation, relative mixing of water from cold and warm sources, and evaporation of source water.

Source water temperature and mixing

For the samples that plot along the same slope as the meteoric water line, the samples more depleted in heavy isotopes (samples that plot closer to the bottom left of the graph) suggest water that precipitated from a colder atmosphere (Siegel, 1989). Person et al (2007) provided a compilation of paleohydrological studies of groundwater systems in North America that were affected by the advance and retreat of the Laurentide ice sheet. He concluded that the range of del^{18}O groundwater values from cold ice or snow melt sources ranges from del -25 to -9. Most values of groundwater samples from south central Minnesota ranged from approximately del -8 to del -10 suggesting a mixture of glacial meltwater and a larger component of post-glacial precipitation. The data are consistent with the younger ^{14}C ages dates (7,000 to 8,000 years) from the post-glacial and post River Warren era as discussed previously.

It is also signif cant to note that many of the older ^{14}C values in this area are in the range of the last glacial advance in the upper Midwest (12,000 to 24,000 years BP) but the del^{18}O values are just slightly within the range of water from ice melt sources (del-25 to del-9). This apparent discrepancy suggests that these waters are from mixed sources and time periods, indicating a combination of much younger and much older water. Recognizing that all groundwater is a mixture, Mt. Simon ^{14}C residence time values greater than 9,000 or 10,000 years may represent a minimum age in these areas.

Evaporation of Source Water

Deuterium (^{2}H) is an isotope of hydrogen consisting of a proton and a neutron, whereas hydrogen (^{1}H) consists of a proton. Deuterium, therefore, has approximately twice the mass of common hydrogen. Similarly, oxygen-18 (^{18}O) has more mass than the more common oxygen-16 (^{16}O). Fractionation occurs because of these mass differences. Molecules of water with the more common hydrogen and oxygen are lighter and more readily evaporated, leaving the remaining water more concentrated in the heavier isotopes. As a result, lake water typically shows an evaporative signature (a higher concentration of the heavier isotopes than precipitation). Water that directly inf ltrates the ground is not fractionated in this manner, so it has a *meteoric signature* (higher concentration of the lighter, more prevalent isotopes). The effect of this type of fractionation is that isotopic values from samples with an evaporative signature will plot along a line with a slope less than the slope of the meteoric water line.

On Figure 9 the evaporated types of samples are shown on the right upper portion of the graph (Peterson unit, Helget Braulick WMA, and the Nicollet Bay unit). These three samples, from buried sand and gravel aquifers, show evidence of water that inf ltrated from lakes or wetlands.

The majority of samples plotted in the center portion of the graph along the meteoric water line (Figure 9) suggest sources from post ice-age precipitation (normal rain and snow meltwater) that inf ltrated directly into the subsurface and did not reside for long periods in lakes or similar water bodies.

Major Ions

Some evidence of distinct source water types and mixing of these waters can be understood by considering the relative abundances of some common cations and anions as ion concentrations plotted as percentages from area groundwater samples. Figure 10 shows the relative abundances of these common ions plotted on a ternary plot. Table 5 also shows the concentrations of these constituents in mg/l. The most common type of water in this area has Ca and Mg (Ca+Mg) as the predominant cation. There is a fairly even distribution between waters containing bicarbonate as the primary anion and waters containing sulfate as the predominant anion. The bicarbonate type of water is common in glacial aquifers of the upper Midwest (Freeze and Cherry, 1979, p. 284) and is derived from dissolution of calcite and dolomite minerals in soil and glacial sediments by inf ltrating precipitation. Higher sulfate concentrations in the Mt. Simon aquifer tend to occur in the southern and western portions of the study area (Figure 11) where inf ltrating water has passed through Cretaceous sandstone and shale layers that contain sulfate minerals such as gypsum and anhydrite.

The data from a few samples plotted on the lower right corner of the cation ternary plot show that some Na/K waters are also present in the area. These Na/K type waters (Mt. Simon aquifer: Norwegian Grove and Flandreau; Sioux Quartzite: Courtland West) may have a partial deep bedrock origin. Other evidence of deep isolated groundwater or upwelling from deep crystalline bedrock sources is suggested by some elevated chloride values of samples collected near the Minnesota River Valley (Figure 12). Elevated chloride values at the Helget Braulick and Peterson unit sites should be dismissed since samples from these wells probably contain some chloride from the chloride disinfectant that was added to these wells during the well construction process.

Trace Elements

Analysis of groundwater samples for a suite of trace element constituents reveal exceedences of drinking water standards for boron (one sample) and arsenic (f ve samples). A boron concentration of 1,910 ug/l (ppb) was measured in water from the Lake Hanska well that was completed in a Cretaceous sandstone aquifer. The Minnesota Department of Health (MDH) health risk limit (HRL) for this element is 600 ug/l. This elevated value is not typical of concentrations measured in the rest of the samples which otherwise ranged from 74 to 464 ug/l (Table 4). The reason for the elevated concentration of boron is unknown; however, the most negative ^{18}O value (del -10.27) of all the samples collected in the study area was also detected in the sample from this well which suggests that this aquifer is relatively stagnant and isolated.

Arsenic concentrations that exceeded the federal drinking water standard of 10 ug/l were detected in samples collected from f ve wells, three from buried sand and gravel aquifers and two from the Mt. Simon aquifer (Table 4 and Figure 13). Two of the exceedences (Nicollet Bay unit and Helget-Braulick WMA) from buried sand and gravel aquifers also contained water from evaporated surface water sources (discussed in evaporation of source water section). Arsenic in groundwater tends to come from disseminated mineral sources in glacial till (MDH, 2001; Erickson, M.L. 2005). Arsenic can be released from these minerals into solution by oxygenated water. Inf ltrated lake water could be a possible source of oxygenated water resulting in the elevated arsenic concentrations found in these samples.

Two of the elevated arsenic samples were collected from the Mt. Simon wells at the Peterson unit and the Nicollet Bay unit. Both of these wells are near Swan Lake in Nicollet County, the apparent source of the evaporated water from the shallow Nicollet Bay unit well. Elevated arsenic values in the Mt.

Simon aquifer may be also due to mobilization of arsenic by oxygenated lake water that has inf ltrated through multiple interconnected layers of glacial sand and till.

Hydrogeology illustrated by cross sections and hydrographs from observation well nests

A set of 12 geologic cross sections were created for this report to provide location-specif c representations of the stratigraphy and geologic structure for each well nest and to provide a hydrogeologic context for the hydrograph and geochemical data. The cross sections were constructed by projecting lithologic, stratigraphic, and well construction information onto the line of each cross section (Figure 3) from within a one kilometer zone on either side of the cross section.

Water level data were plotted to create hydrographs illustrating water elevation changes over time. Hydrographs provide a method of representing large amounts of data from one or more well. The water elevation hydrographs are included in the Figures section. Each displays the water levels recorded in two wells nested at the same site, the Mt. Simon well (blue) and the shallower depth well (red). Nested wells are located at the same site within a few feet of each other. On several hydrographs the difference in water elevation is large enough to require the use of a secondary axis. The shallower well information is set on the secondary axis and the corresponding units are indicated on the right side of the hydrograph.

Seasonal high and low water level cycles are apparent on most hydrographs. These are yearly cycles where groundwater levels decline during the summer months and increase during the winter and spring. In many cases both nested wells follow similar trends. Average cumulative precipitation increased throughout the period of record for the water level data (Figure 14). A corresponding rise of water levels throughout 2010 is apparent from the hydrographs at several sites. Considering the relatively old residence times typical of most aquifers that were sampled for this study most of these water level f uctuations are not caused by rapid inf ltration of precipitation (recharge), but a pressure response to the increased volume and weight of additional groundwater in the overlying water table aquifer and shallow buried aquifers (Maliva et al, 2011).

The hydrograph data of the nested observation wells, shown on Figures 15b through 26b, show two general patterns of vertical gradients: downward and upward. Most of the hydrograph comparisons show a downward gradient. A downward gradient exists where the shallower groundwater elevation is higher than a deeper groundwater elevation. This condition indicates that groundwater will move downward, if a f ow pathway is available. Within this group of downward gradient hydrograph pairs most of the hydrographs follow identical although offset patterns (Sibley County Landf ll, Peterson Unit, Bergdahl WMA, Case WMA, Madelia WMA, Exceder WMA, and Rooney Run WMA). These identical patterns strongly suggest that f uctuations within both the shallow and Mt. Simon aquifers are due to pressures affects of changes in the overlying water weight of the water table aquifer. A smaller group of downward gradient nests (Severance Lake WMA, Nicollet Bay Unit, and Helget Braulick WMA) show shallow aquifer patterns that a different from the Mt. Simon hydrograph pattern suggesting local pumping or surf cial inf uences in the shallow aquifer.

The Courtland West Unit, Long Lake WA, and possibly Norwegian Grove WMA sites demonstrate locations where upward groundwater movement is apparently occurring. At these locations the groundwater elevation from the shallower well is lower than the deeper bedrock groundwater elevations indicating an upward gradient condition. An upward gradient suggests that groundwater from the deeper bedrock will move upward if a f ow pathway is available due to local pumping inf uences or proximity to major discharge zones such as the Minnesota River.

Cross section A-A' and Severence Lake WMA hydrograph (Figures 15a and b)

The Severence Lake WMA is located in northern Sibley County near the subcrop (eastern edge) of the Mt. Simon. The shallow well was completed in a buried sand and gravel aquifer that appears to be part of a stack of intermingled and hydraulically connected sand bodies. The hydrograph from this well shows several feet of variation throughout 2010 with low water levels occurring during summer and early fall (high water use period) and higher recovery values occurring through late fall through early spring. A similar but more muted pattern is apparent for the Mt. Simon aquifer, suggesting no connection or a very minor connection to the summer pumping that is occurring in the area.

Cross section B-B' and Sibley County landfill property (Figures 16a and b)

The well nest on the Sibley County landf ll property in central Sibley County is located near the City of Gaylord. The Gaylord city wells and some domestic wells completed in the same buried sand aquifer as the shallow well are shown northwest of the well nest. The stratigraphy and geochemistry shown on Cross section B-B' (Figure 16a) suggest a direct hydraulic connection between the buried sand and gravel aquifer that the shallow well is completed in and the Mt. Simon aquifer. The well nest hydrographs (Figure 16b) show a downward gradient from the buried sand and gravel aquifer. The area stratigraphy, old residence times, and identical water level f uctuation trends suggest that the water level f uctuations are a pressure response to the changes in weight of overlying water table aquifer.

Cross section C-C' and Norwegian Grove WMA hydrograph (Figures 17a and b)

The Norwegian Grove WMA well nest in northern Nicollet County is located at the eastern edge of the Mt. Simon subcrop. The cross section (Figure 17a) shows the shallow well is completed in a stack of intermingled, and hydraulically connected sand bodies and an almost direct connection of these buried sand aquifers to the underlying Mt. Simon aquifer. The hydrographs (Figure 17b) shows a very slight upward gradient from the Mt. Simon to the buried sand and gravel aquifer. The hydraulic connection between the two aquifers, however, may not be very extensive since there is a large difference in groundwater residence time (4,000 years versus 20,000 years) and chloride/sodium concentrations.

Cross Section D-D' and Peterson Unit Hydrograph (Figures 18a and b)

The Peterson unit well nest in central Nicollet County is located near the eastern edge of the Mt. Simon subcrop. The hydrograph (Figure 18a) shows very little f uctuation in water levels (approximately one foot) and the buried sand aquifer levels are about eight feet higher than those of the Mt. Simon. These water level data and the 22,000 year ^{14}C residence time of the Mt. Simon aquifer suggest that these aquifers are not directly connected and are both relatively isolated.

Cross section E-E' and Courtland West/Nicollet Bay unit hydrographs (Figures 19a, b and c)
The geologic setting of two well nests (Courtland West unit and Nicollet Bay unit) in south central Nicollet County and an existing well that was sampled (Flandreau State Park) in eastern Brown County, is shown on this cross section. An upward gradient exists at the Courtland West site, east of the Minnesota River, which may result in upward groundwater f ow direction due to the proximity of the river. Upward gradients are commonly found near major rivers where groundwater discharges to the alluvial aquifer from underlying aquifers locally. West of the Minnesota River a similar upward gradient is suggested by the 30,000 year ^{14}C residence time and high sodium - chloride concentrations (Table 5 and Figure 12). These chemical characteristics suggest old, isolated groundwater from the underlying crystalline bedrock is moving upward through the thin Mt. Simon aquifer to the base of the Minnesota River alluvium.

At the Nicollet Bay unit location at the east side of the cross section the shallow well is shown completed in a stacked complex of buried sand and gravel aquifers. The graph of stable isotope values (Figure 9) shows that the sample from this well contains some water from an evaporated surface water source. The detectable tritium concentration from this sample is also good evidence of focused recharge at this location. The relatively constant water level elevation measurements from this well (Figure 19c) and these chemical characteristics suggest a strong hydraulic connection to a stable surface water source such as Swan Lake. The hydrograph of the Mt. Simon well at this location appears to show some inf uence from local pumping possibly from the wells shown on the cross section west of the Nicollet Bay well nest.

Cross section F-F' and Helget-Braulick WMA hydrograph (Figures 20a and b)
The Helget-Braulick WMA well nest is located in central Brown County near the western edge of the Mt. Simon subcrop. The shallow well, completed in a buried sand and gravel aquifer, contained some groundwater from an evaporated surface water source (Figure 9). A very short ^{14}C residence value (500 years) is consistent with this stable isotope data. In addition, the hydrograph trend follows the precipitation trend of higher than average rainfall during the summer of 2010, also suggesting a hydraulic connection and pressure response to the additional water at or near the surface. The muted but similar hydrograph pattern of the Mt. Simon well hydrograph is probably a pressure response.

Cross section G-G' and Bergdahl WMA hydrograph (Figure 21a and b)
The Bergdahl WMA well nest of northeastern Watonwan County and a shallower well completed in Cretaceous sandstone at the SE Lake Hanska WA are shown on this cross section. The deeper well that was planned for the Lake Hanska site was not built since no Mt. Simon sandstone was found at this site during drilling. Both hydrographs in the Bergdahl WMA well nest show a rising pressure response corresponding to a cumulative increase in precipitation in the area.

Cross section H-H' and Case WMA hydrograph (Figures 22a and b)
The Case WMA well nest located in eastern Watonwan County and an irrigation well that was sampled for this project are shown on this cross section. Some of the youngest Mt. Simon groundwater in the area was collected from the irrigation well which is located at the eastern edge of the Mt. Simon subcrop. The 7,000 year ^{14}C residence time from this well is actually younger than groundwater that was sampled from the shallower buried sand and gravel aquifer at the Case WMA well nest. This irrigation well sample also contained elevated concentrations of sulfate indicating migration through the overlying sulfate mineral rich Cretaceous sandstone and shale. Both hydrographs at the Case WMA well

nest show an approximate 4.5 foot pressure response rise in water levels throughout 2010 which corresponds to a cumulative increase in precipitation in the area.

Cross section I-I' and Madelia WMA hydrograph (Figures 23a and b)
The Madelia WMA well nest located in eastern Watonwan County is shown on the eastern side of this cross section. The Mt. Simon sample from this location was also one of the youngest ^{14}C residence values suggesting a closer proximity to the eastern edge of the Mt. Simon subcrop than is suggested by this cross section or Figure 4. Both hydrographs at the Madelia WMA well nest show an approximate 4.5 foot pressure response rise in water levels throughout 2010 corresponding to a cumulative increase in precipitation in the area.

Cross section J-J 'and Long Lake WA hydrograph (Figures 24a and b)
The Long Lake WA well nest located in south central Watonwan County is shown on the western side of this cross section possibly near the center of the Mt. Simon subcrop. Similar to the sites described on cross sections H-H' and I-I', the Mt. Simon ^{14}C residence time value at this location is among the youngest (8,000 years). Elevated sulfate concentrations indicate groundwater migration through the overlying Cretaceous sandstone and shale.

The shallow well was completed in a buried sand and gravel aquifer just above the Cretaceous sandstone and shale. The gradient between the shallow well and the Mt. Simon well is upward (lower hydraulic head in the shallow aquifer compared to the deeper aquifer) possibly due to intensive pumping of the shallow buried aquifers from domestic wells surrounding Long Lake. The approximate 1.5 to 2.5 foot rise of water levels in both wells throughout 2010 corresponds to a cumulative increase in precipitation in the area.

Cross section K-K' and Exceder WMA hydrograph (Figures 25a and b)
The Exceder WMA well nest, located in north central Martin County, is shown near the center of this cross section. The approximate two-foot pressure response rise of water levels in both wells throughout 2010 corresponds to a cumulative increase in precipitation in the area.

Cross section L-L' and Rooney Run WMA hydrograph (Figures 26a and b)
The bedrock geology of the Rooney Run area is relatively unknown. The top of the Mt. Simon Sandstone at the DNR observation well site was deeper than the Mt. Simon tops from wells drilled in the Welcome area (Figure 26b). Therefore, a fault is shown on cross section L-L' northwest of Welcome to account for this elevation difference. Southwick (2002) also shows a fault in this area shown as an "Inferred fault, mapped beneath the Sioux Quartzite or Paleozoic strata." The hydrographs of the buried sand and gravel and Mt. Simon wells show very little f uctuation during 2010 and are diff cult to interpret without a longer period of record.

Paleohydrology and Recharge Estimates

Data and interpretations generated by this project provide some basis for a rough estimate of groundwater recharge through overlying glacial sediments and Cretaceous formations to the Mt. Simon aquifer subcrop in south central Minnesota. In addition to improving the general understanding of the aquifer boundaries, thickness, permeability, and extent of overlying conf ning units, basic data have been generated regarding the residence time of groundwater in the Mt. Simon aquifer and its source water characteristics.

The 7,000-8,000 year residence time of Mt. Simon groundwater in the region (Figure 27- Watonwan County and adjoining areas and northern Sibley County near the City of Arlington) and development of post-glacial drainage conditions in the Minnesota River Valley at approximately 9,000 years BP (before present) suggests the current f ow conditions toward the valley and slow recharge of the aquifer began at approximately that time. Prior to that time the much larger volume of water f owing through the valley as glacial River Warren would have created higher head conditions in that area and a lower gradient that would have inhibited f ow toward the valley in the Mt. Simon and overlying aquifers. Siegel (1989) suggests that f ow in the Mt. Simon aquifer during the glacial maximum (16,000-14,000 years BP) was easterly toward the ancestral Mississippi River.

A conceptual model of recharge to the Mt. Simon subcrop is based on geochemical data shown on the generalized cross section Z-Z' (Figure 28) which extends from the Long Lake WA site in southwestern Watonwan County to the North Star WMA observation well in the Minnesota River Valley. This cross section is drawn perpendicular to the potentiometric contours of the Mt. Simon aquifer and is meant to represent a f ow path from the recharge areas southwest of the Minnesota River to the discharge area (Minnesota River).

On cross section Z-Z' ^{14}C residence times are younger in areas to the southwest in the Mt. Simon aquifer and overlying aquifers. Higher sulfate concentrations in the Mt. Simon aquifer in the southwest indicate downward groundwater f ow through the overlying Cretaceous formations. Slightly higher chloride concentrations have been detected in wells closer to the discharge area suggesting some upward migration of older water from Precambrian crystalline bedrock. Finally, the least negative (warmer) del ^{18}O values are found in Mt. Simon wells on the left portion (upgradient) of the cross section and in the shallower wells, whereas the more negative del ^{18}O values (colder) were found in wells on the right (downgradient) portion of the cross section.

Southern area recharge

A recharge model based on this information is shown in Figure 29. The groundwater residence time values from most of the Mt. Simon wells are assumed to be an average value of age-stratif ed water in the well. Actual values from discrete intervals within the wells might vary from top to bottom. Therefore, an assumed 5,000 year value contour was placed near the top of the Mt. Simon aquifer for the wells in the "post-glacial recharge" area. The depth to the top of this contour in this area ranges from approximately 350 to 450 feet. Assuming an average inf ltration depth of 400 feet, groundwater inf l-trating to the top of the Mt. Simon aquifer moved at approximately 0.08 feet/year or approximately 2 cm/year. The area labeled "post- glacial recharge" (Figure 27) is approximately 1,000 square km (386 square miles). The volume of recharge across this area would be approximately 20 million cubic meters or about 5 billion gallons/year.

Northern area recharge

A similar recharge estimate of the Mt. Simon aquifer for the eastern portions of Nicollet and Sibley Counties (area north and west of the Minnesota River) is more diff cult since only a small portion of the area west of the City of Arlington and the Severence Lake WMA is shown as post-glacial recharge (Figure 27). In most of this area ^{14}C residence time values are approximately three times older than the youngest values southwest of the Minnesota River. In general, groundwater recharge of the Mt. Simon in the northern portion of this region (north and west of the Minnesota River) is probably lower than in the southern part of this region (south of the Minnesota River).

2009 Groundwater Appropriation

Southern area appropriation

For this appropriation discussion the southern area is def ned as a triangular area that extends from the southernmost well nest (Rooney Run WMA) to Mankato and along the Minnesota River to New Ulm (Figure 30). Mt. Simon groundwater in the southern area is currently used by permitted (large capacity) municipal wells, agricultural processing wells, and irrigation wells (DNR web page). The DNR 2009 reported use data indicate approximately 2.2 billion gallons were pumped out of the Mt. Simon aquifer in this area. However, the actual volume pumped from just the Mt. Simon aquifer is smaller since some of the older municipal wells in the area are also open to overlying aquifers. This volume, therefore, may be approximately one third of the post-glacial recharge described in the previous section. Permitted volumes (volume of water that the users are allowed to pump) for appropriators in this area are approximately 4.7 billion gallons/year, or roughly equal to the estimated Mt. Simon post-glacial recharge in the southern area.

Northern Area Appropriation

The northern area is def ned as the eastern parts of Nicollet and Sibley Counties. Mt. Simon groundwater in the northern area is currently used by permitted (large capacity) municipal wells, agricultural processing wells, and crop irrigation wells, and golf course irrigation wells (DNR web page). The DNR 2009 reported use data indicate approximately 1.1 billion gallons were pumped out of the Mt. Simon aquifer in this area. As in the southern area, the actual number from just the Mt. Simon aquifer is smaller since some of the older municipal wells in the area are also open to overlying aquifers. Permitted volumes for appropriators in this area are approximately 1.9 billion gallons/year.

Conclusions

The results of this project suggest that Mt. Simon groundwater use in the study area, for the most recent period, may be below the replacement rate along the Mt. Simon subcrop. However, the sum of the permitted volumes may be equal to those replacement rates. The region is currently not an area of rapid municipal or industrial growth. Locally intensive groundwater pumping can create groundwater interference issues (lowered water levels in nearby wells or surface water features) but at current extraction the region appears to be in a steady state. The effect of future increases in groundwater appropriation from the Mt. Simon due to population growth, industrial development, or drought might push this resource beyond this steady state. However, a major accomplishment of this project is the creation of a network of observation well nests along the western margin of this aquifer system. Long term water level data and geochemistry from these wells will enable future hydrologists to evaluate the local and regional affects of any future expansion of Mt. Simon groundwater pumping in the region beyond current volumes. In addition, this project demonstrated the value of continuous, nested water level measurements, and groundwater chemistry/residence time data in constructing conceptual models of groundwater f ow and recharge.

References

Alexander, S.C., and Alexander, E.C., Jr., 1989, Residence times of Minnesota groundwaters: Minnesota Academy of Sciences Journal, v. 55, no.1, p. 48-52.

Alexander, S.C., personal communication, e-mail correspondence received May 26, 2009 containing ^{14}C and general chemistry information from wells in southeastern Minnesota.

Anderson, Julia R, 2010, Bedrock geology, Plate 2 of Geologic Atlas of Blue Earth County, Minnesota: Minnesota Geological Survey County Geologic Atlas C-26 (in progress).

Chandler, Val. W. and John H. Mossler, 2009, Bedrock Geology, Plate 2 of Lusardi, Barbara, project manager, Geologic Atlas of McLeod County, Minnesota: Minnesota Geological Survey County Atlas C-20, 6 pls., scale 1:100,000.

Erickson, M.L., and Barnes, R.J., 2005, Glacial sediment causing regional-scale elevated arsenic in drinking water: Ground Water, November-December, v. 43, no. 6, p. 796–805.

Fetter, C.W., 1988, Applied hydrogeology (2d ed.): Columbus, Ohio, Merrill, 592 p.

Freeze, R. Allan, and John A. Cherry, 1979, Groundwater, Englewood Cliffs, NJ, Prentice Hall, Inc., 604 p.

Jirsa, Mark A. and others, 2011, Geologic Map of Minnesota-Bedrock Geology, Minnesota Geological Survey State Map Series S-21, scale 1:500,000.

Kendall, C. and Doctor, D., 2003, Stable isotope applications in Hydrologic studies, Holland, H.D. and Turekian, K.K., editors, chap. 11 of v. 5, Surface and ground water, weathering, and soils, in Treatise on geochemistry: Amsterdam, The Netherlands, Elsevier, Inc., p. 319-364.

Lively, Richard S. et al, 1992, Radium in the Mt. Simon-Hinckley aquifer, east-central and southeastern Minnesota, Information Circular 36, Minnesota Geological Survey, 58 p.

Maliva, Robert G. et al, 2011, Conf ned aquifer loading: Implications for groundwater management, Groundwater, May-June 2011, vol. 49, No. 3, p. 302-304.

Minnesota Department of Health, 2001, Minnesota arsenic study (MARS): St. Paul, Minnesota Department of Health, 3 p.

Minnesota Department of Natural Resources, Water use – Water Appropriations Permit Program web page: http://www.dnr.state.mn.us/waters/watermgmt_section/appropriations/wateruse.html

Mossler, J.H., 1992, Sedimentary rocks of Dresbachian age (Late Cambrian), Hollandale embayment, southeastern Minnesota: Minnesota Geological Survey Report of Investigations 40, 71 p.

Mossler, J.H., 2008, Paleozoic stratigraphic nomenclature for Minnesota: Minnesota Geological Survey Report of Investigations 65, 76 p., 1 pl.

Mossler, J.H., and V.W. Chandler, 2009, Bedrock geology, Plate 2 of Bauer, Emily J., project manager, Geologic Atlas of Carver County, Minnesota: Minnesota Geological Survey County Atlas C-21, 5 pls., scale 1:100,000.

Mossler, J.H., and V.W. Chandler, 2010, Bedrock geology, Plate 2 of Geologic Atlas of Sibley County, Minnesota: Minnesota Geological Survey County Geologic Atlas C-24 (in progress).

Mossler, J.H., and V.W. Chandler, 2010, Bedrock geology, Plate 2 of Geologic Atlas of Nicollet County, Minnesota: Minnesota Geological Survey County Geologic Atlas C-25 (in progress).

Person, M., J. McIntosh, V. Bense, and V. H. Remenda, 2007, Pleistocene hydrology of North America: The role of ice sheets in reorganizing groundwater f ow systems, Rev. Geophys., 45, RG3007, doi:10, 1029/2006RG000206.

Siegel, D.I., 1989, Geochemistry of the Cambrian-Ordovician aquifer system in the northern Midwest, United States: U.S. Geological Survey Professional Paper 1405-D, 76 p.

Southwick, D.L., 2002, M-121 Geologic map of pre-Cretaceous bedrock in southwest Minnesota. Minnesota Geological Survey map series M-121, scale 1:250,000

Wright, H. E., 1987, Quaternary History of Minnesota in Geology of Minnesota, Minnesota Geological Survey, University of Minnesota, St. Paul, Minnesota p. 515-548

Tables

Table 1 - Well Summary

DNR OB#	MN Unique	County	Site Name	Formation	Drilling Method	Depth	UTM Easting	UTM Northing	Top casing elevation (ft above msl)	Ground elevation (ft above msl)	Depths of open hole or screened interval (ft)	Depth to water (ft)
52001	768263	Nicollet	Nicollet Bay	CMTS	DR/RC	519	400938.203	4902807.503	990.669	988.370	410-519	157.07
52002	768264	Nicollet	Nicollet Bay	QBAA	MR	198	400936.287	4902804.578	990.761	988.448	188-198	145.60
52003	768261	Nicollet	Courtland West	PMSX	DR/RC	463	392095.616	4905565.047	996.321	992.730	356-463	108.87
52004	768262	Nicollet	Courtland West	QBAA	MR	202	392095.445	4905567.941	994.935	992.493	195-205	108.21
52005	770449	Nicollet	Peterson	CMTS	DR/RC	545	397939.24	4911110.024	993.467	991.333	390-545	163.92
52006	770450	Nicollet	Peterson	QBAA	MR	223	397937.852	4911106.35	993.752	991.497	215-223	156.12
52007	770444	Nicollet	Norwegian Grove	CMTS	DR/RC	537	405653.717	4923018.885	981.188	978.378	390-537	152.71
52008	770445	Nicollet	Norwegian Grove	QBAA	MR	260	405655.564	4923015.735	980.876	978.349	245-253	152.37
08012	768259	Brown	Heget Braulick	CMTS	DR/RC	282	369435.816	4896564.649	1021.947	1019.757	267-282	40.10
08013	768260	Brown	Heget Braulick	QBAA	RS	70.5	369438.015	4896564.977	1021.900	1019.371	65.5-70.5	26.23
sealed	760651	Brown	Lake Hanska	CMTS	MR	316	374745.213	4885215.946	1004.311	1004.161	sealed	sealed
08014	760692	Brown	Lake Hanska	KRET	MR	164	374743.738	4885218.599	1009.414	1003.582	155-164	3.52
83017	760687	Watonwan	Case	CMTS	MR	672	389450.77	4871991.533	1041.922	1038.803	495-672	55.30
83018	760686	Watonwan	Case	QBAA	MR	206	389453.682	4871989.969	1041.967	1039.160	197-206	38.62
83019	760689	Watonwan	Madelia	CMTS	MR	648	382101.048	4870093.555	1067.011	1063.842	495-648	48.65
83020	760688	Watonwan	Madelia	KRET	MR	120	382101.235	4870090.087	1067.303	1064.408	109-119	28.10
83021	760691	Watonwan	Bergdahl	CMTS	MR	479	388508.699	4883267.002	999.802	996.857	415-479	40.31
83022	760690	Watonwan	Bergdahl	QBAA	MR	129	388504.074	4883267.280	1002.757	1000.712	119-129	36.67
83023	770427	Watonwan	Long Lake	CMTS	DR/RC	547	365169.986	4862854.602	1131.407	1129.111	373-547	32.69
83024	770439	Watonwan	Long Lake	QBAA	MR	128	365174.415	4862852.802	1131.731	1129.249	118-128	32.59
46006	768125	Martin	Exceder	CMTS	MR	680	372699.859	4851318.450	1176.856	1174.015	497-680	75.24
46007	768139	Martin	Exceder	KRET	MR	232	372700.159	4851322.787	1176.966	1174.086	222-232	81.95
46008	771163	Martin	Rooney Run	CMTS	MR	718	366704.522	4843431.030	1203.873	1201.236	640-718	69.06
46009	771161	Martin	Rooney Run	QBAA	MR	444	366705.458	4843427.544	1204.317	1201.381	434-444	68.12
72000	770440	Sibley	Sibley Co. LF	CMTS	MR*	575	405883.249	4932926.374	995.742	993.624	460-575	126.90
72001	770441	Sibley	Sibley Co. LF	QBAA	MR	430	405888.095	4932926.352	996.049	993.974	420-430	126.73
72002	770442	Sibley	Severance Lake	CMTS	DR/RC	630	410698.789	4947369.756	1010.648	1008.529	458-630	144.23
72003	770443	Sibley	Severance Lake	QBAA	DR/RC	280	410696.317	4947369.955	1009.977	1008.182	272-280	88.32

Drilling methods: MR = mud rotary; DR/RC = dual rotary/reverse circulation; QBAA = Quaternary buried aquifer; KRET = Cretaceous sandstone; CMTS = Cambrian Mt. Simon sandstone; PMSX = Precambrian Sioux quartzite

Table 2 - Specific Capacity and Water Level Data Summary

Date sampled	MN unique	County	Site name	Formation	Depth to static water from top casing (ft)	Static water elevation (ft above msl)	Pumping (minutes)	Pumped volume (gallons)	Average pumping rate (gpm)	Water level drawdown (feet)	Specific capacity (gpm/drawdown)
10/7/2009	770442	Sibley	Severance Lake	CMTS	144.18	866.468	156	1240	8.0	1.22	6.5
10/7/2009	770443	Sibley	Severance Lake	QBAA	88.78	921.197	78	620	7.9	0.86	9.2
10/8/2009	770440	Sibley	Sibley Co. LF	CMTS	126.95	868.792	114	970	8.5	1.69	5.0
10/8/2009	770441	Sibley	Sibley Co. LF	QBAA	126.74	869.309	70	590	8.4	0.30	28.0
10/8/2009	770444	Nicollet	Norwegian Grove	CMTS	152.38	828.808	107	880	8.2	1.18	7.0
10/9/2009	770445	Nicollet	Norwegian Grove	QBAA	152.25	828.626	44	310	7.1	0.88	8.0
10/9/2009	770449	Nicollet	Peterson	CMTS	163.69	829.777	120	834	7.0	1.22	5.7
10/9/2009	770450	Nicollet	Peterson	QBAA	155.94	837.812	40	326	8.2	2.66	3.1
10/13/2009	768261	Nicollet	Courtland West	PMSX	109.65	886.670	90	126	1.4	186.25	0.0075
10/9/2009	768262	Nicollet	Courtland West	QBAA	108.57	886.365	39	320	8.1	0.69	11.8
10/14/2009	768263	Nicollet	Nicollet Bay	CMTS	157.73	832.940	57	1200	21.2	8.27	2.6
10/14/2009	768264	Nicollet	Nicollet Bay	QBAA	146.52	844.240	13	250	20	4.8	4.2
10/14/2009	768259	Brown	Heget Braulick	CMTS	40.71	981.237	103	230	2	63	0.036
10/14/2009	768260	Brown	Heget Braulick	QBAA	25.95	995.950	29	337	11.7	32.0	0.367
10/15/2009	760691	Watonwan	Bergdahl	CMTS	42.03	957.770	36	944	26	22.8	1.1
10/14/2009	760690	Watonwan	Bergdahl	QBAA	38.45	964.307	20	536	26	90.2	0.3
10/15/2009	760687	Watonwan	Case	CMTS	57.20	984.722	40	1040	26	4.7	5.5
10/15/2009	760686	Watonwan	Case	QBAA	40.10	1001.867	38	930	25	8.7	2.8
10/15/2009	760689	Watonwan	Madelia	CMTS	50.43	1016.581	62	1610	26	7.2	3.6
10/15/2009	760688	Watonwan	Madelia	KRET	29.40	1037.903	23	627	27	5.3	5.1
10/15/2009	770427	Watonwan	Long Lake	CMTS	32.49	1098.917	74	1887	26	3.8	6.7
10/15/2009	770439	Watonwan	Long Lake	QBAA	32.70	1099.031	23	586	25	11.3	2.2
10/16/2009	768125	Martin	Exceder	CMTS	76.38	1100.476	64	1503	23	1.8	13.1
10/16/2009	768139	Martin	Exceder	KRET	63.20	1113.766	48	967	20	16.7	1.2
10/26/2009	771163	Martin	Rooney Run	CMTS	69.06	1134.813	65	1070	17	12.5	1.3
10/26/2009	771161	Martin	Rooney Run	QBAA	68.12	1136.197	53	1270	24	12.6	1.9
10/28/2009	760692	Brown	Lake Hanska	KRET	4.33	1005.084	57	171	3	0.6	4.8
11/24/2009	132275	Watonwan	83012	CMTS	8.89	1025.87	16	14400	900	na	na
10/26/2009	405338	Brown	Flandrau SP	CMTS	na	na	150	450	3	na	na

QBAA = Quaternary buried aquifer
KRET = Cretaceous sandstone
CMTS = Cambrian Mt. Simon sandstone
PMSX = Precambrian Sioux quartzite

Table 3 Field Sample Collection and Handling Details

Parameter	Lab	Sample container	Head space	Rinse	Filter	Preservative	Refrigeration	Shelf life	Field duplicate	Field blank	Storage duplicate
Tritium	Waterloo	500 ml, HDPE	yes	**NO**	no	no	no	long	1 for every 20	none	yes
18O, Deuterium	Waterloo	60 ml, HDPE	yes	**NO**	no	no	no	long	1 for every 20	none	yes
Cations	U of M	15 ml, Fisherbrand BLUE cap	yes	yes *	yes	1 drop 6N HCl	yes	2-3 weeks	1 for every 20	1 for every 20 ****	no
Anions	U of M	50 ml, Argos BLACK ***	yes	yes *	yes	no	yes	2-3 weeks	1 for every 20	1 for every 20 ****	no
Trace constituents	U of M	15 ml, Sarstedt RED cap	yes	yes *	yes	5 drops 15N HNO_3	yes	2-3 weeks	1 for every 20	1 for every 20 ****	no
Alkalinity	onsite	500 ml, plastic	**NO**	yes **	no	no	Yes, if not analyzed onsite	24-48 hours	none	none	no
14C	U of M	30 gallon barrel	yes	no	yes	NH_4OH to pH 8.5	no	years	none	none	no

* Rinse the bottle once with FILTERED sample water prior to collecting the sample. Rinsing means fill the bottle with sample water (FILTERED if sample is filtered) and then pour the contents out over the cap.

** Rinse the bottle three times with sample water prior to collecting the sample. Fill bottle submerged with cap in hand. Seal bottle submerged ensuring no remnant bubbles.

*** Fill 50 ml anion bottle unless filtering is very difficult. Bottle must be at least 1/3 full.

**** Use DI water from small bottle for field blanks (NOT THE CARBOY). Pour DI water into the back of the syringe when the plunger is removed. Fill bottles through filter.

Table 4 Residence time indicators, stable isotopes, and selected trace elements

						Trace elements**		Residence time indicators		Stable isotopes****		
MN unique	**Site name**	**County**	**Formation**	**Depth (ft)**	**Date sampled**	As	B	^{14}C (years)	Tritium***	Deuterium	^{18}O	Mn
00405338	Flandrau State Park	Brown	CMTS	200	10/26/2009	0.19	89	30,000	<0.8	-68.61	-9.95	0.074
00760692	Lake Hanska WMA	Brown	Kret	164	10/28/2009	0.13	1910	11,000	<0.8	-68.69	-10.27	0.215
00768259	Helget-Braulick WMA	Brown	CMTS	284	10/14/2009	0.29	361	13,000	<0.8	-63.42	-8.56	0.304
00768260	Helget-Braulick WMA	Brown	QBAA	70.5	10/14/2009	41.2	376	500	<0.8	-50.23	-6.39	0.143
00768125	Exceder WMA	Martin	CMTS	680	10/16/2009	0.37	173	13,000	<0.8	-69.97	-9.85	0.192
00768139	Exceder WMA	Martin	KRET	231	10/16/2009	0.44	272	11,000	<0.8	-65.92	-9.11	0.256
00771161	Rooney Run WMA	Martin	QBAA	444	10/26/2009	3.78	335	8,000	<0.8	-66.69	-9.88	0.274
00771163	Rooney Run WMA	Martin	CMTS	718	10/26/2009	0.61	193	10,000	<0.8	-69.42	-9.70	0.210
00768261	Courtland West Unit*	Nicollet	PMSX	463	10/9/2009	0.23	571	NA	<0.8	-72.7	-9.81	0.0185
00768262	Courtland West Unit*	Nicollet	QBAA	202	10/9/2009	1.45	74	2,300	<0.8	-54.04	-7.72	0.429
00768263	Nicollet Bay Unit*	Nicollet	CMTS	474	10/14/2009	44.2	152	18,000	<0.8	-65.90	-9.66	0.126
00768264	Nicollet Bay Unit*	Nicollet	QBAA	198	10/14/2009	14.3	114	Recent	<0.8	-40.89	-4.84	0.311
00770444	Norwegian Grove WMA	Nicollet	CMTS	540	10/8/2009	1.93	497	20,000	<0.8	-66.42	-9.59	0.141
00770445	Norwegian Grove WMA	Nicollet	QBAA	260	10/9/2009	1.75	452	4,000	<0.8	-64.82	-8.65	0.838
00770449	Peterson Unit*	Nicollet	CMTS	545	10/9/2009	22.8	89	22,000	<0.8	-60.05	-8.23	0.165
00770450	Peterson Unit*	Nicollet	QBAA	223	10/9/2009	1.37	322	8,000	<0.8	-56.77	-7.45	0.191
00770440	Sibley Co Landfill	Sibley	CMTS	575	10/8/2009	2.41	336	17,000	<0.8	-67.46	-9.75	0.0925
00770441	Sibley Co Landfill	Sibley	QBAA	430	10/8/2009	0.36	344	18,000	<0.8	-67.27	-10.09	0.203
00770442	Severance Lake WMA	Sibley	CMTS	630	10/7/2009	1.88	241	10,000	<0.8	-66.70	-9.28	0.114
00770443	Severance Lake WMA	Sibley	QBAA	280	10/7/2009	0.42	192	5,000	<0.8	-61.30	-8.88	0.271
00132275	Darrin Bocock	Watonwan	CMTS	484	11/24/2009	0.21	357	7,000	<0.8	-58.41	-9.15	0.197
00760686	Case WMA	Watonwan	QBAA	209	10/15/2009	0.26	317	9,000	<0.8	-65.65	-9.07	0.1126
00760687	Case WMA	Watonwan	CMTS	672	10/15/2009	0.1	213	10,000	<0.8	-66.38	-9.36	0.203
00760688	Madelia WMA	Watonwan	QBAA	120	10/15/2009	5.11	183	4,000	<0.8	-63.67	-9.04	0.313
00760689	Madelia WMA	Watonwan	CMTS	648	10/15/2009	0.37	244	7,000	<0.8	-65.18	-9.18	0.1134
00760690	Bergdahl WMA	Watonwan	QBAA	129	10/14/2009	10.3	260	8,000	<0.8	-65.96	-9.19	0.891
00760691	Bergdahl WMA	Watonwan	CMTS	479	10/15/2009	0.13	225	20,000	<0.8	-67.30	-9.39	0.218
00770427	Long Lake WA	Watonwan	CMTS	547	10/15/2009	1.67	464	8,000	<0.8	-61.71	-8.64	1.037
00770439	Long Lake WA	Watonwan	QBAA	128	10/15/2009	5.27	295	2,600	2.9	-58.81	-8.31	0.388

*part of Swan Lake WMA
** ug/l (parts per billion)
*** tritium units (TU), < means not detected
**** delta values reported in units per thousand relative to standard
NA = not analyzed
QBAA = Quaternary buried aquifer
KRET = Cretaceous sandstone
CMTS = Cambrian Mt. Simon Sandstone
PMSX = Precambrian Sioux Quartzite

Table 5 Selected anion and cation data

						Anions mg/l				Cations mg/l					
MN unique	**Site name**	**County**	**Formation**	**Depth (ft)**	**Date sampled**	Cl	SO4	Br	Cl/Br	Ca	Mg	Na	K	Fe	Mn
00405338	Flandrau State Park	Brown	CMTS	200	10/26/2009	130.9	239	0.450	291	47.2	22.0	203	10.02	1.30	0.074
00760692	Lake Hanska WA	Brown	KRET	164	10/28/2009	4.21	544	0.052	81	219	71.2	57.4	5.21	3.72	0.215
00768259	Helget-Braulick WMA	Brown	CMTS	284	10/14/2009	34.6	191	0.038	911	96.0	42.7	45.3	12.4	1.28	0.304
00768260	Helget-Braulick WMA	Brown	QBAA	70.5	10/14/2009	0.60	481	0.013	46	168	106.5	48.7	10.38	4.26	0.143
00768125	Exceder WMA	Martin	CMTS	680	10/16/2009	2.67	493	0.049	54	190	58.4	65.6	5.49	2.12	0.192
00768139	Exceder WMA	Martin	KRET	231	10/16/2009	2.25	435	0.043	52	186	57.5	54.4	5.49	1.91	0.256
00771161	Rooney Run WMA	Martin	QBAA	444	10/26/2009	2.10	615	0.043	49	208	60.9	82.2	5.71	2.90	0.274
00771163	Rooney Run WMA	Martin	CMTS	718	10/26/2009	7.04	475	0.057	124	172	51.9	70.1	7.64	2.55	0.210
00768261	Courtland West Unit*	Nicollet	PMSX	463	10/9/2009	10.1	433	0.059	171	8.62	60.9	131	27.1	0.012	0.0185
00768262	Courtland West Unit*	Nicollet	QBAA	202	10/9/2009	1.10	63.6	0.016	69	123	36.6	8.27	4.24	3.90	0.429
00768263	Nicollet Bay Unit*	Nicollet	CMTS	474	10/14/2009	18.0	175	0.062	290	109	35.8	39.9	6.71	0.246	0.126
00768264	Nicollet Bay Unit*	Nicollet	QBAA	198	10/14/2009	2.93	31.4	0.041	71	150	65.8	22.3	8.71	3.52	0.311
00770444	Norwegian Grove WMA	Nicollet	CMTS	540	10/8/2009	60.9	162	0.249	245	86.9	36.7	150	8.70	0.920	0.141
00770445	Norwegian Grove WMA	Nicollet	QBAA	260	10/9/2009	2.5	206	0.060	42	108.7	45.5	95.1	5.85	2.02	0.838
00770449	Peterson Unit*	Nicollet	CMTS	545	10/9/2009	48.7	181	0.016	3044	126	44.4	53.4	5.25	0.780	0.165
00770450	Peterson Unit*	Nicollet	QBAA	223	10/9/2009	3.36	705	0.078	43	198	63.3	170	4.67	2.30	0.191
00770440	Sibley Co Landfill	Sibley	CMTS	575	10/8/2009	3.59	45.1	0.053	68	90.5	38.7	75.0	5.62	1.68	0.0925
00770441	Sibley Co Landfill	Sibley	QBAA	430	10/8/2009	3.43	29.8	0.054	64	93.5	39.5	73.3	5.64	2.21	0.203
00770442	Severance Lake WMA	Sibley	CMTS	630	10/7/2009	21.4	131.7	0.073	293	104.6	40.1	64.4	9.50	2.06	0.114
00770443	Severance Lake WMA	Sibley	QBAA	280	10/7/2009	0.65	51.7	0.043	15	111	43.6	31.4	4.93	1.18	0.271
00132275	Darrin Bocock	Watonwan	CMTS	484	11/24/2009	1.21	751	0.037	33	269.4	95.8	52.3	7.79	5.91	0.197
00760686	Case WMA	Watonwan	QBAA	209	10/15/2009	1.83	320	0.033	55	150	55.8	49.0	5.77	3.81	0.1126
00760687	Case WMA	Watonwan	CMTS	672	10/15/2009	1.75	523	0.042	42	227	66.3	45.1	4.96	2.92	0.203
00760688	Madelia WMA	Watonwan	QBAA	120	10/15/2009	0.56	99.1	0.015	37	112	35.3	22.1	4.88	3.18	0.313
00760689	Madelia WMA	Watonwan	CMTS	648	10/15/2009	0.99	388	0.028	35	192	58.1	33.0	6.25	3.44	0.1134
00760690	Bergdahl WMA	Watonwan	QBAA	129	10/14/2009	1.98	544	0.042	47	210	66.4	68.7	5.49	2.92	0.891
00760691	Bergdahl WMA	Watonwan	CMTS	479	10/15/2009	11.2	586	0.067	167	212	77.6	77.3	6.62	3.25	0.218
00770427	Long Lake WA	Watonwan	CMTS	547	10/15/2009	1.49	1114	0.048	31	363	117	77.6	6.92	1.05	1.037
00770439	Long Lake WA	Watonwan	QBAA	128	10/15/2009	7.77	665	0.056	139	255	84.9	53.2	6.77	3.62	0.388

*part of Swan Lake WMA

QBAA = Quaternary buried aquifer
KRET = Cretaceous sandstone
CMTS = Cambrian Mt. Simon sandstone
PMSX = Precambrian Sioux quartzite

Figures

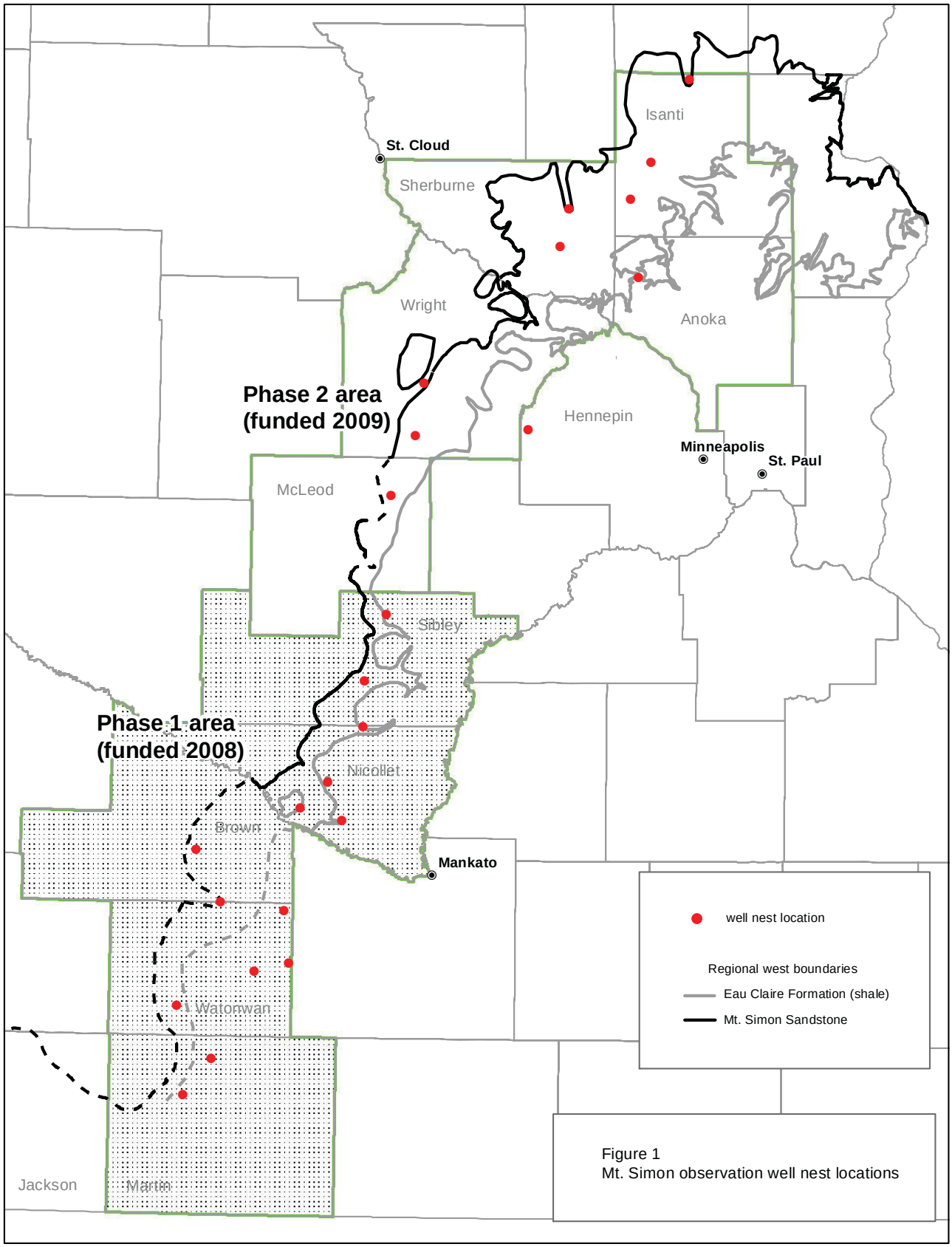


Figure 1
Mt. Simon observation well nest locations

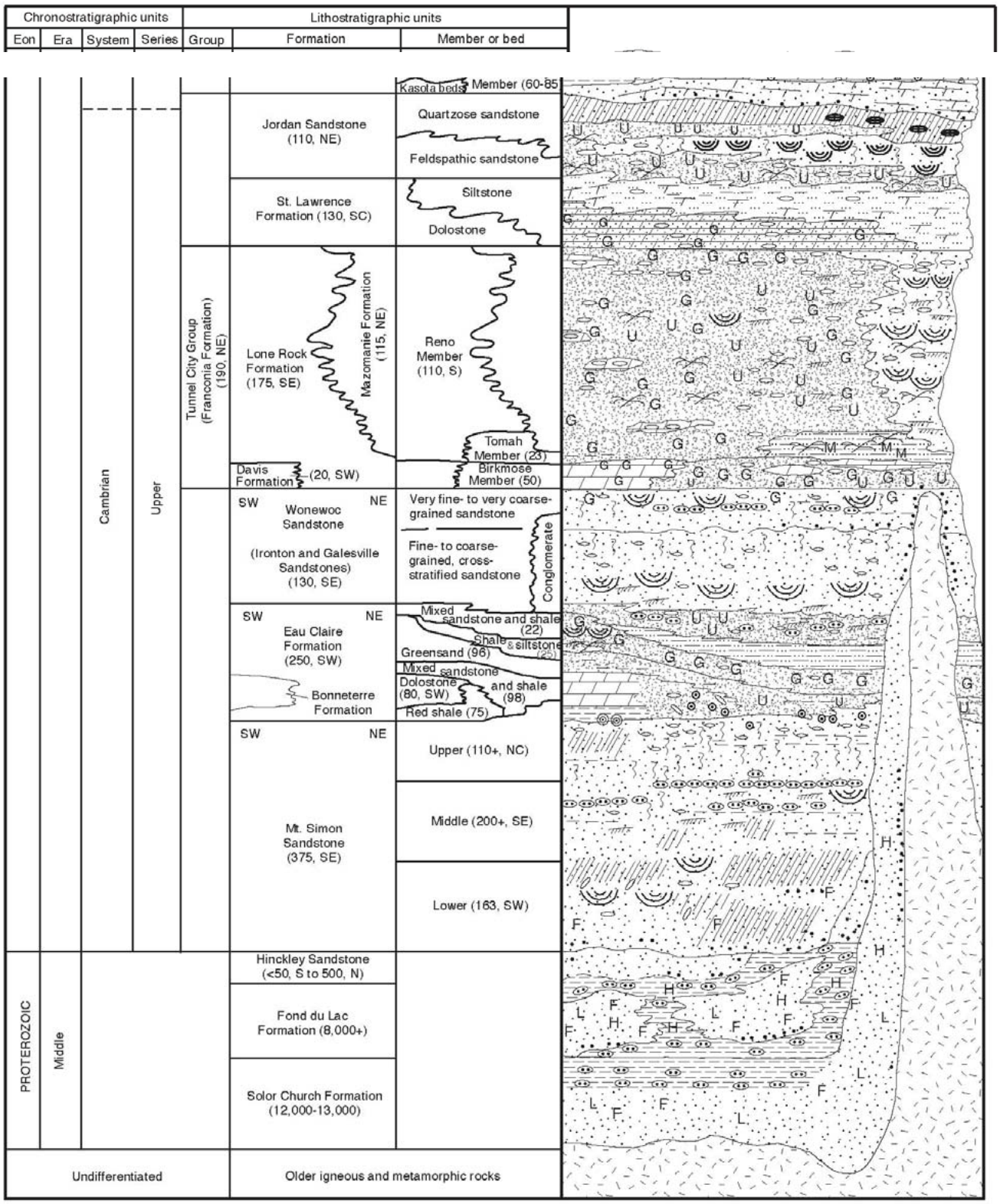


Figure 2 Cambrian and older stratigraphy in study area (Modified from Mossler 2008)

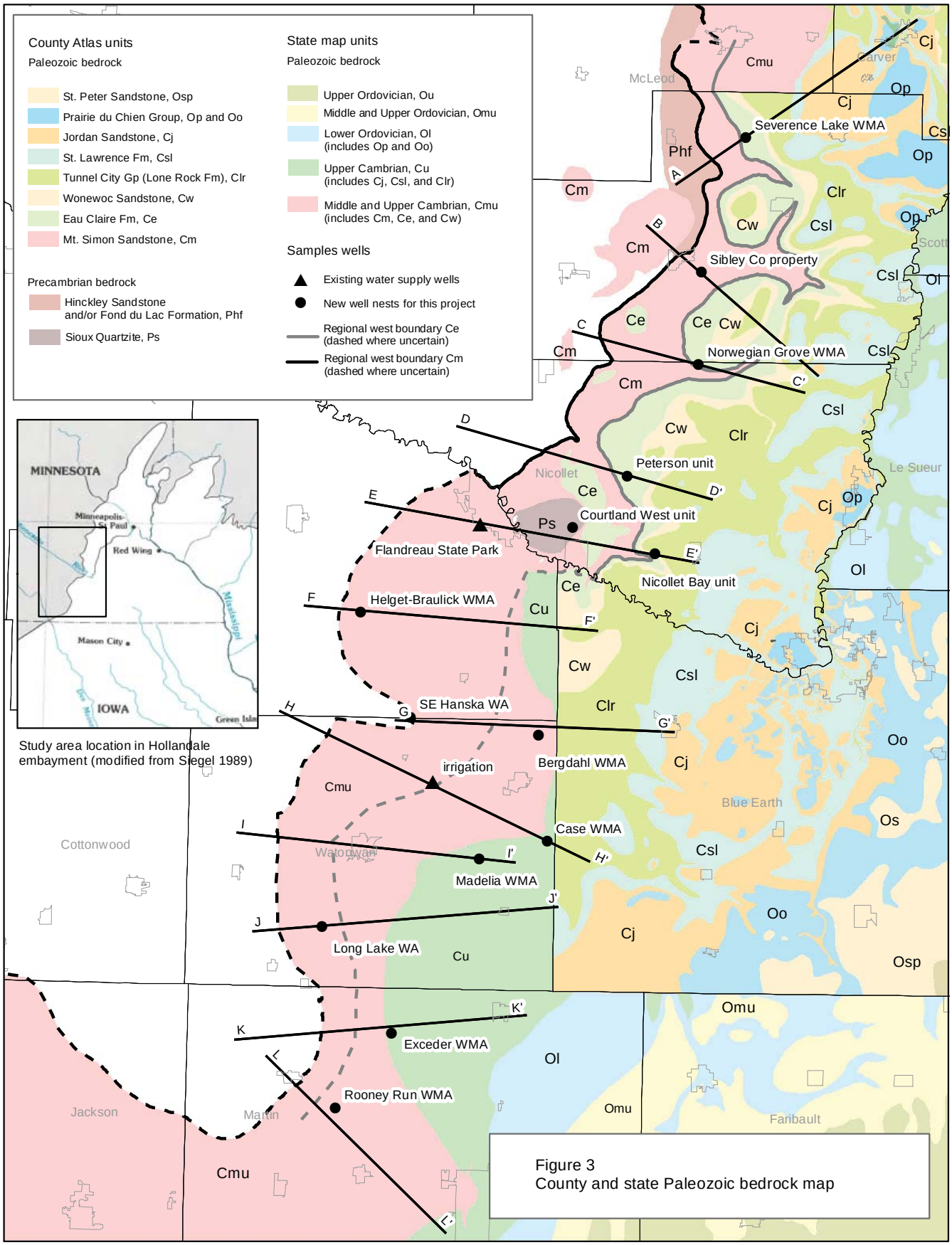


Figure 3
County and state Paleozoic bedrock map

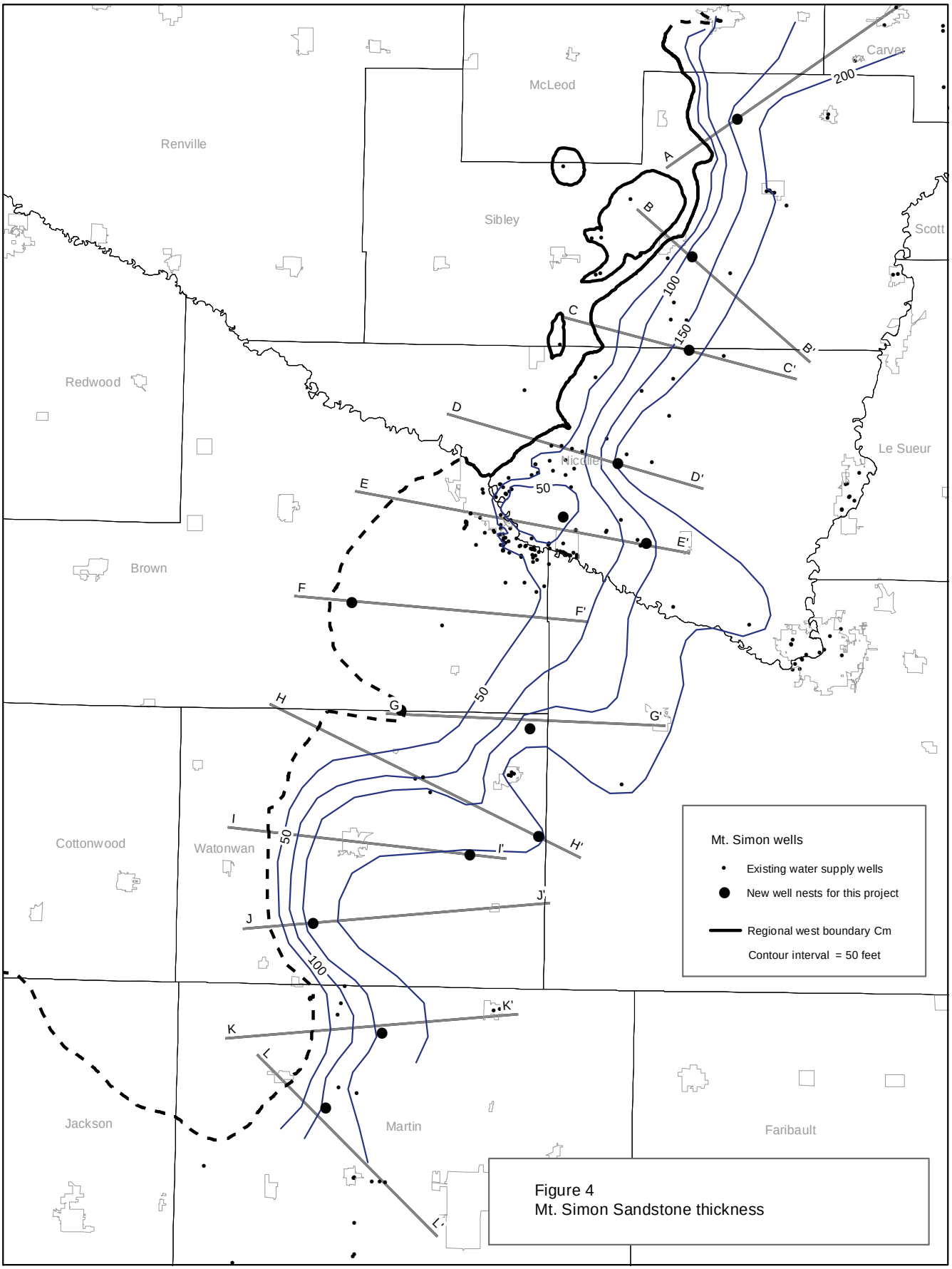


Figure 4
Mt. Simon Sandstone thickness

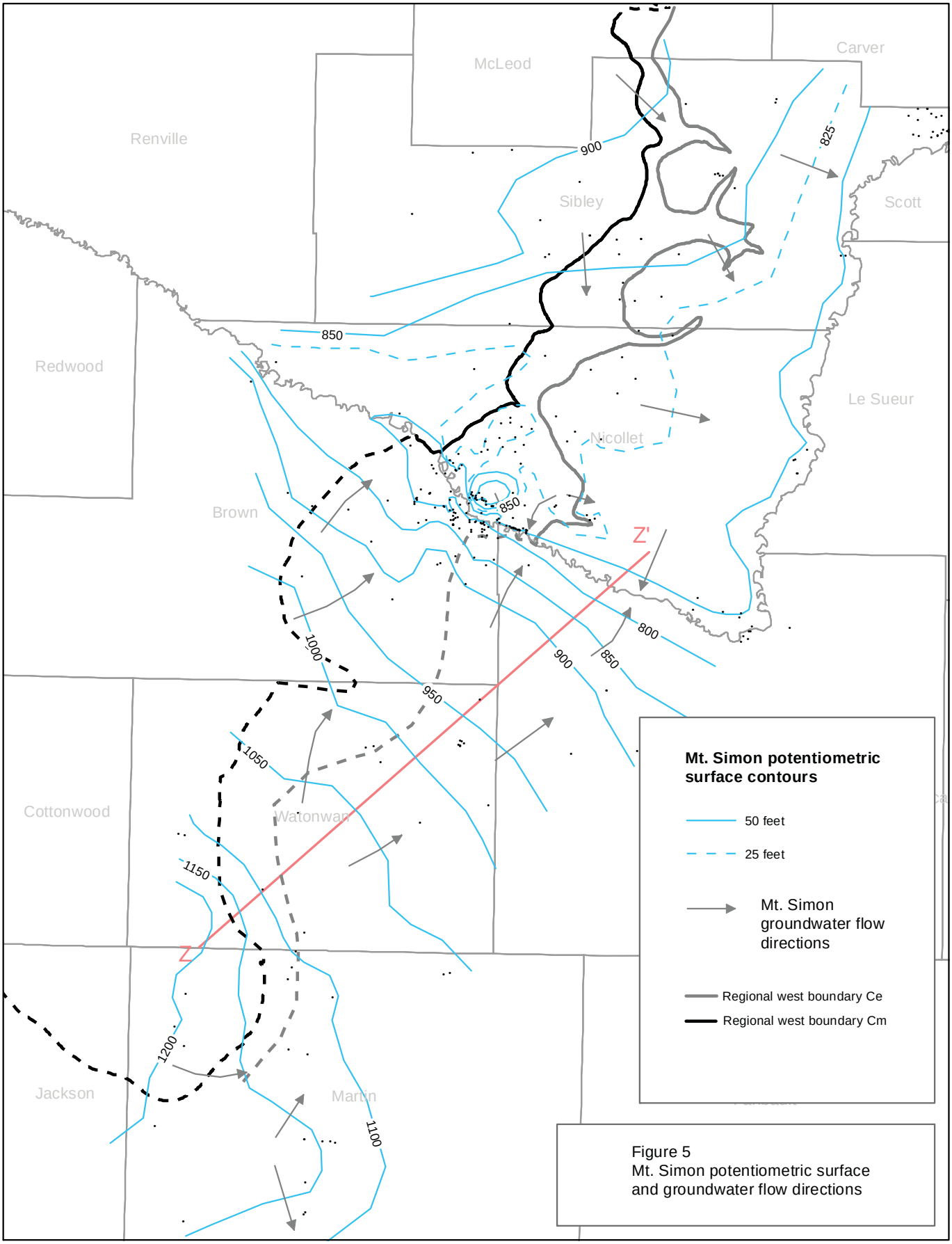


Figure 5
Mt. Simon potentiometric surface and groundwater flow directions

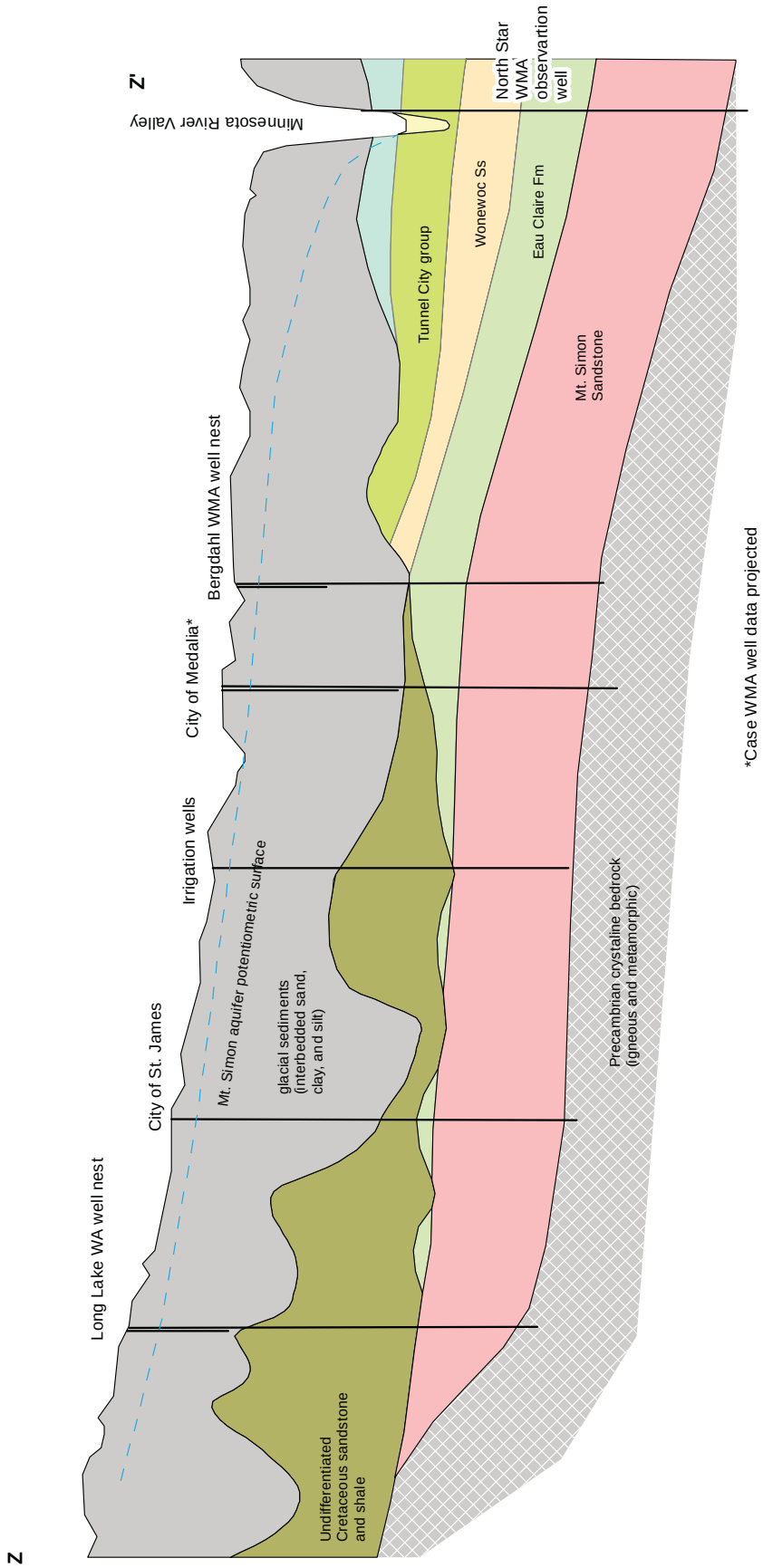


Figure 6 Cross section Z-Z'
Mt. Simon potentiometric surface

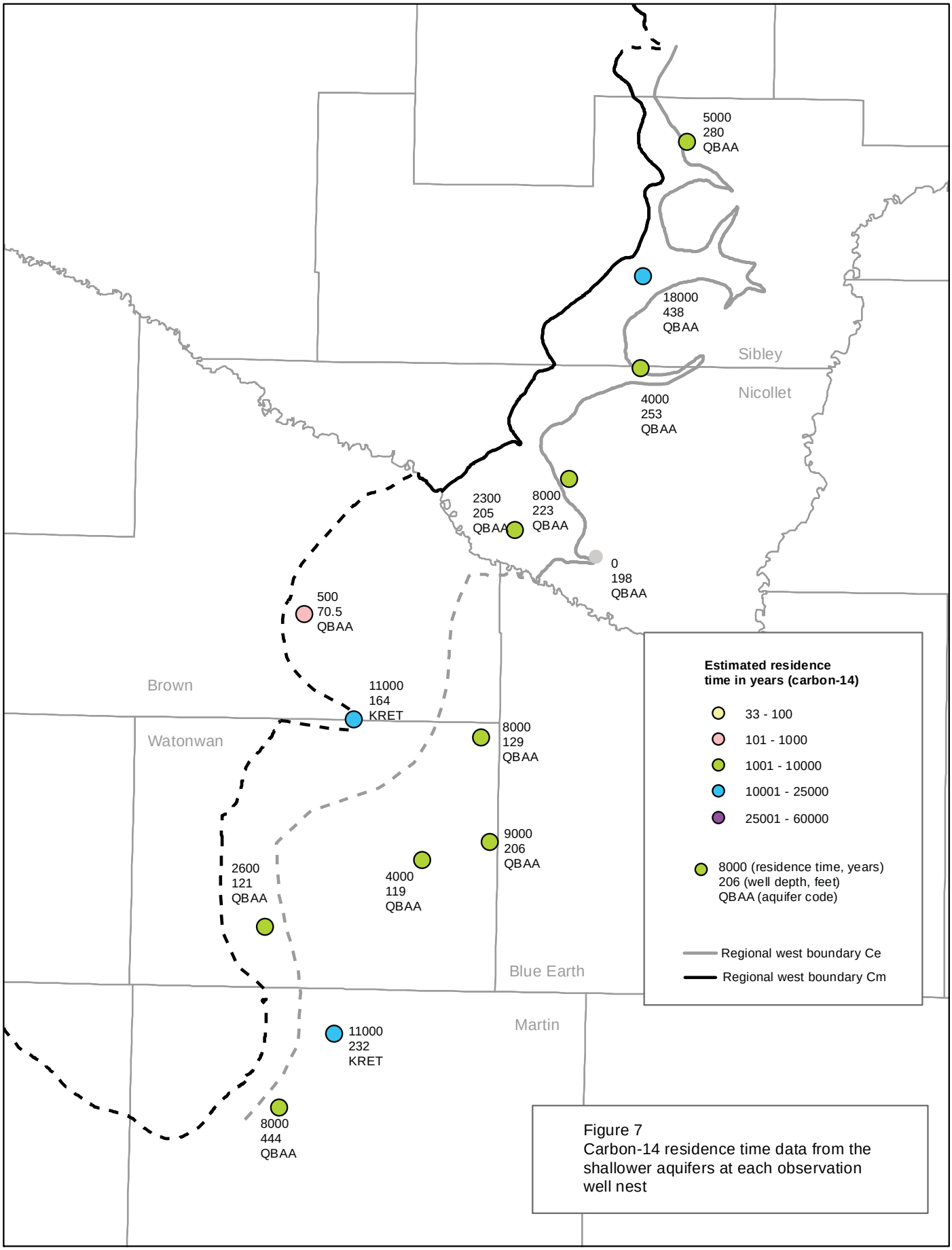


Figure 7
Carbon-14 residence time data from the shallower aquifers at each observation well nest

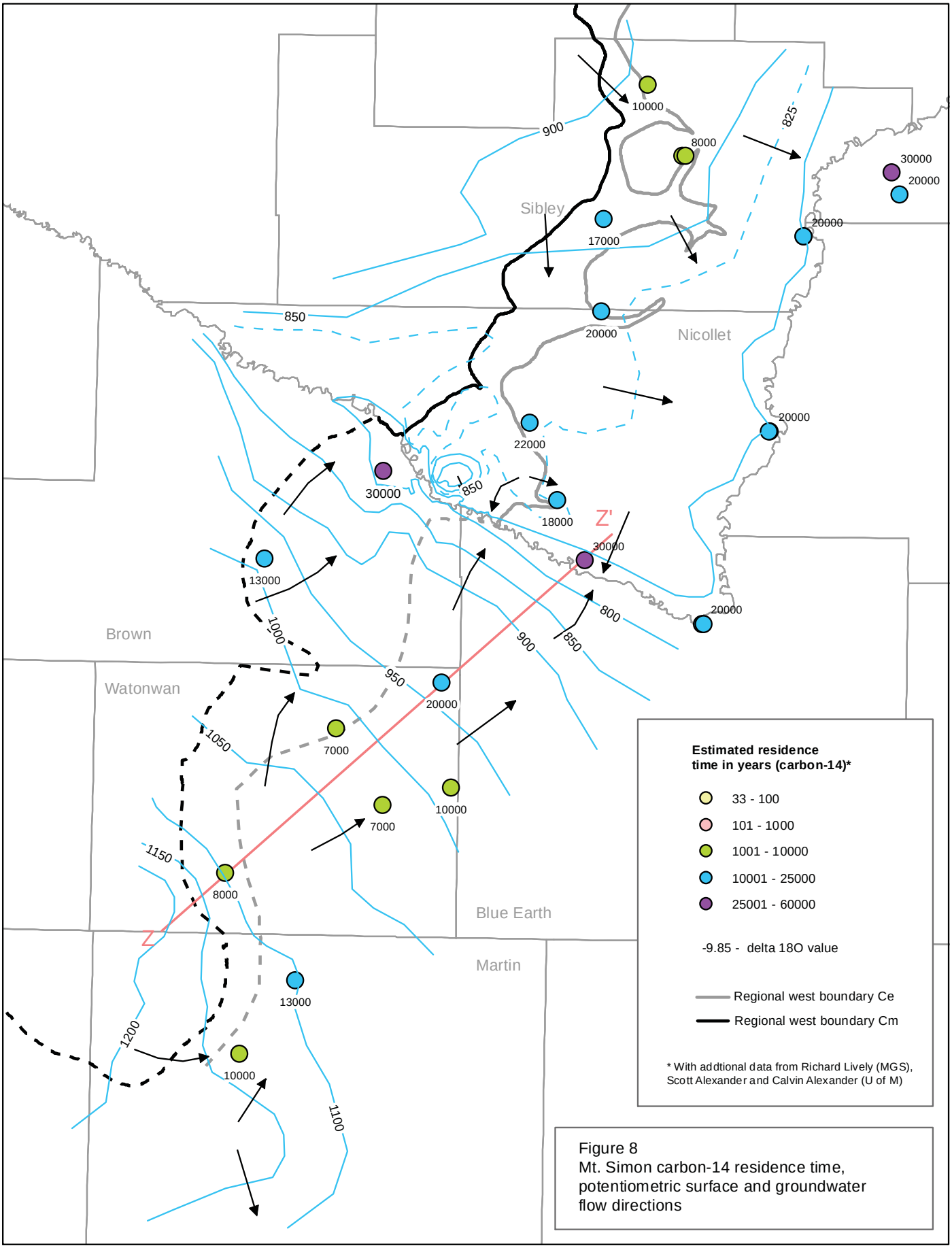


Figure 8
Mt. Simon carbon-14 residence time, potentiometric surface and groundwater flow directions

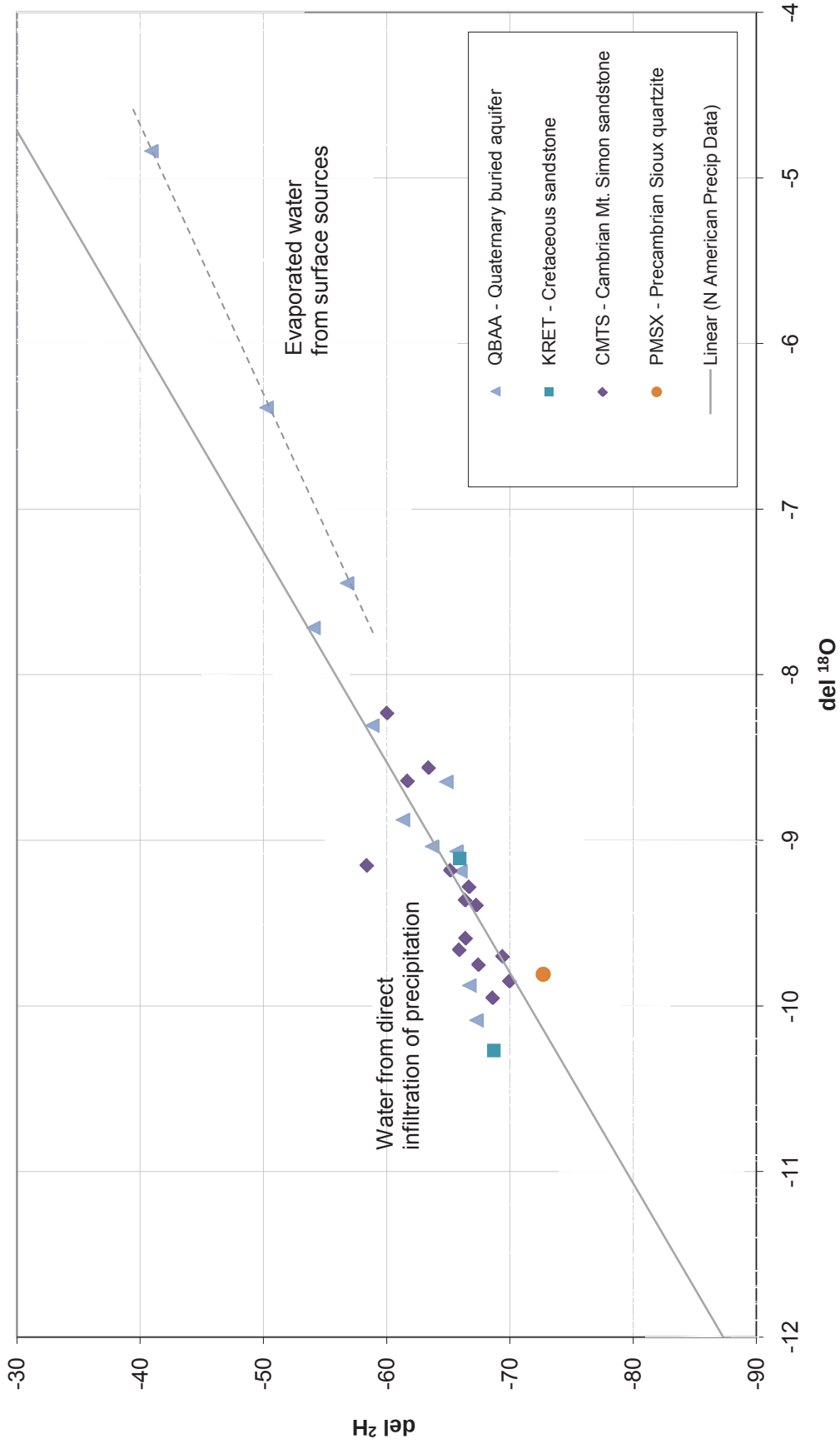


Figure 9 Stable isotope data compared with North American meteoric line

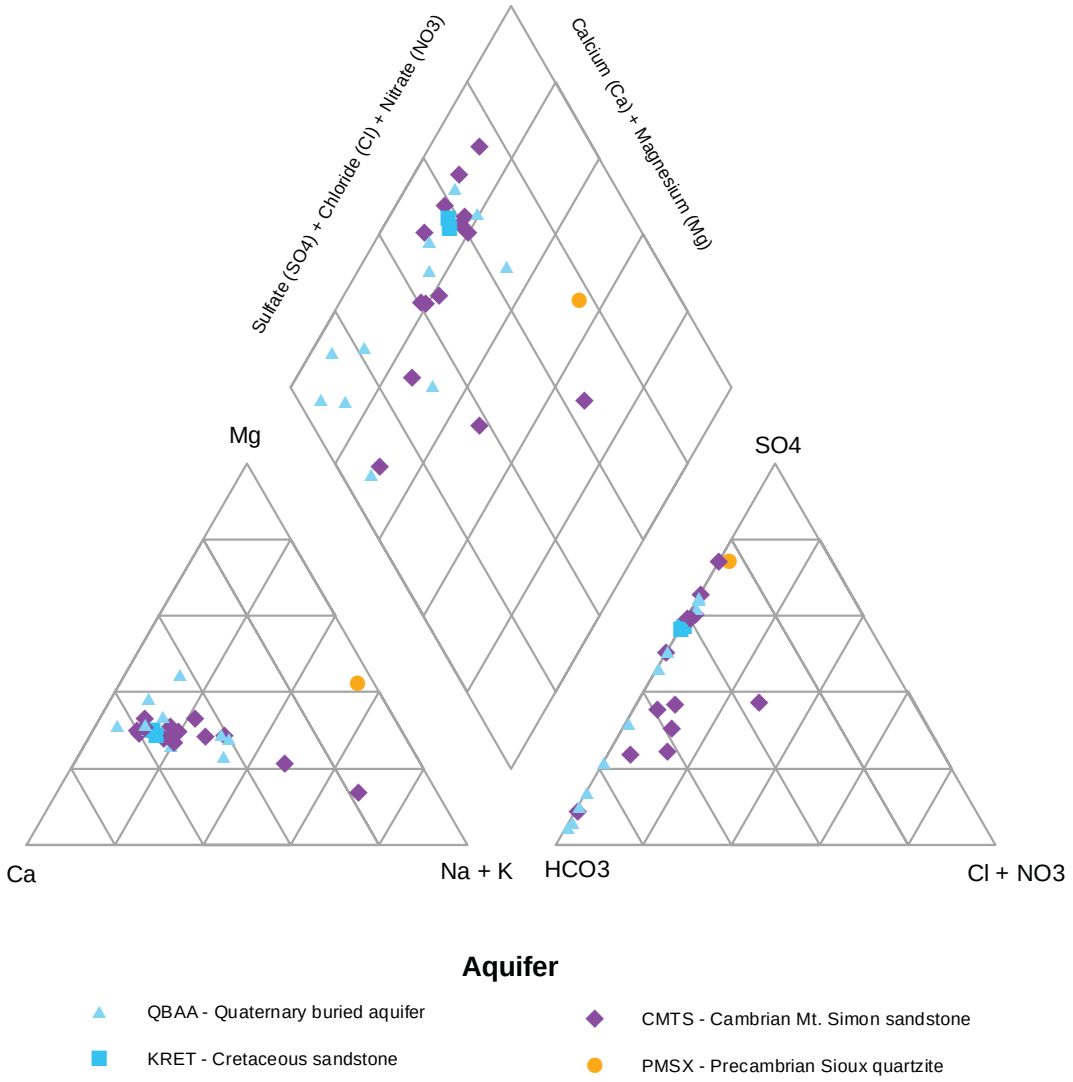


Figure 10
Ternary diagram - relative abundances of major cations and anions

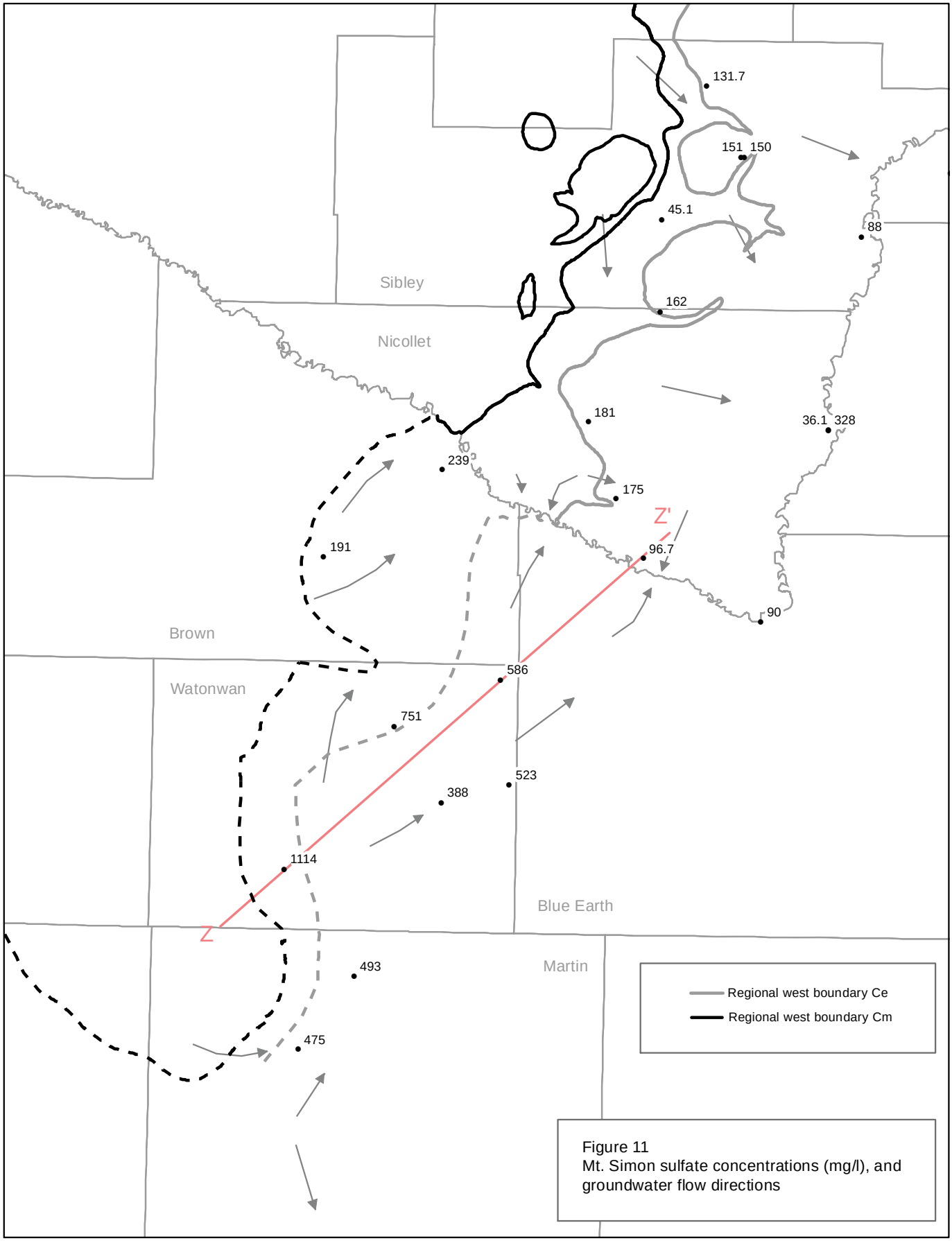


Figure 11
Mt. Simon sulfate concentrations (mg/l), and groundwater flow directions

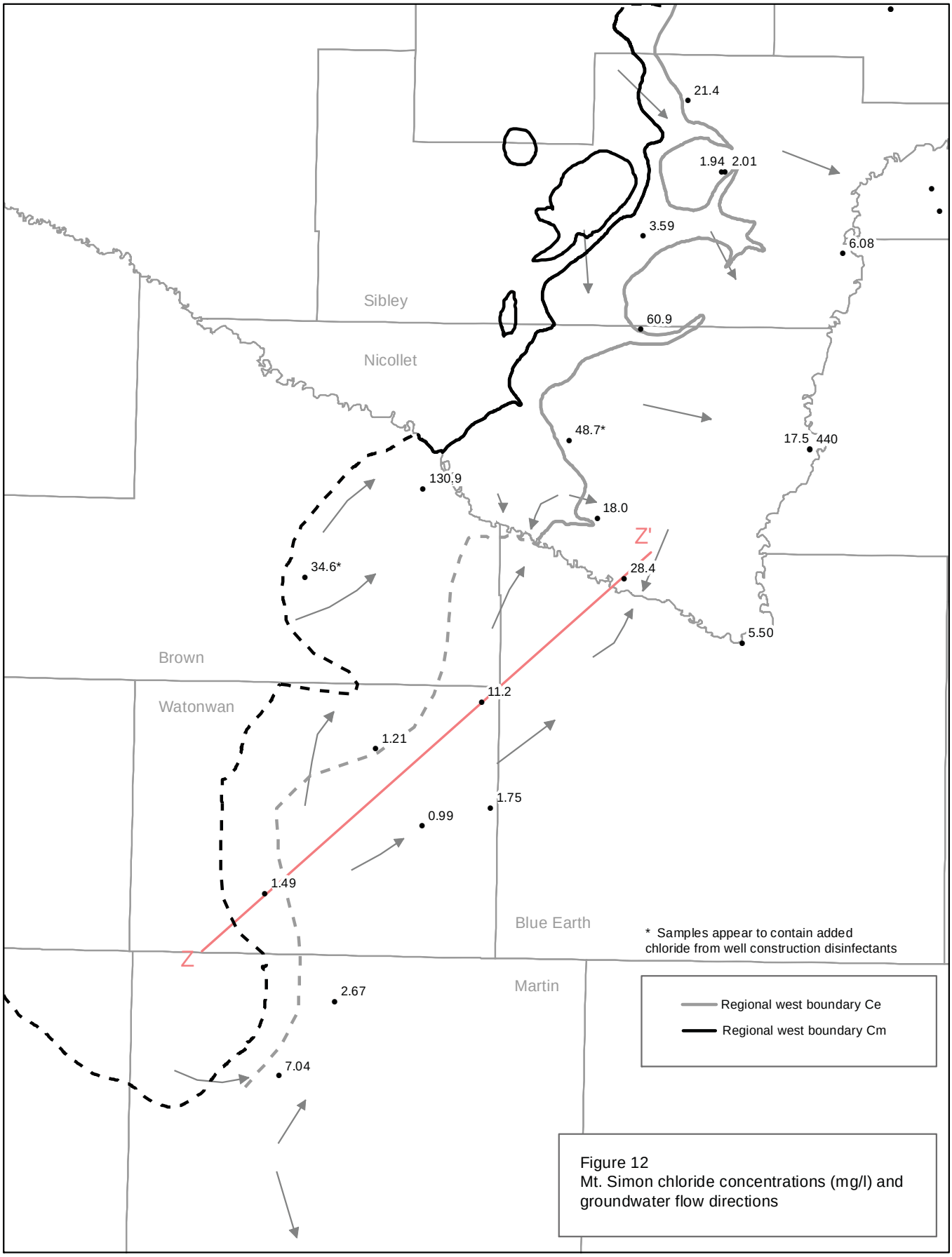


Figure 12
Mt. Simon chloride concentrations (mg/l) and groundwater flow directions

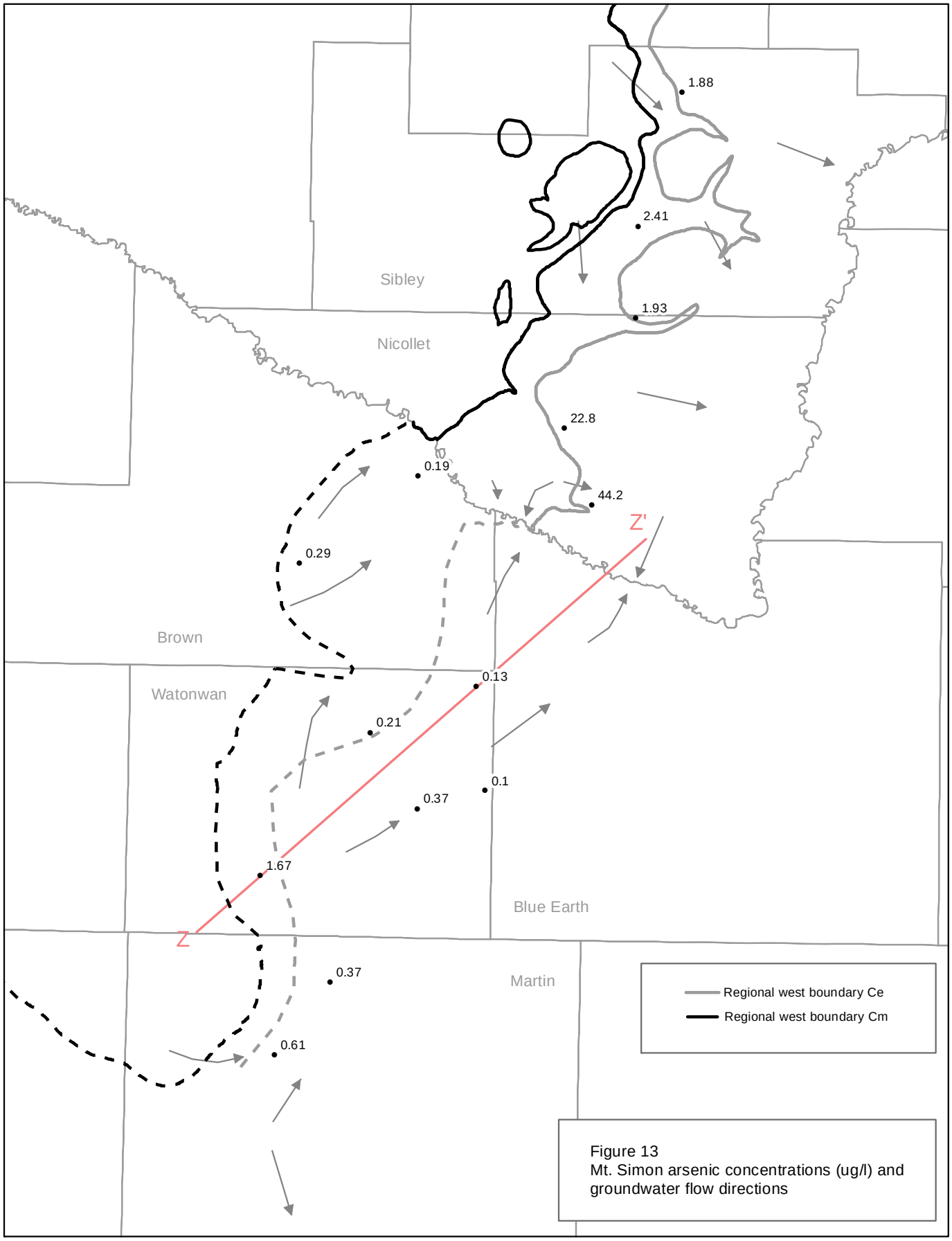


Figure 13
Mt. Simon arsenic concentrations (ug/l) and groundwater flow directions

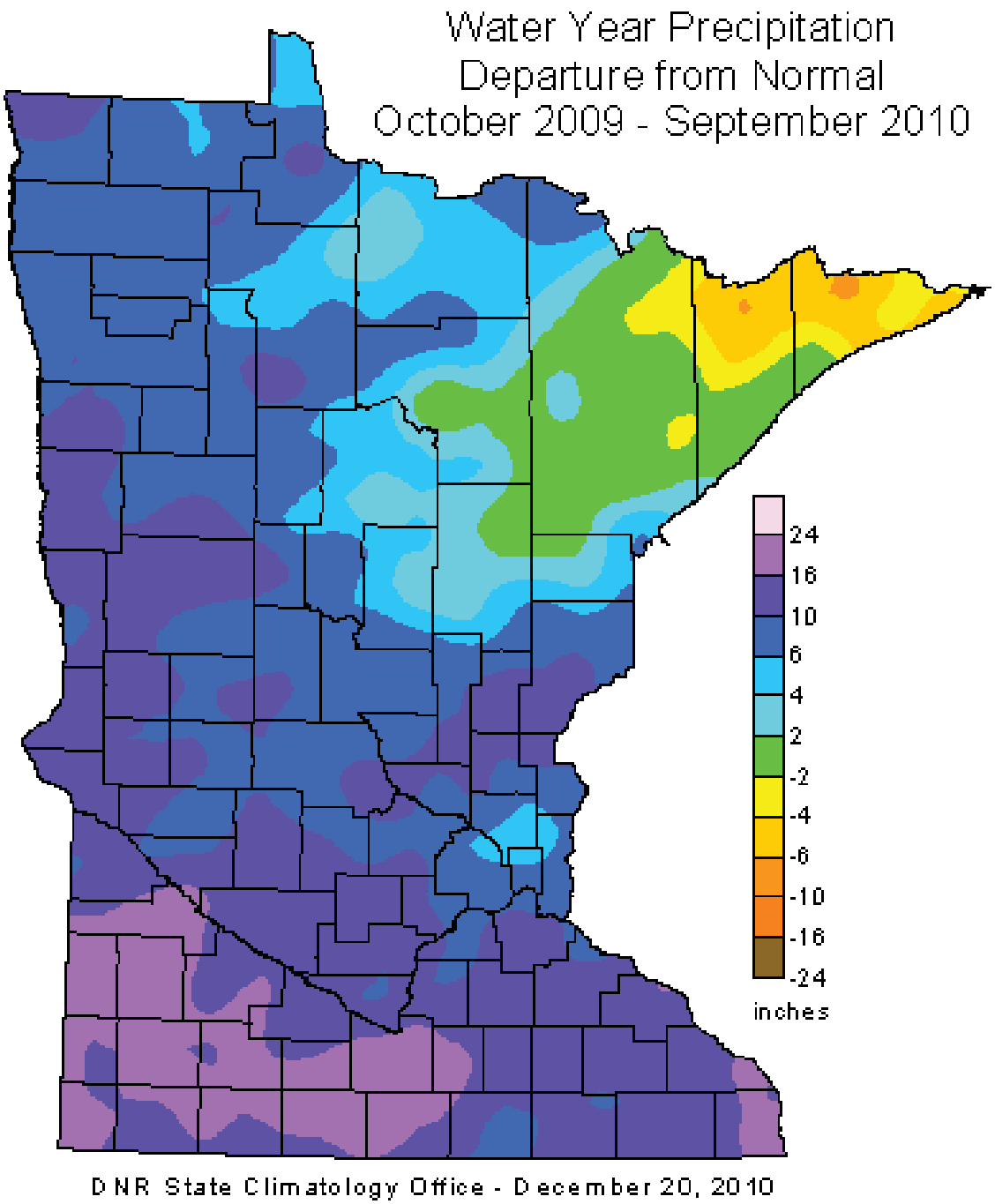


Figure 14
Precipitation departure from normal
October 2009 – September 2010

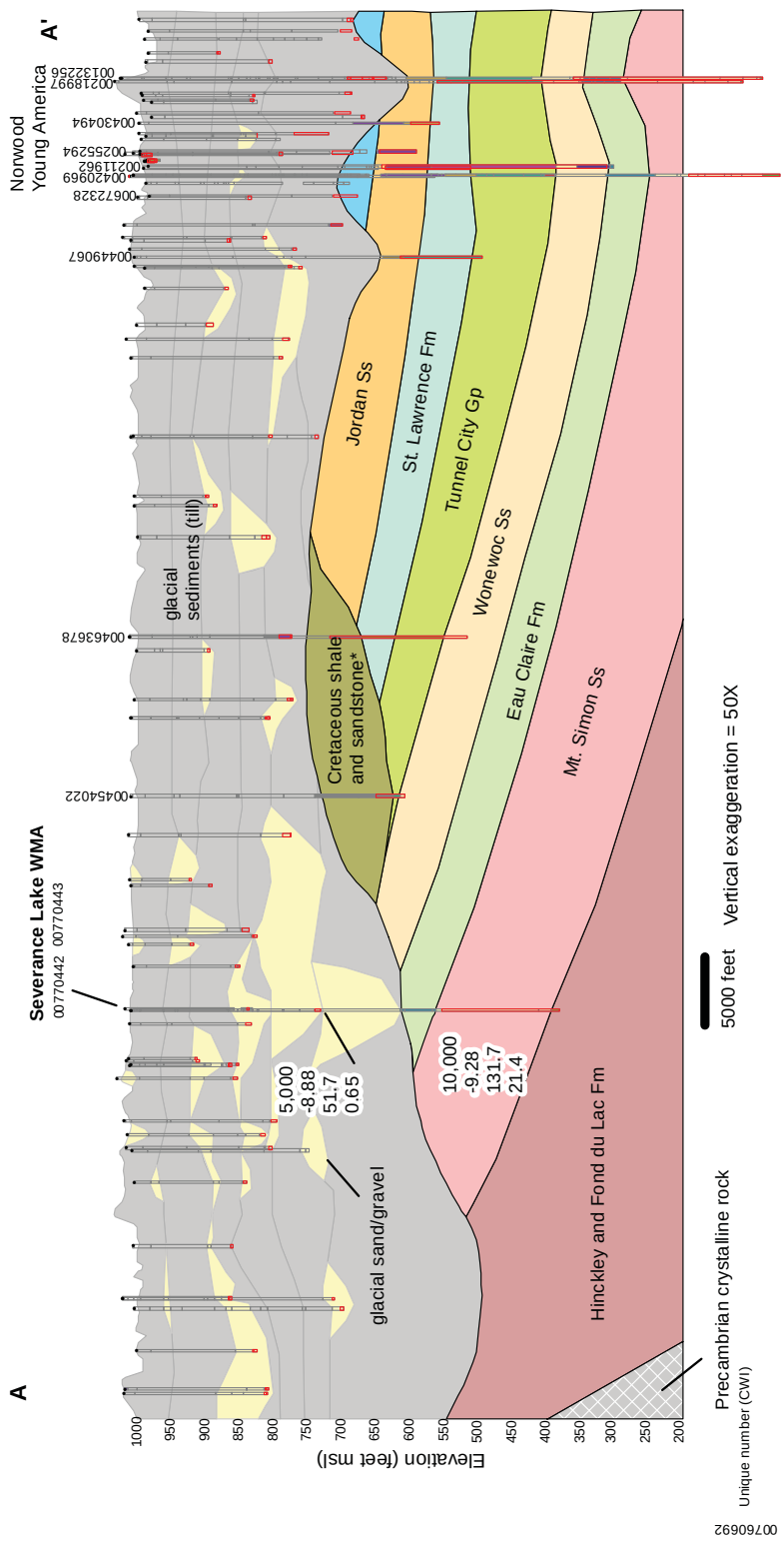


Figure 15a
Cross section A-A'

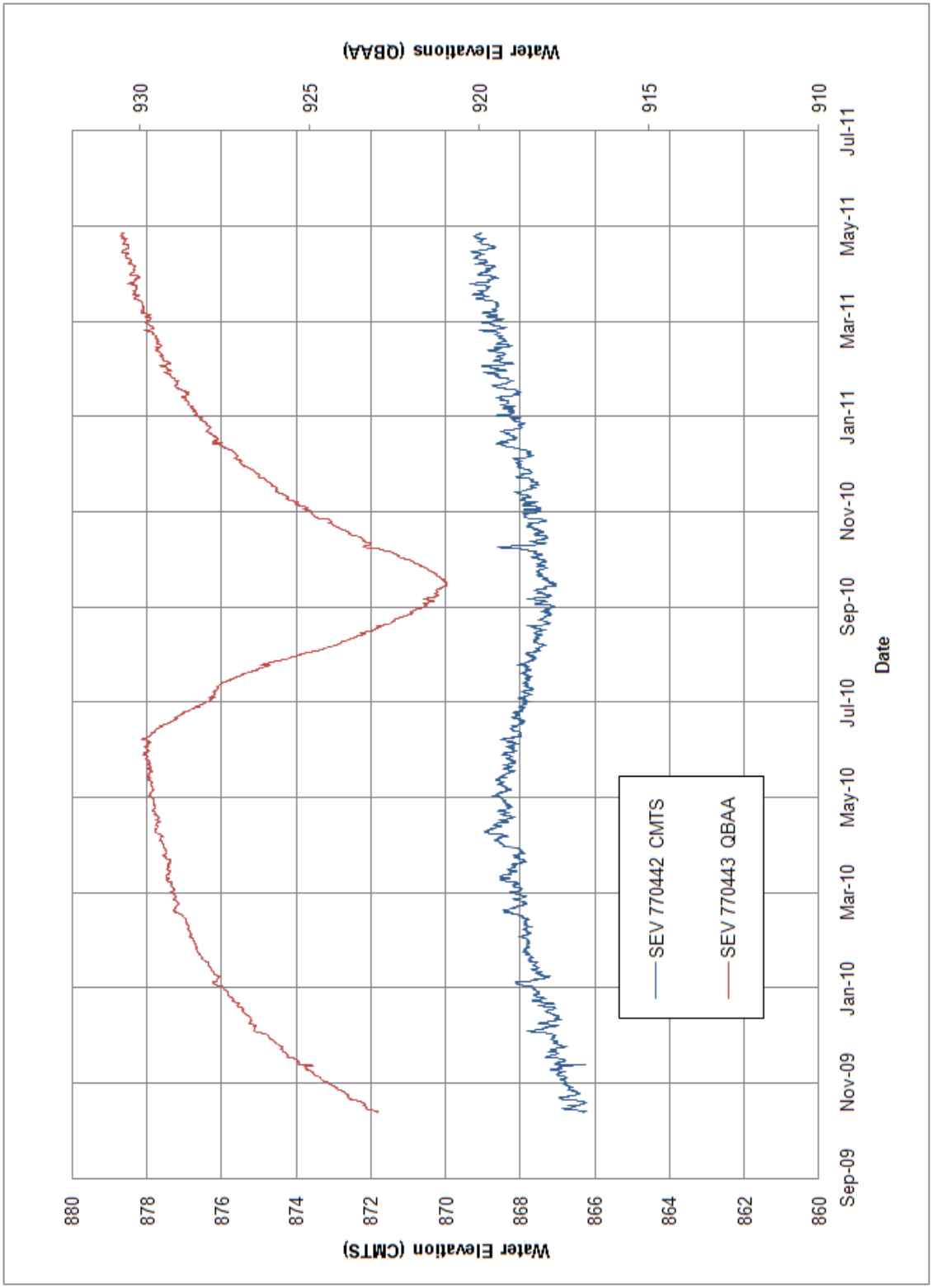


Figure 15b
Severance Lake WMA
Hydrograph

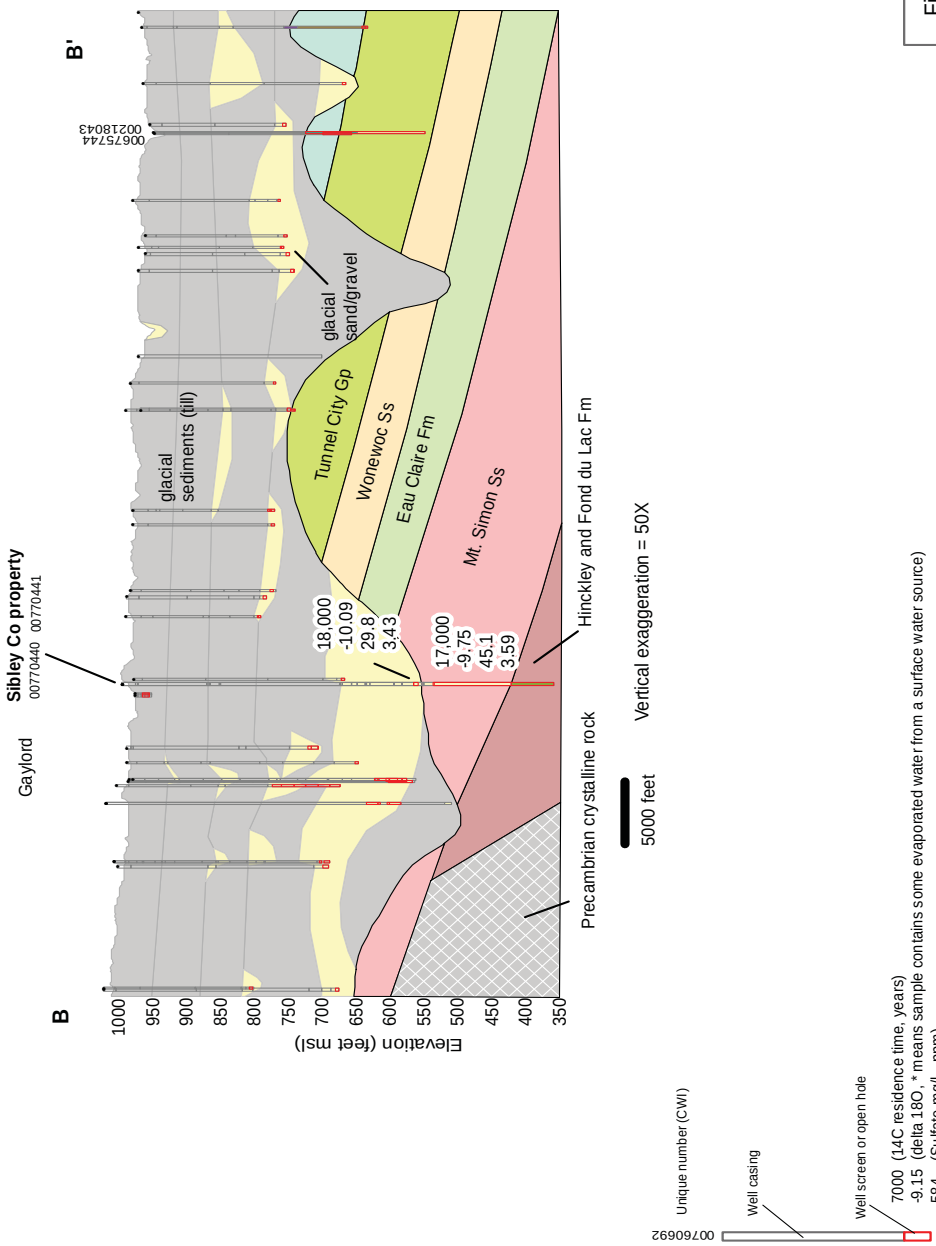


Figure 16a
Cross section B-B'

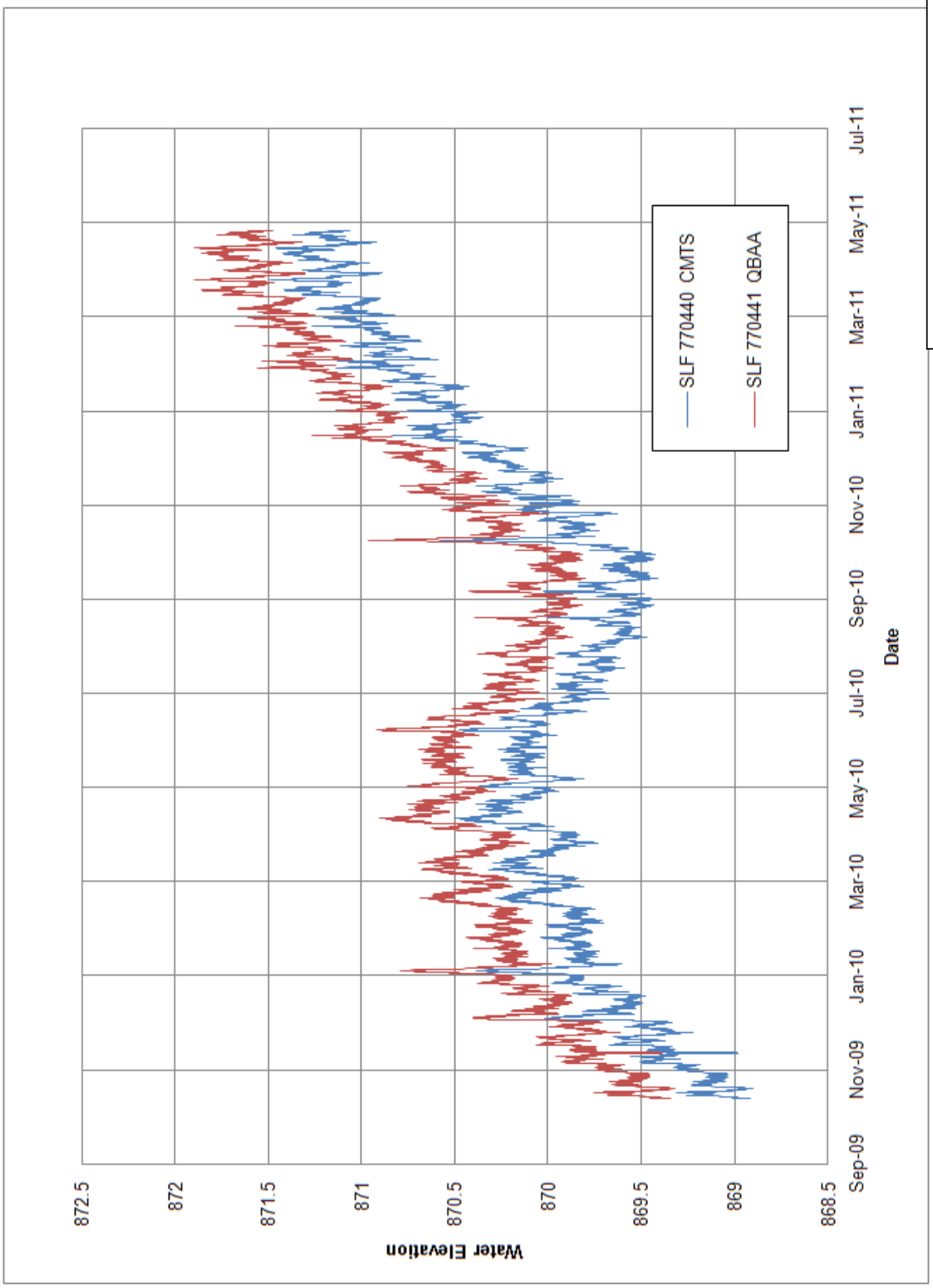


Figure 16b
Sibley County Landfill
Hydrograph

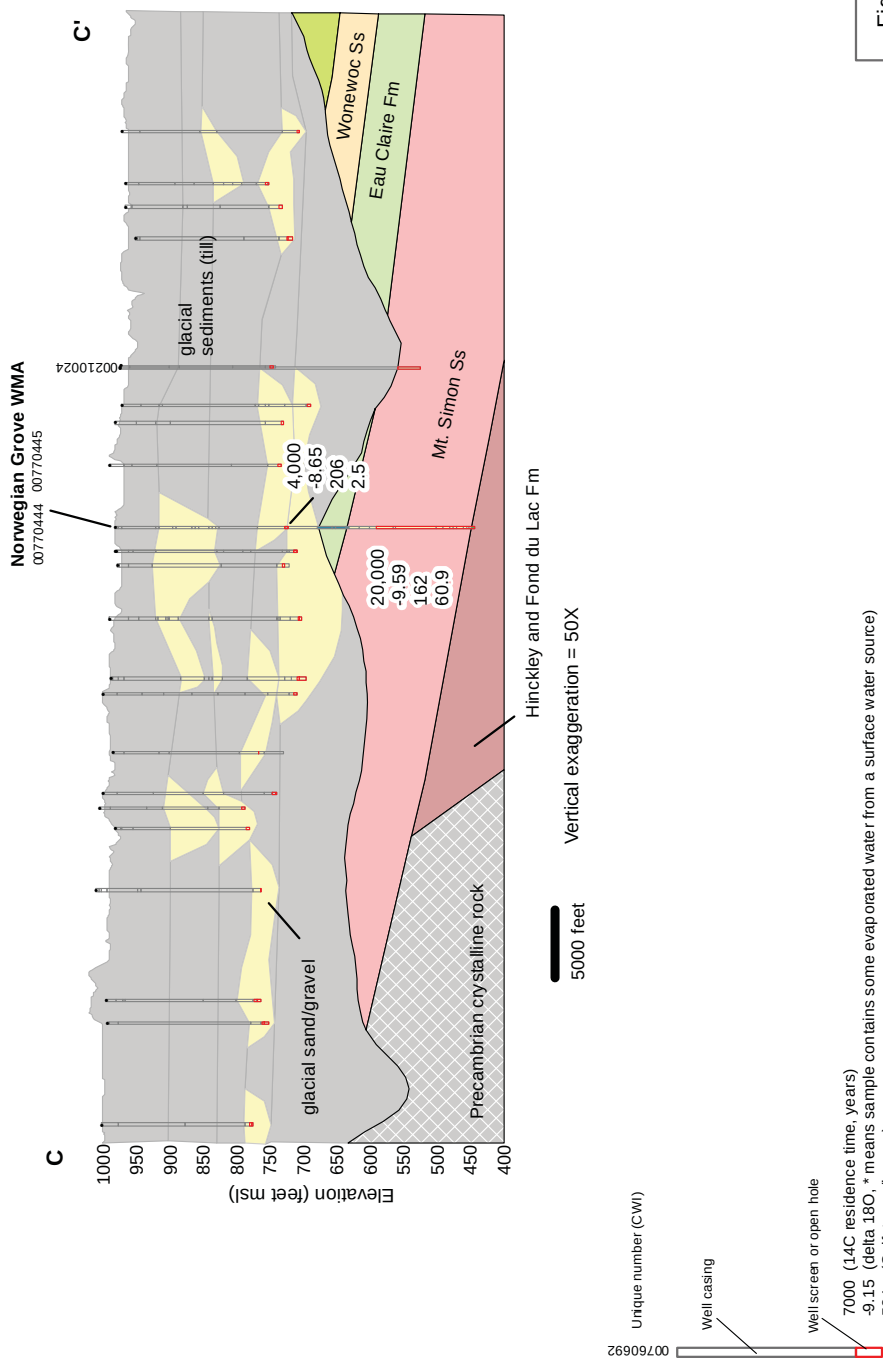


Figure 17a
Cross section C-C'

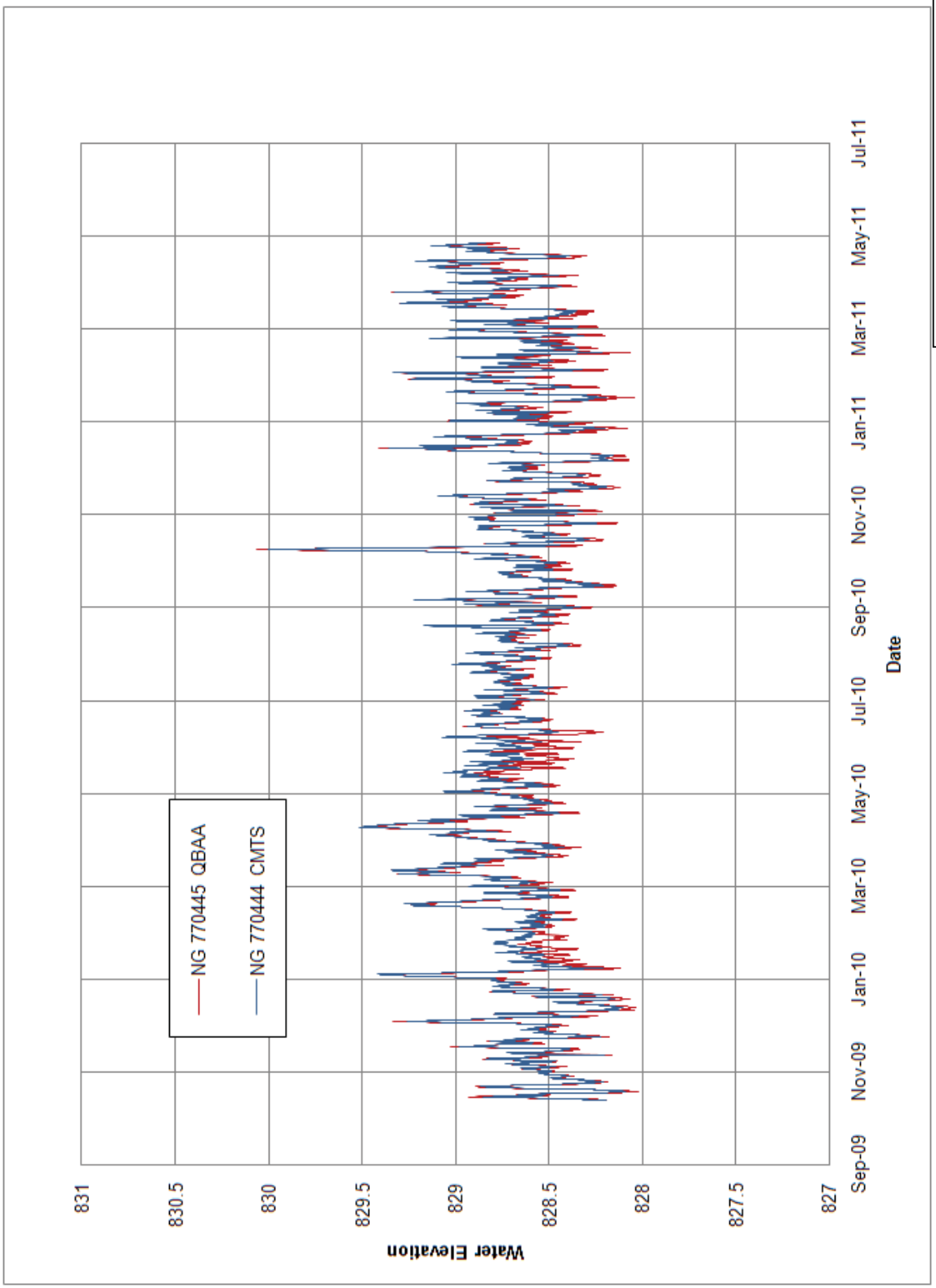


Figure 17b
Norwegian Grove WMA
Hydrograph

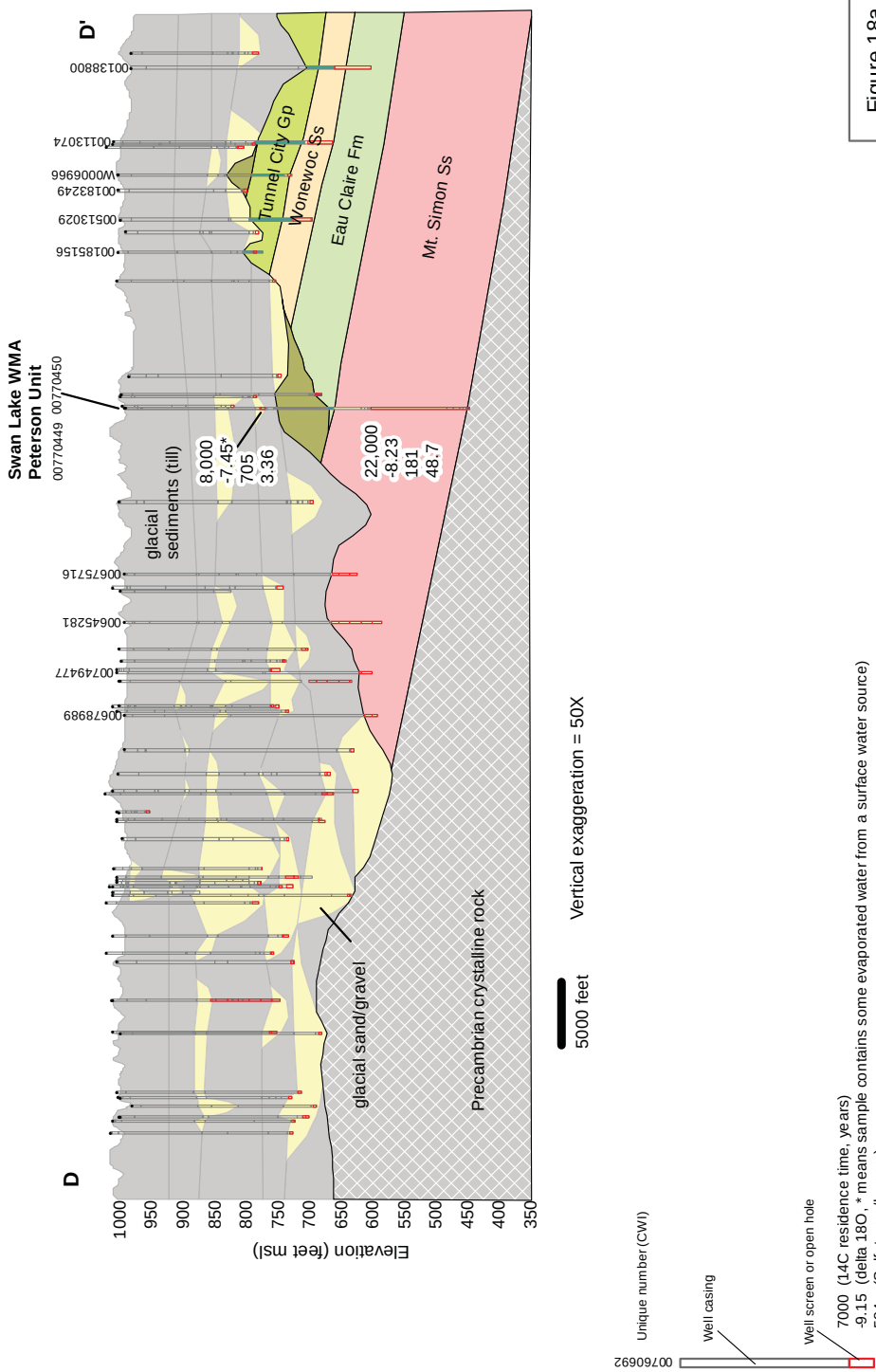


Figure 18a
Cross section D-D'

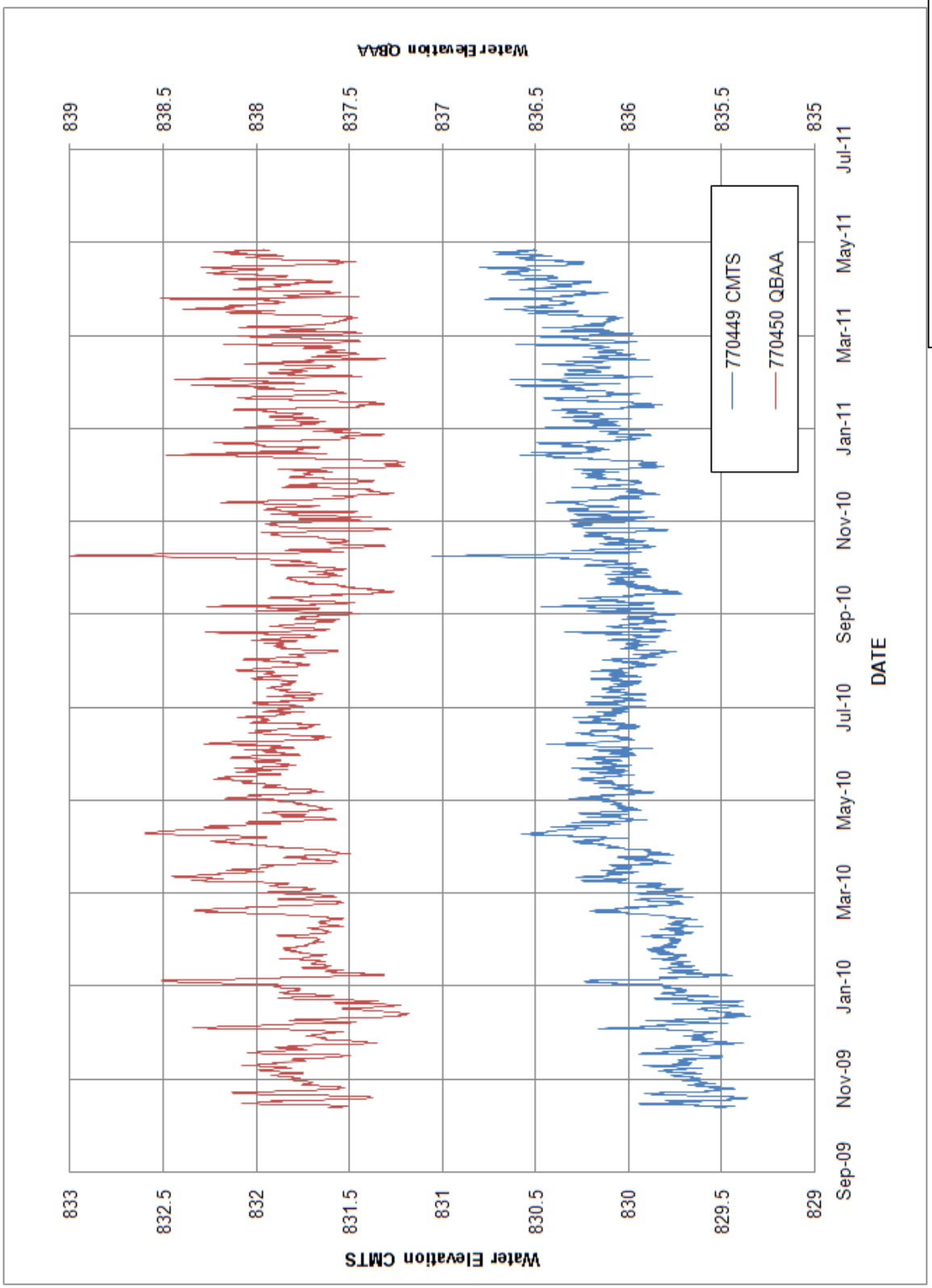


Figure 18b
Peterson Unit
Hydrograph

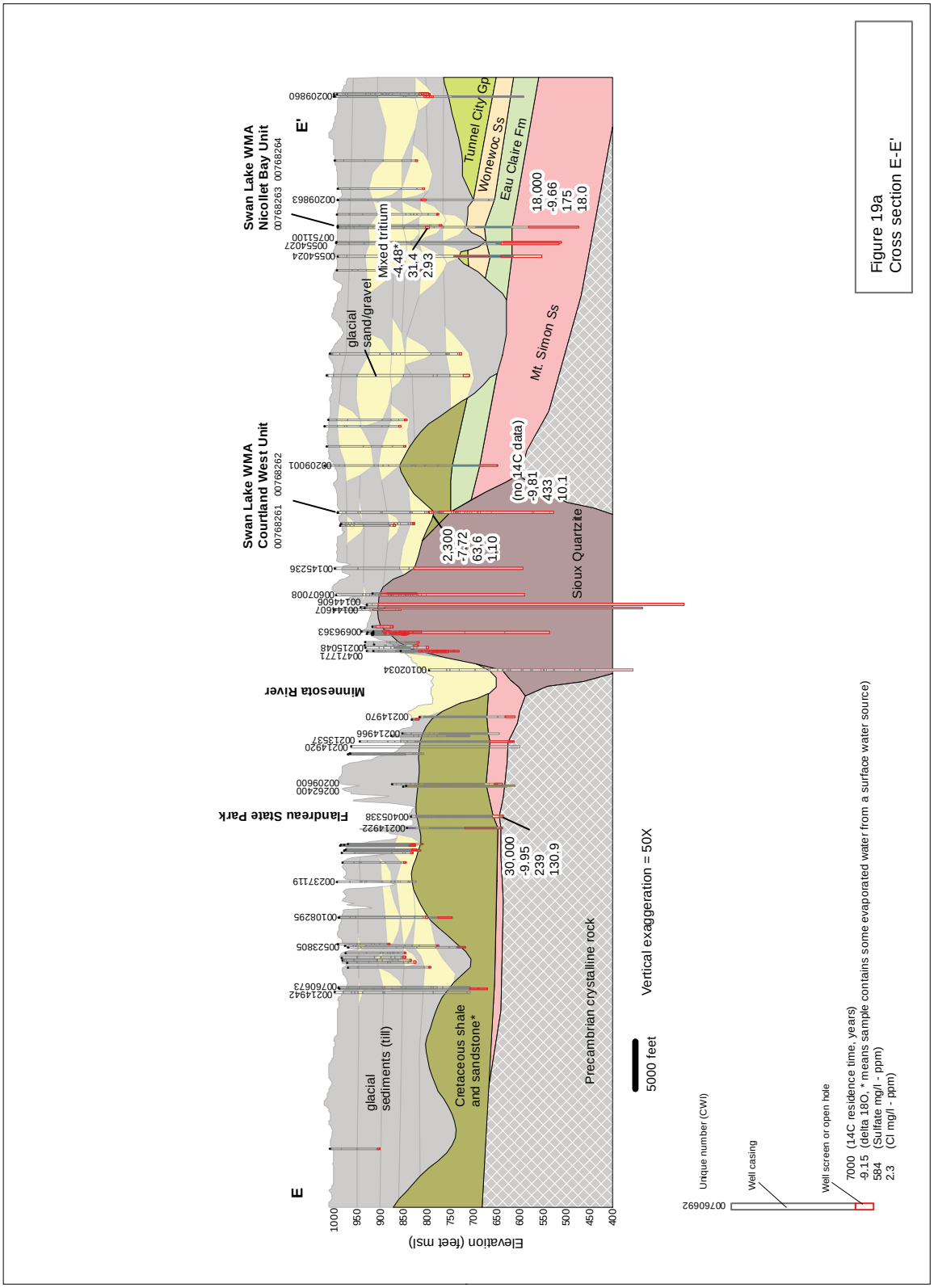


Figure 19a
Cross section E-E'

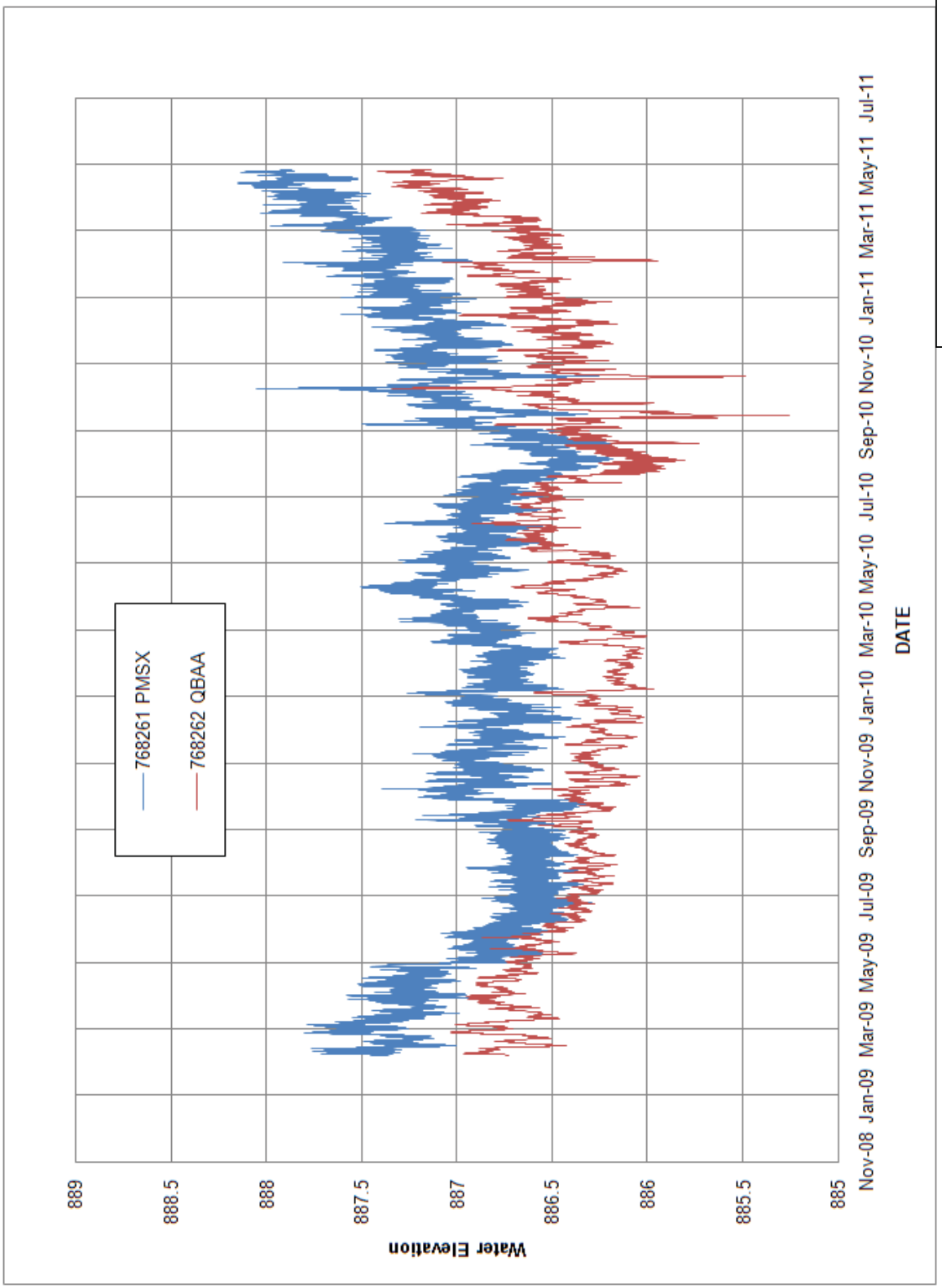


Figure 19b
Courtland West Unit
Hydrograph

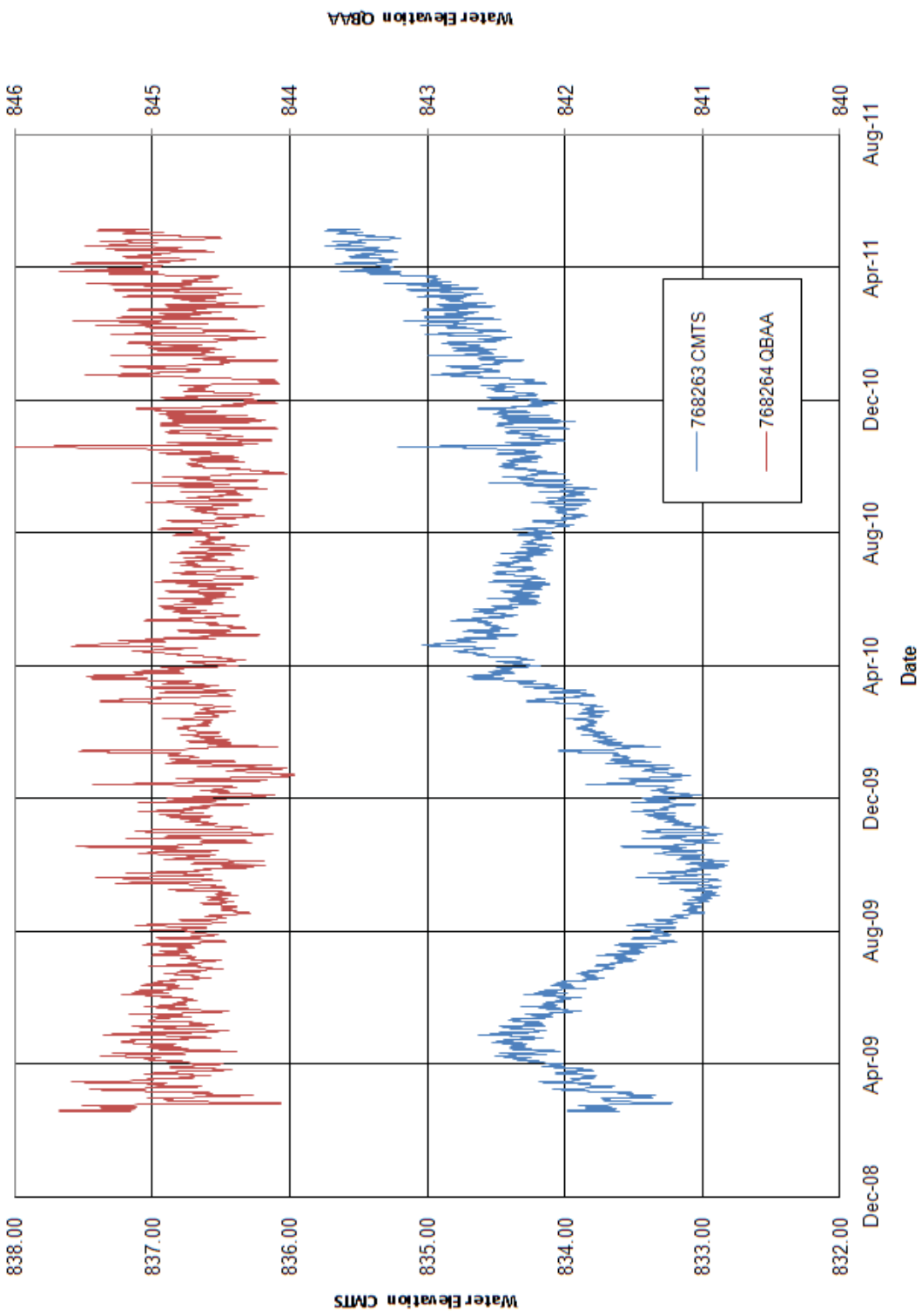


Figure 19c
Nicollet Bay Unit
Hydrograph

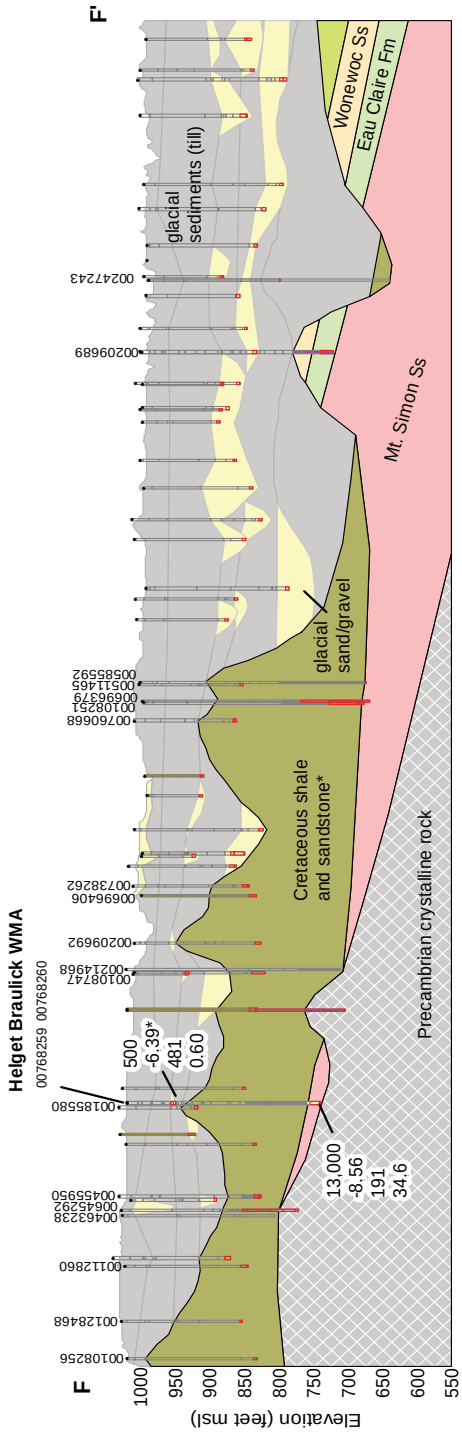


Figure 20a
Cross section F-F'

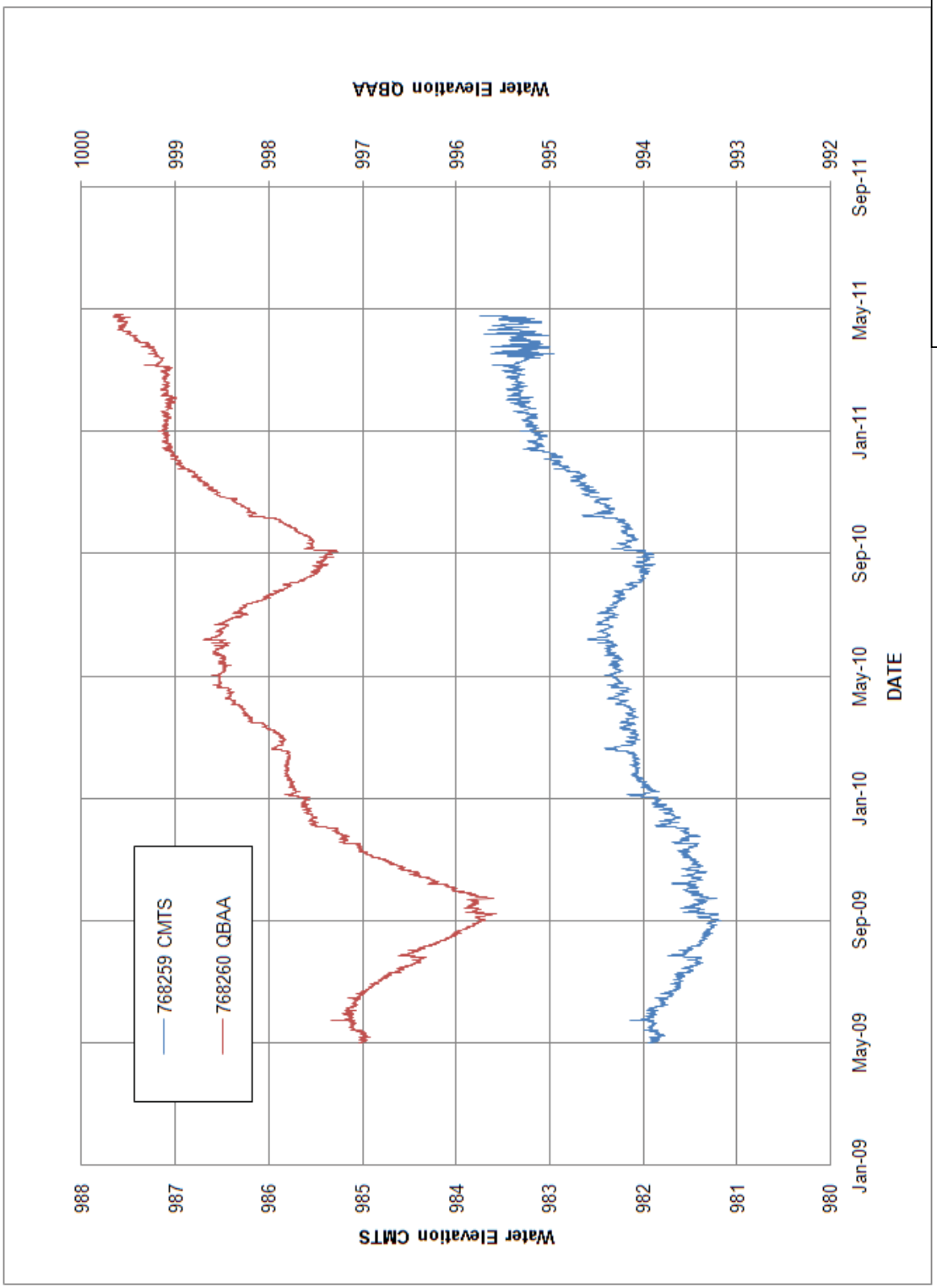


Figure 20b
Helget Braulick WMA
Hydrograph

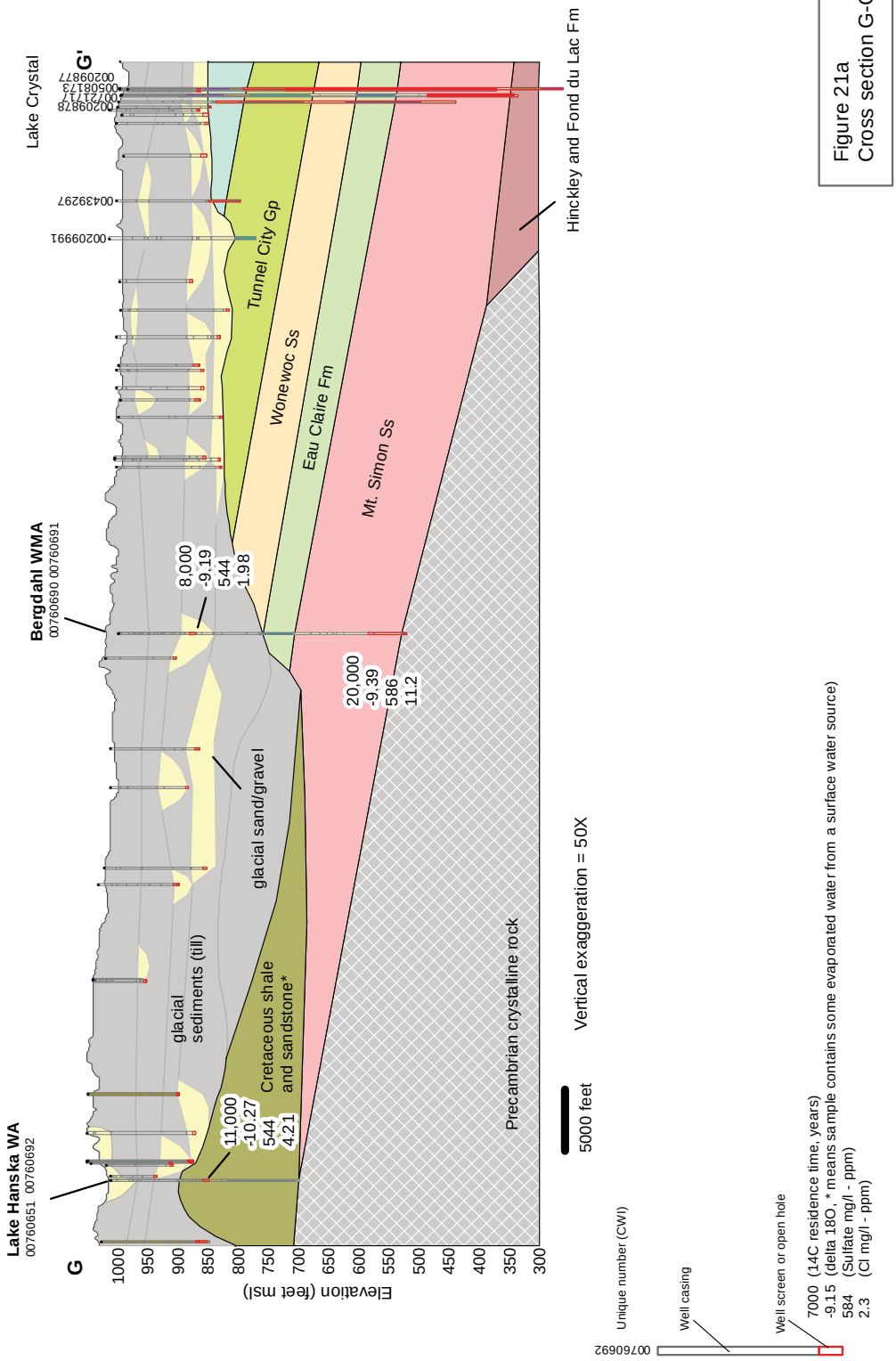


Figure 21a
Cross section G-G'

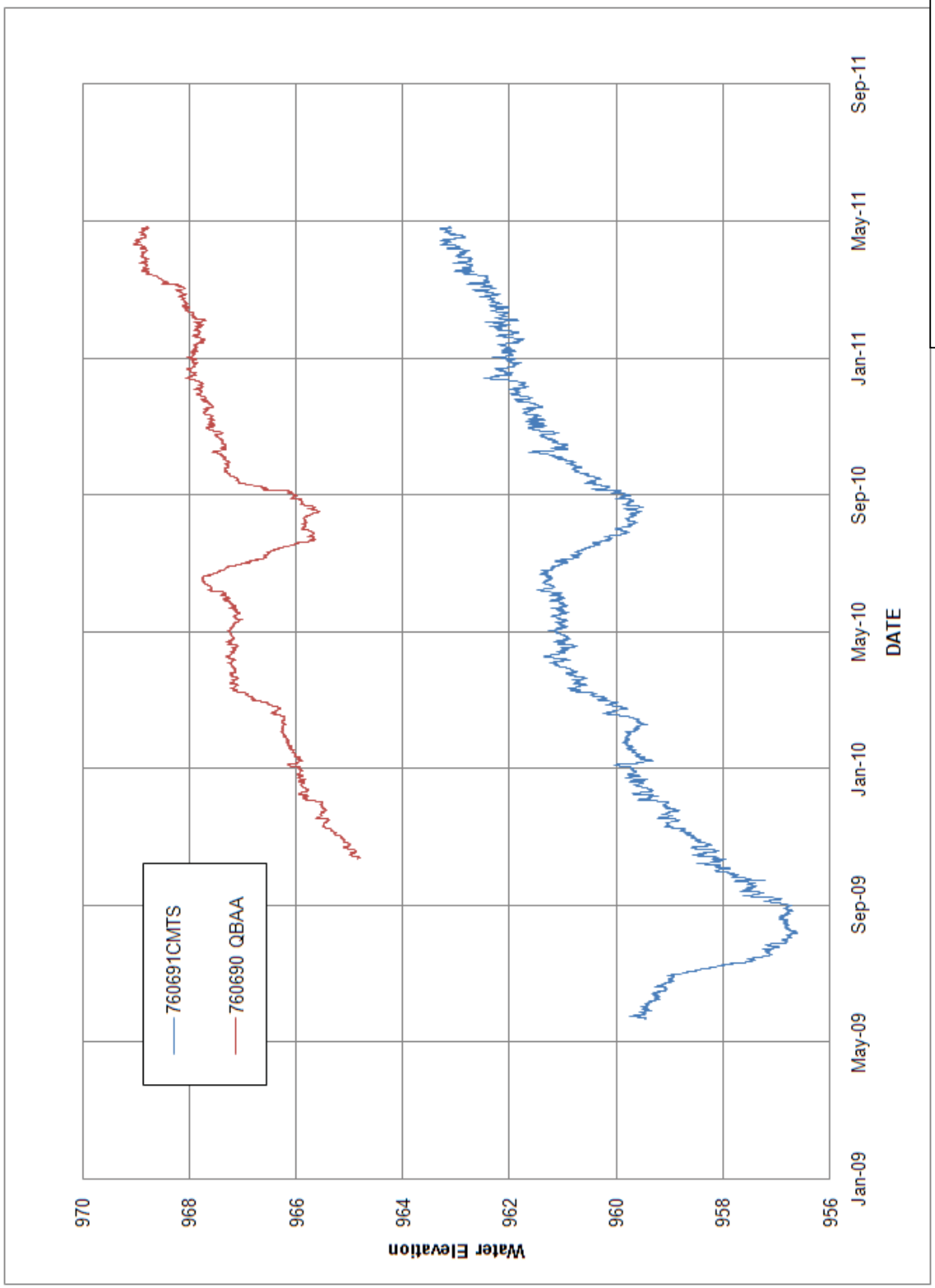


Figure 21b
Bergdahl WMA
Hydrograph

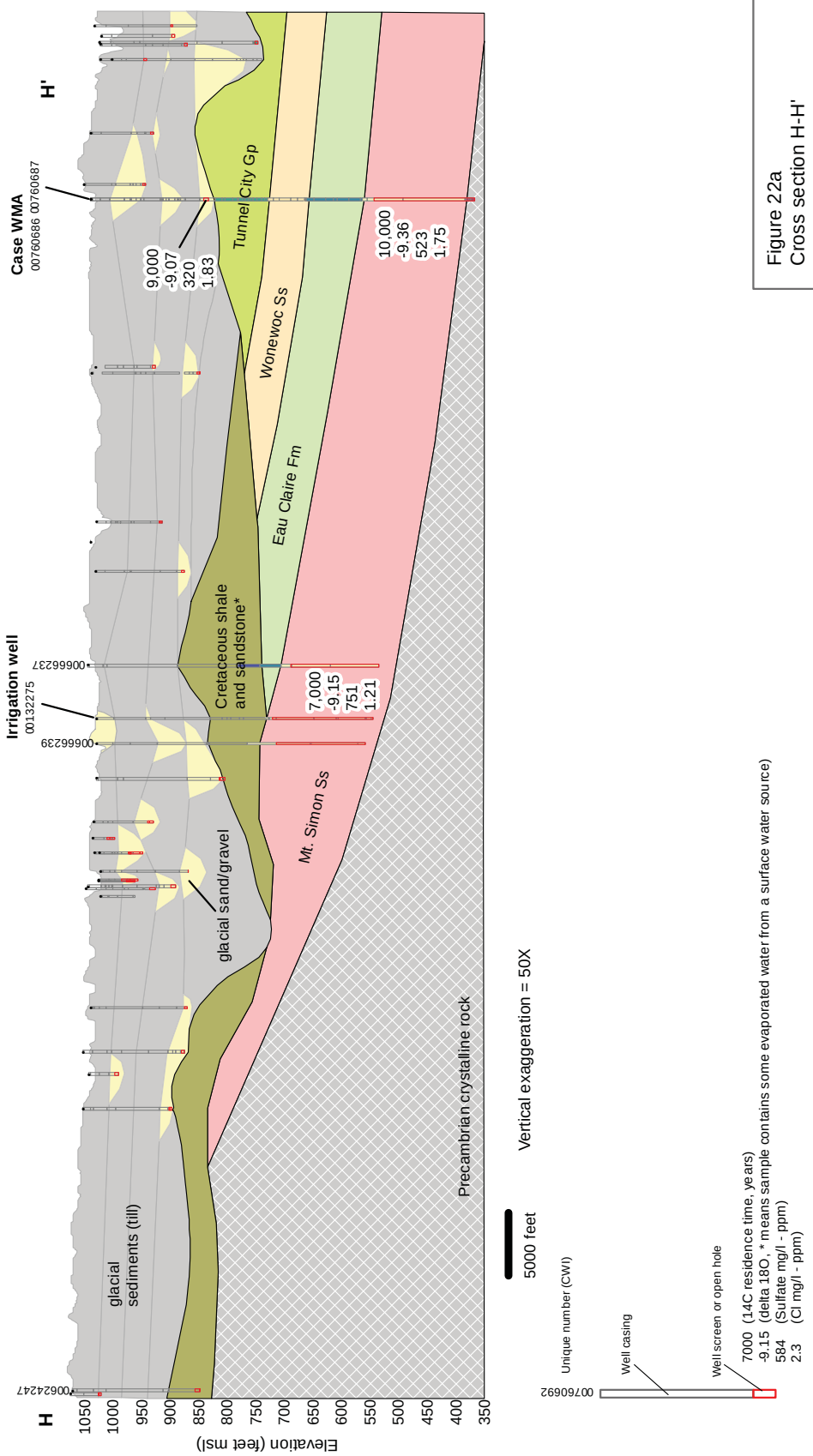


Figure 22a
Cross section H-H'

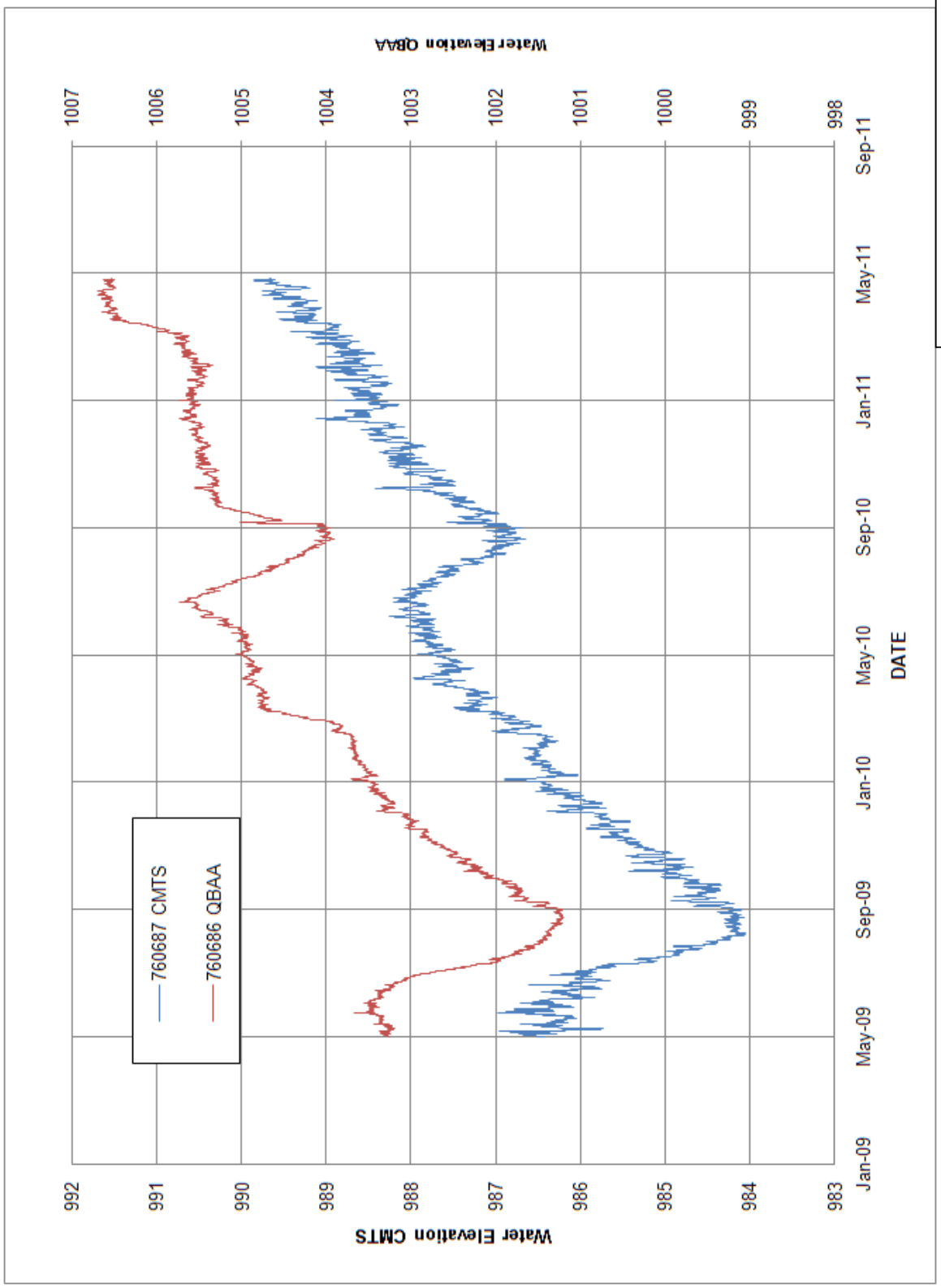


Figure 22b
Case WMA
Hydrograph

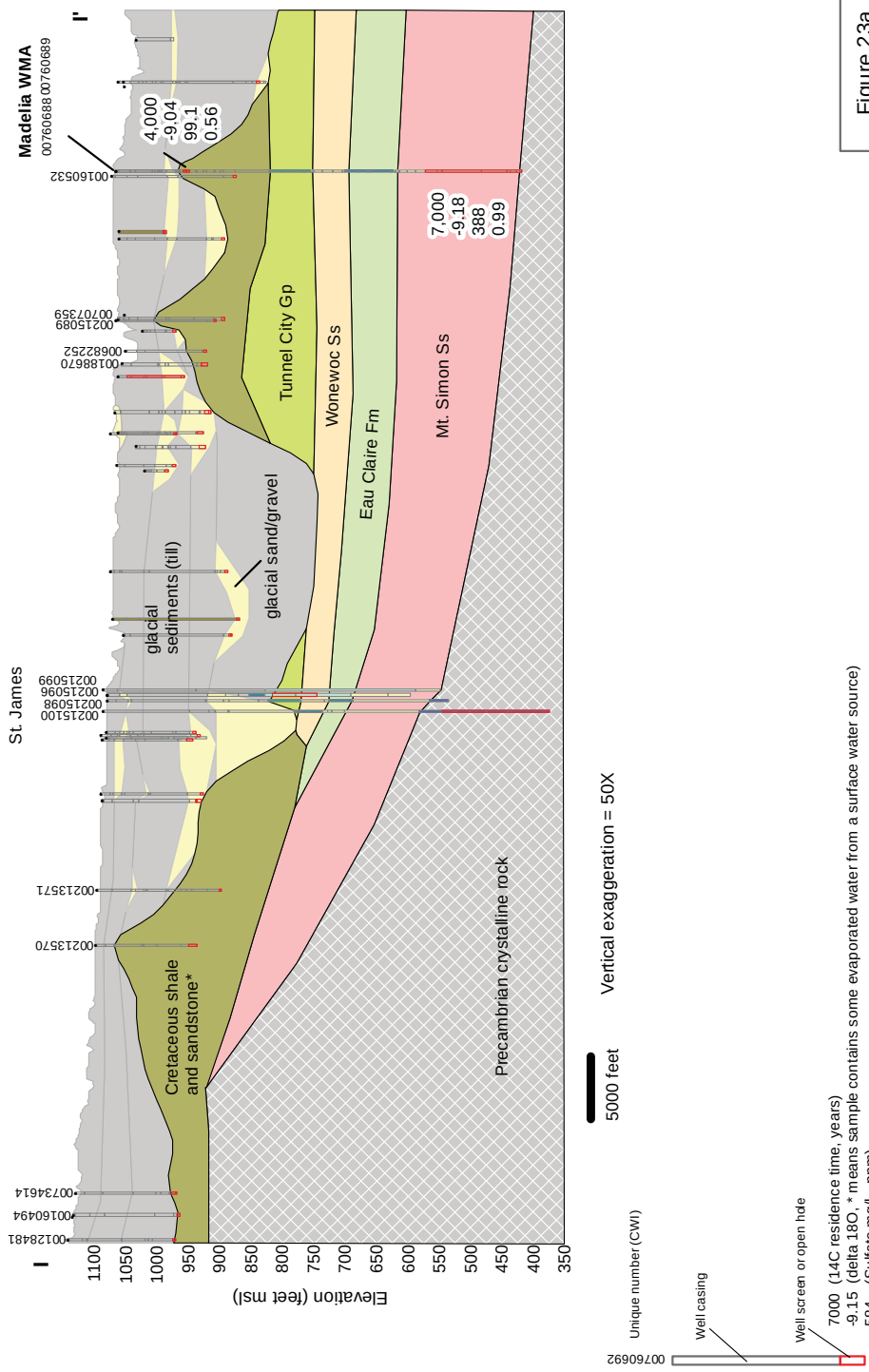


Figure 23a
Cross section I-I'

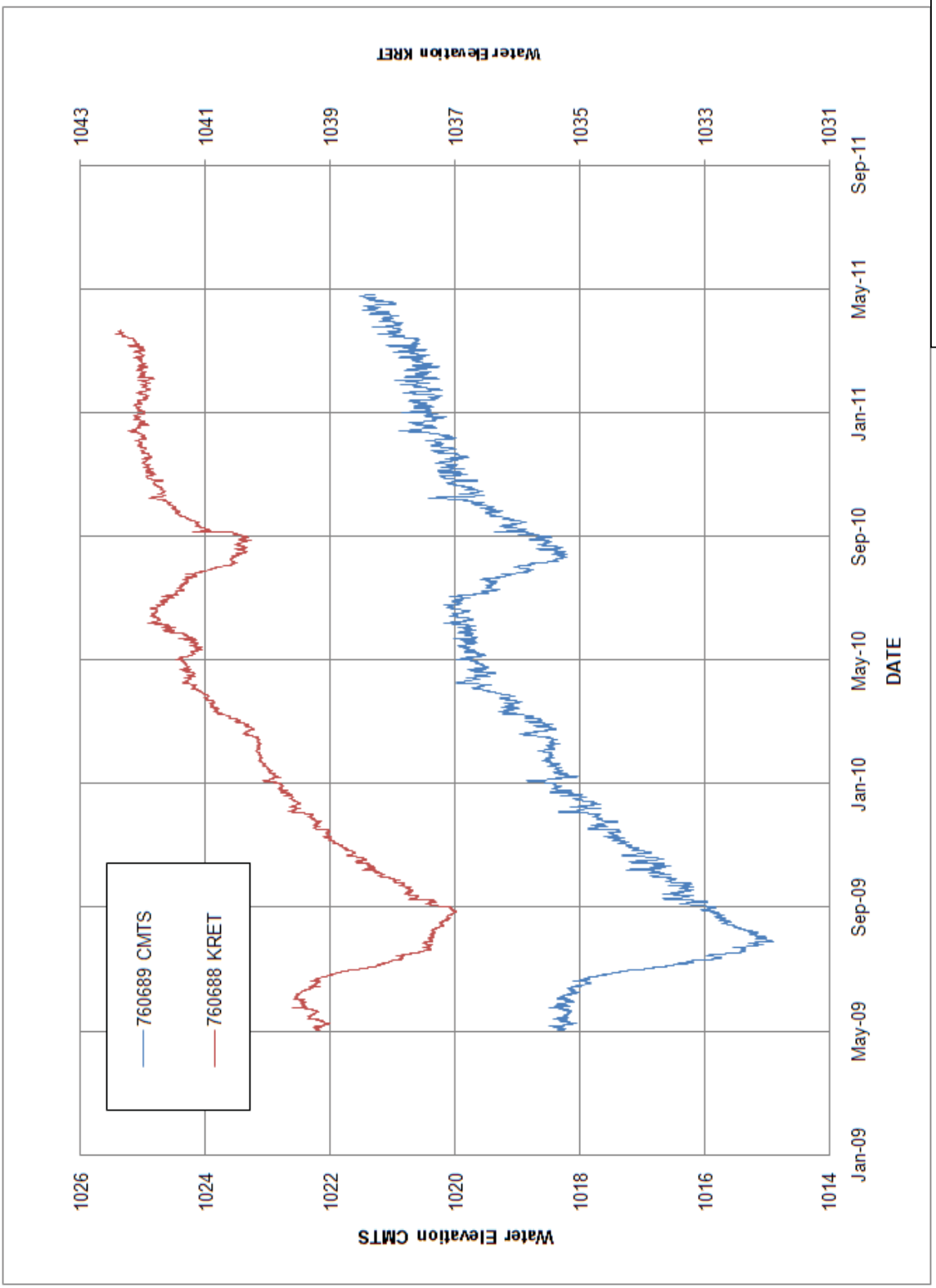


Figure 23b
Madelia WMA
Hydrograph

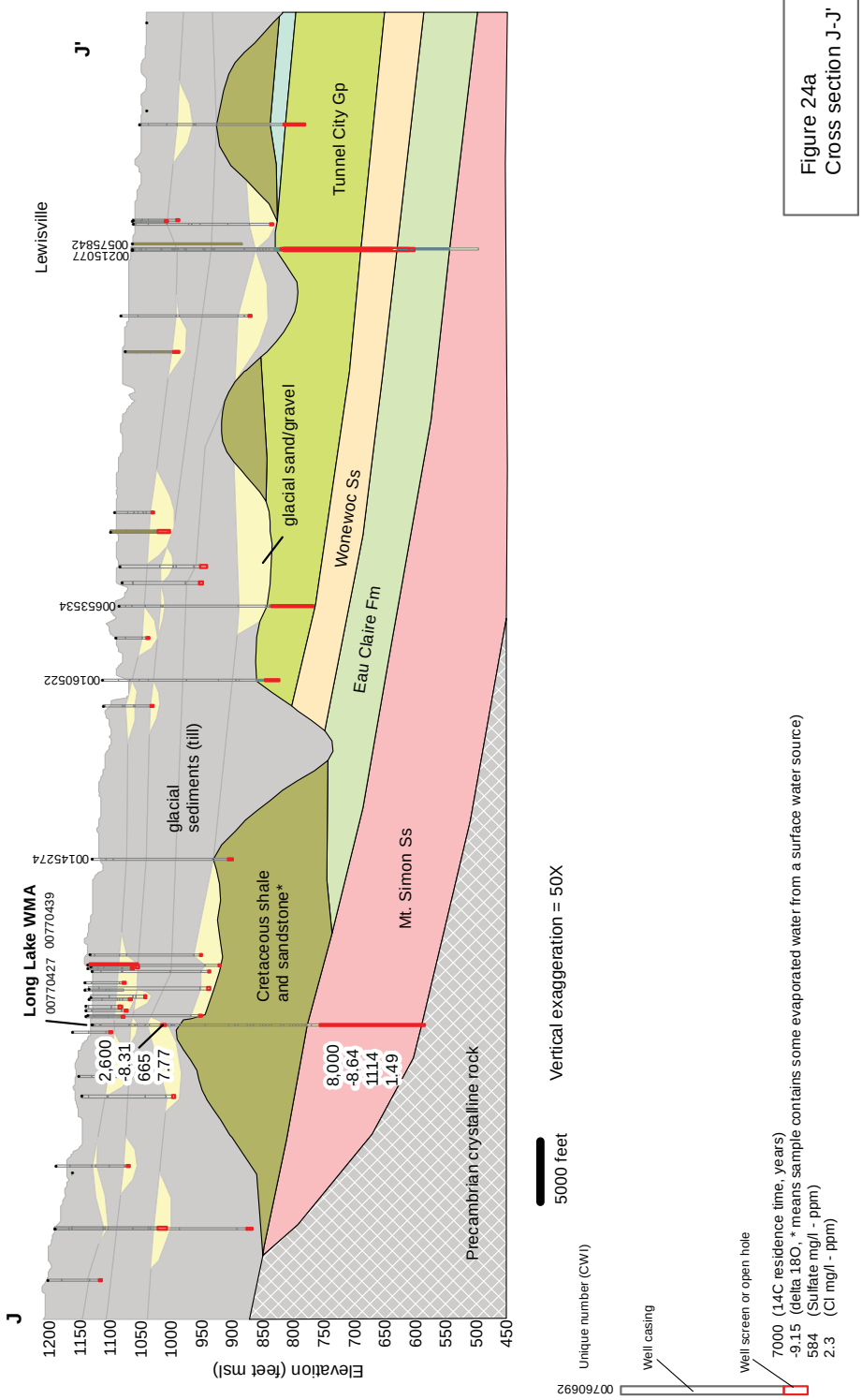


Figure 24a
Cross section J-J'

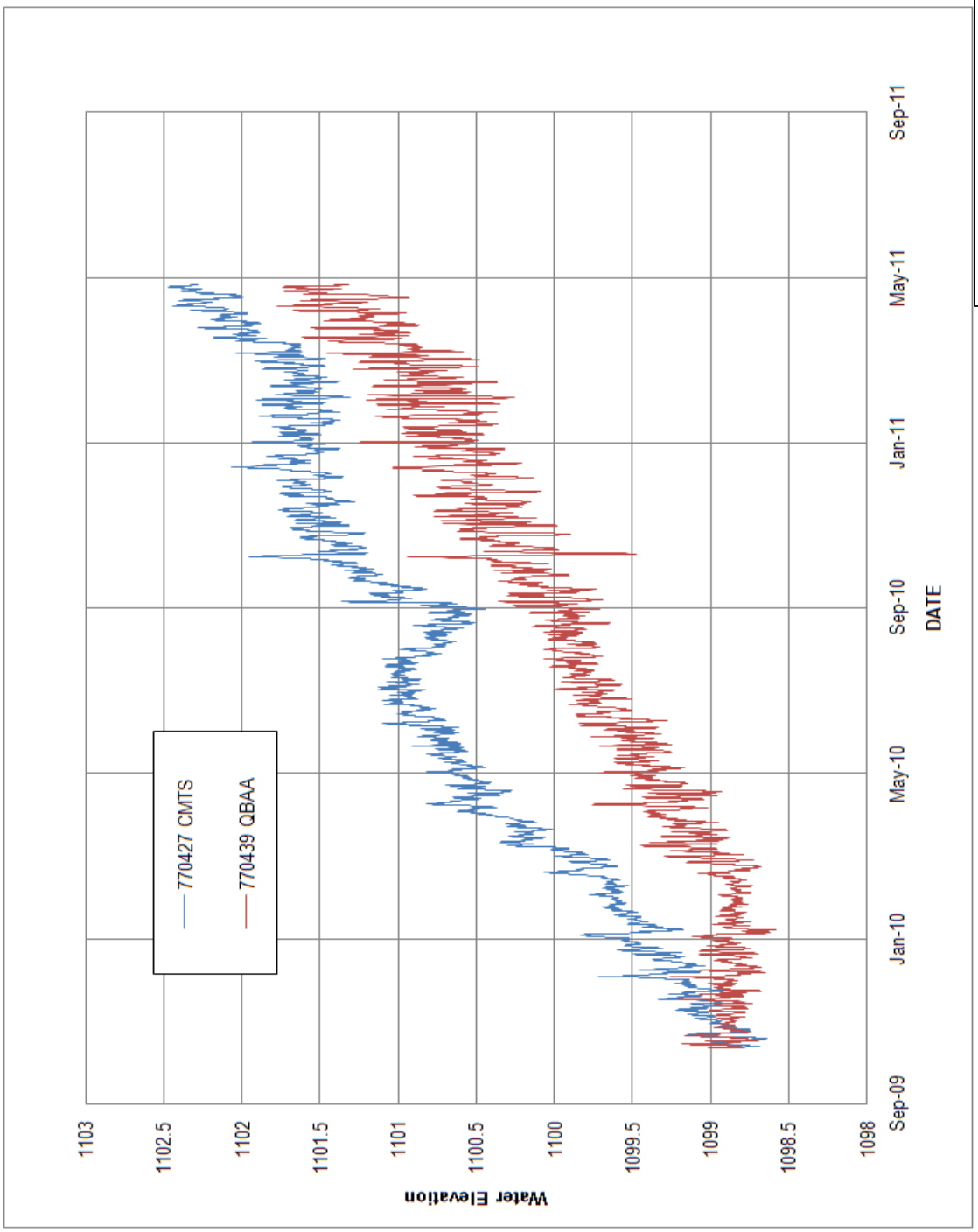


Figure 24b
Long Lake WA
Hydrograph

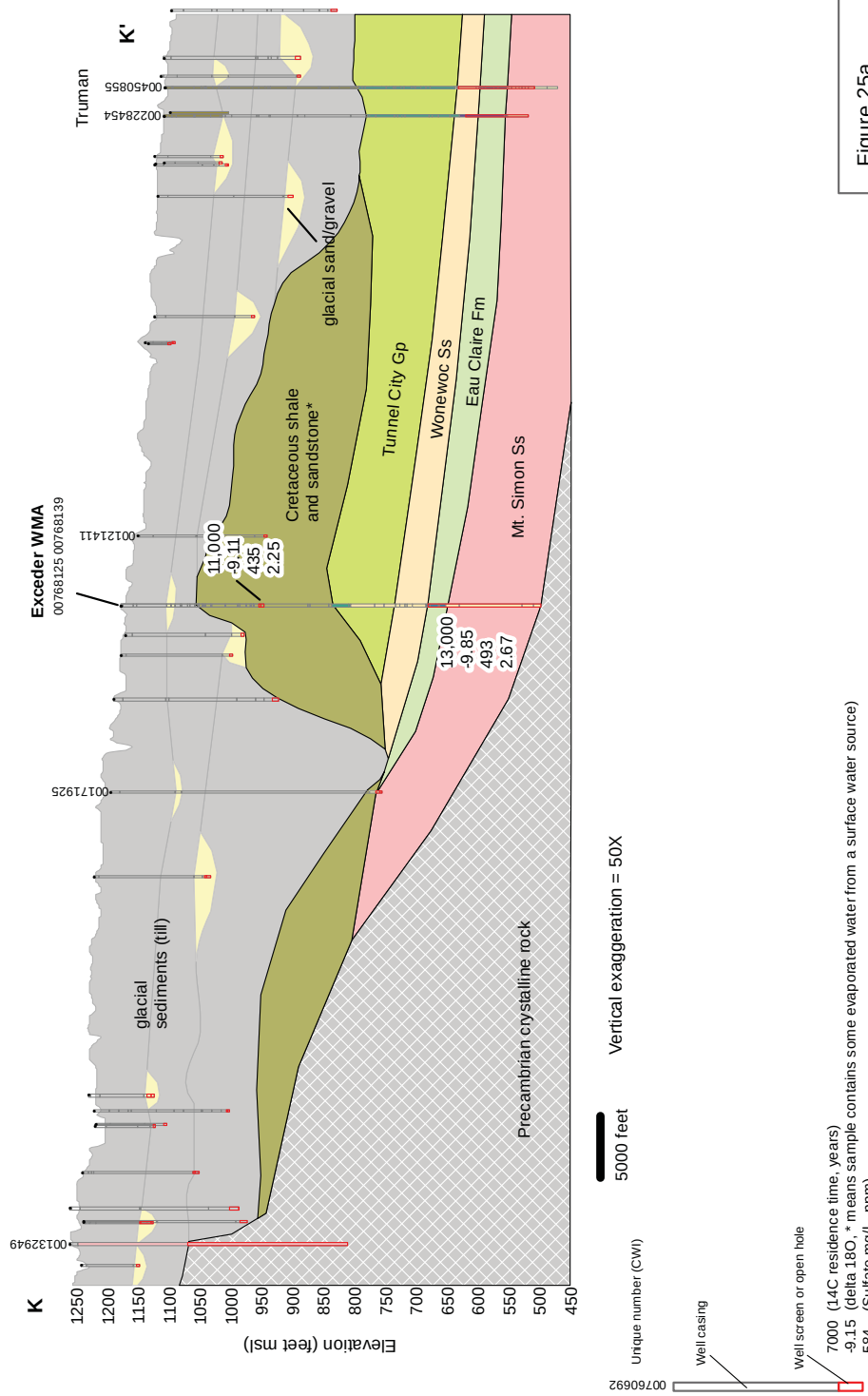


Figure 25a
Cross section K-K'

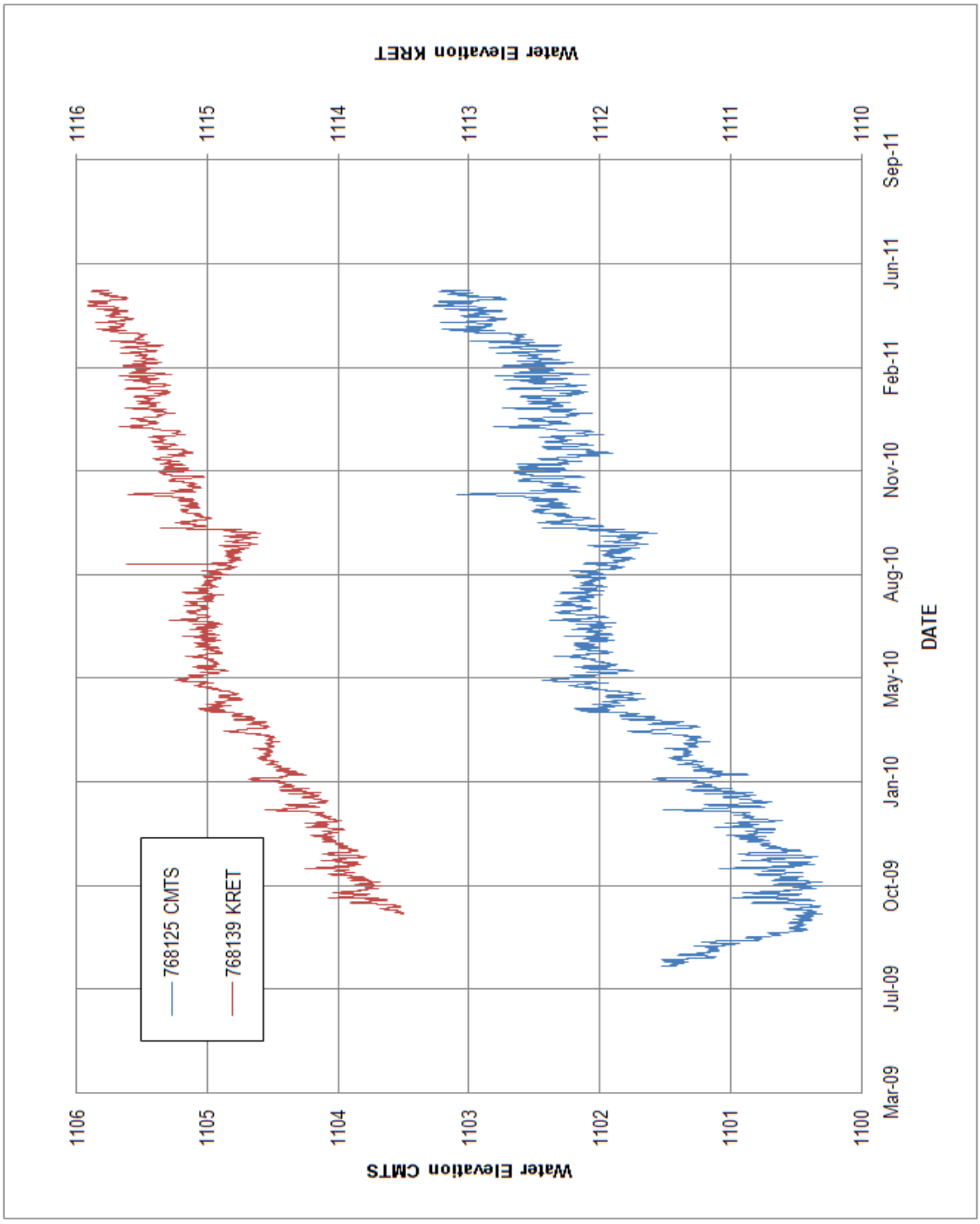


Figure 25b
Exceder WMA
Hydrograph

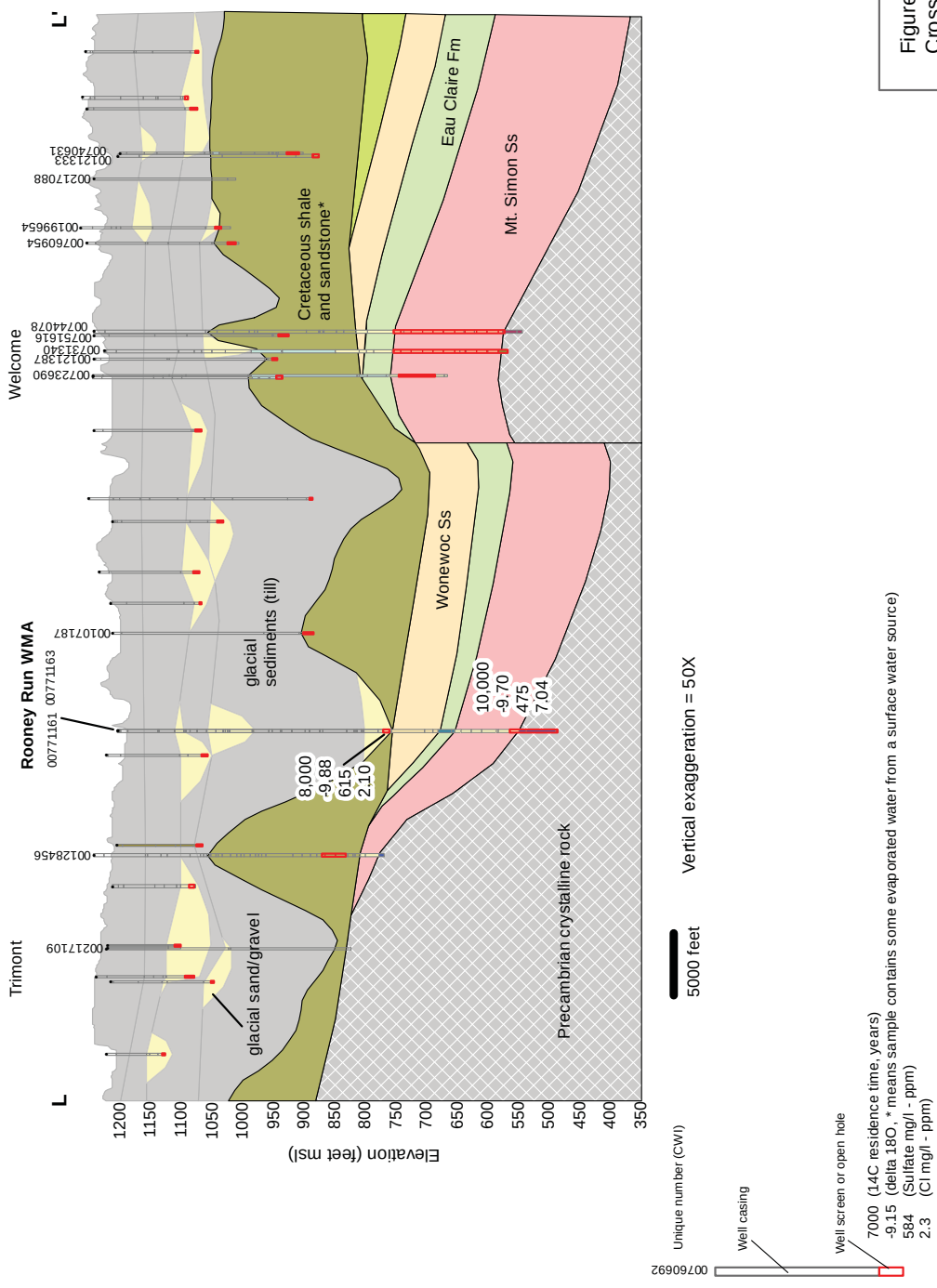


Figure 26a
Cross section L-L'

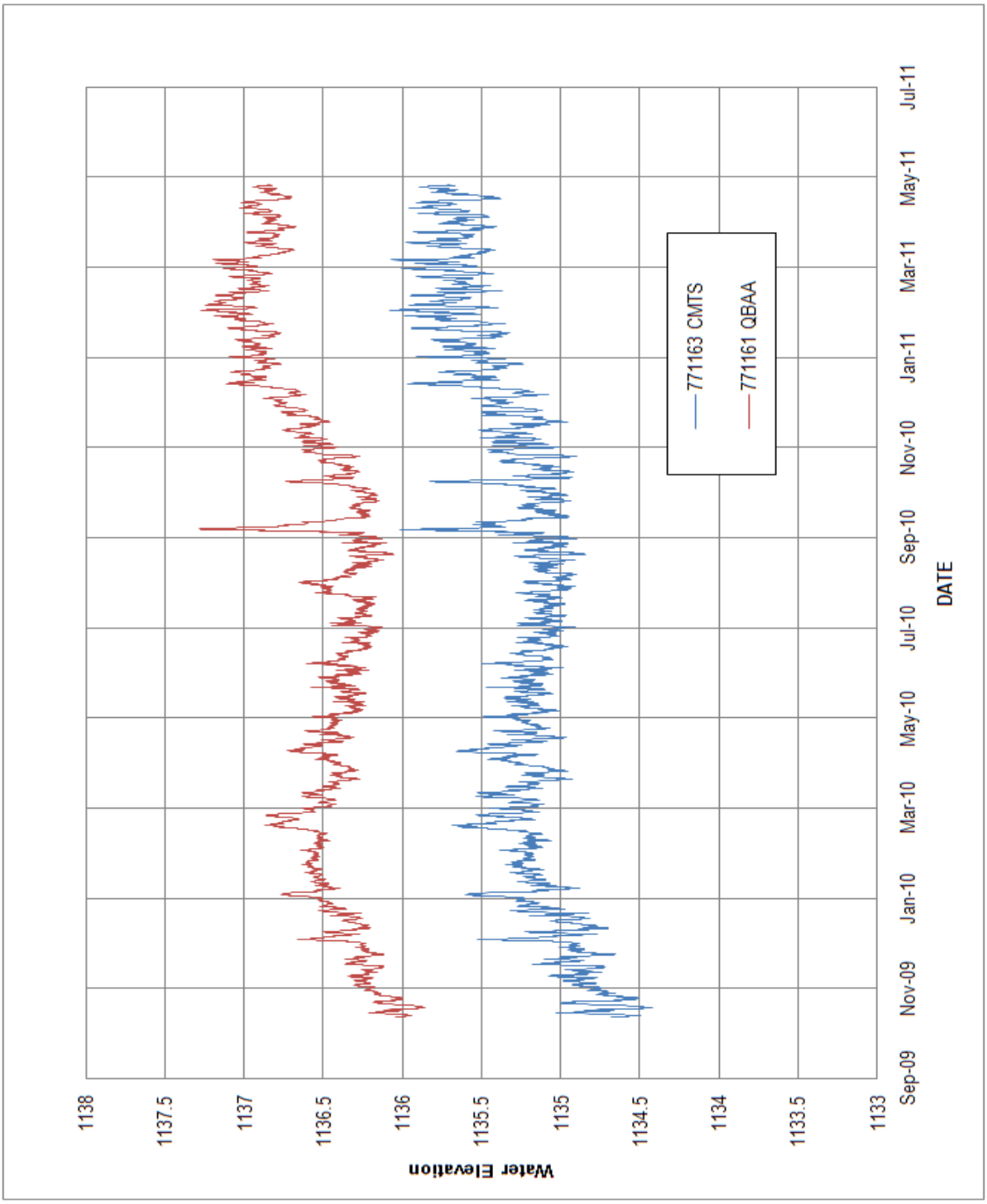


Figure 26b
Rooney Run WMA
Hydrograph

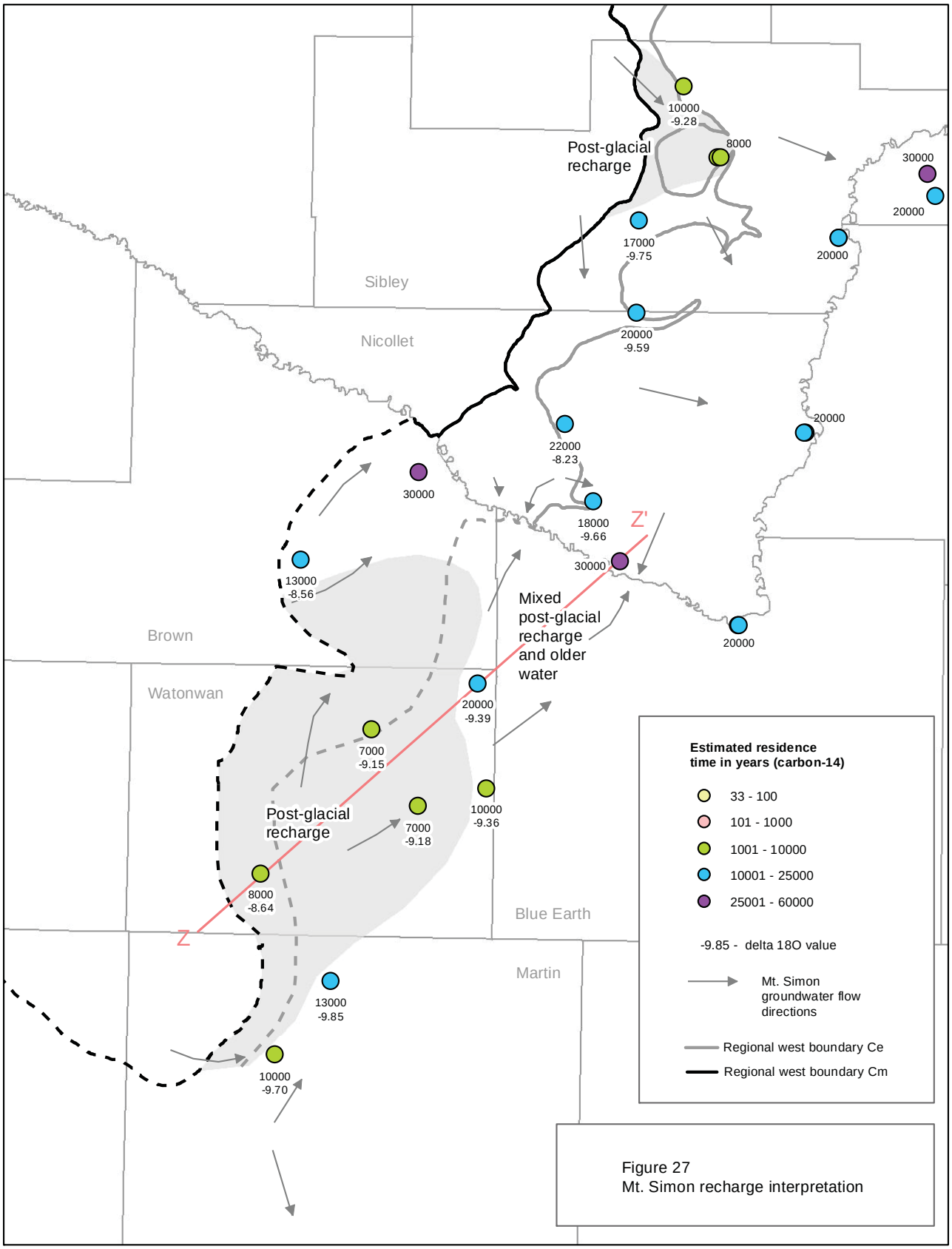


Figure 27
Mt. Simon recharge interpretation

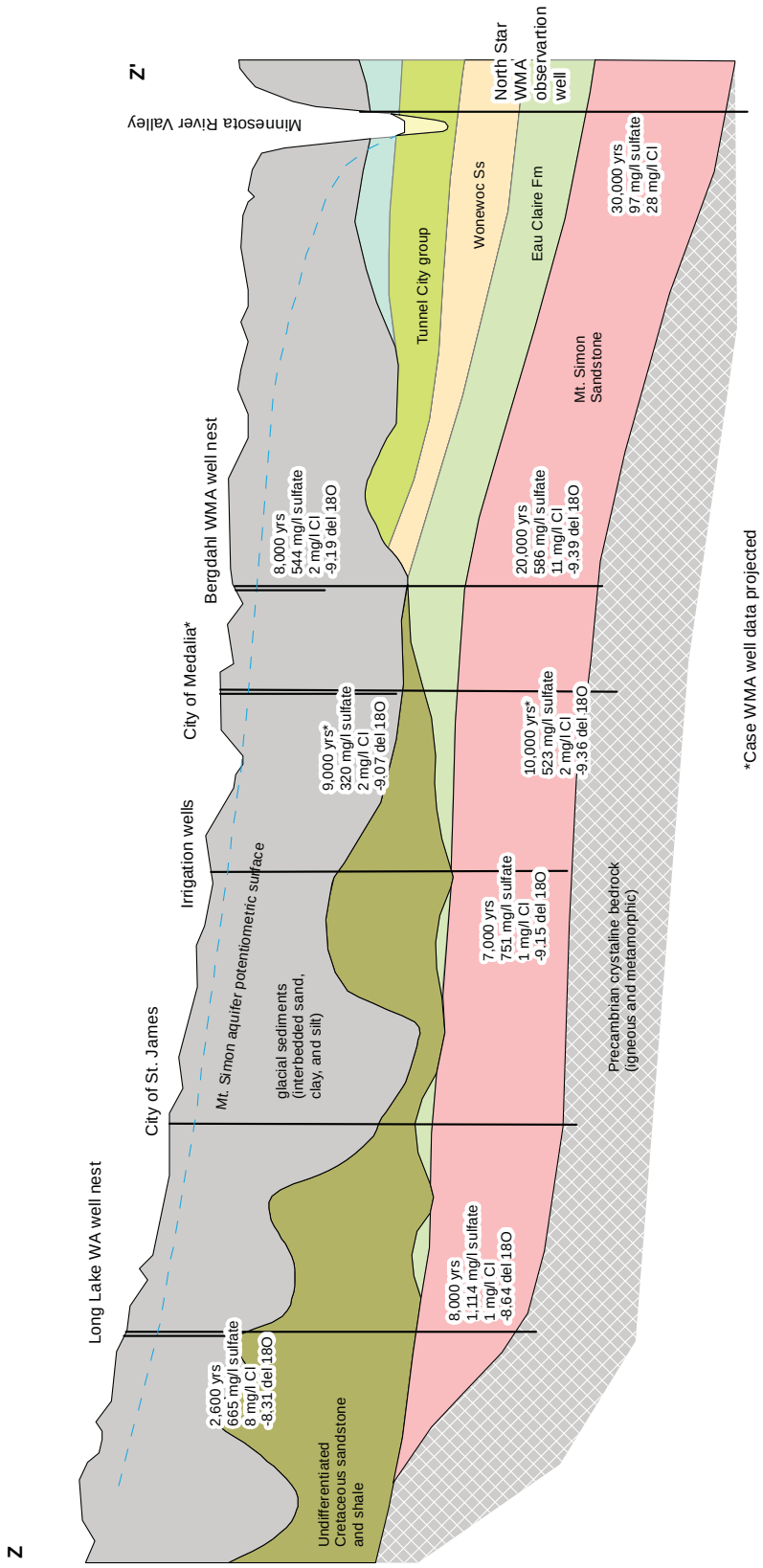


Figure 28
Generalized cross section Z-Z' and selected geochemical data

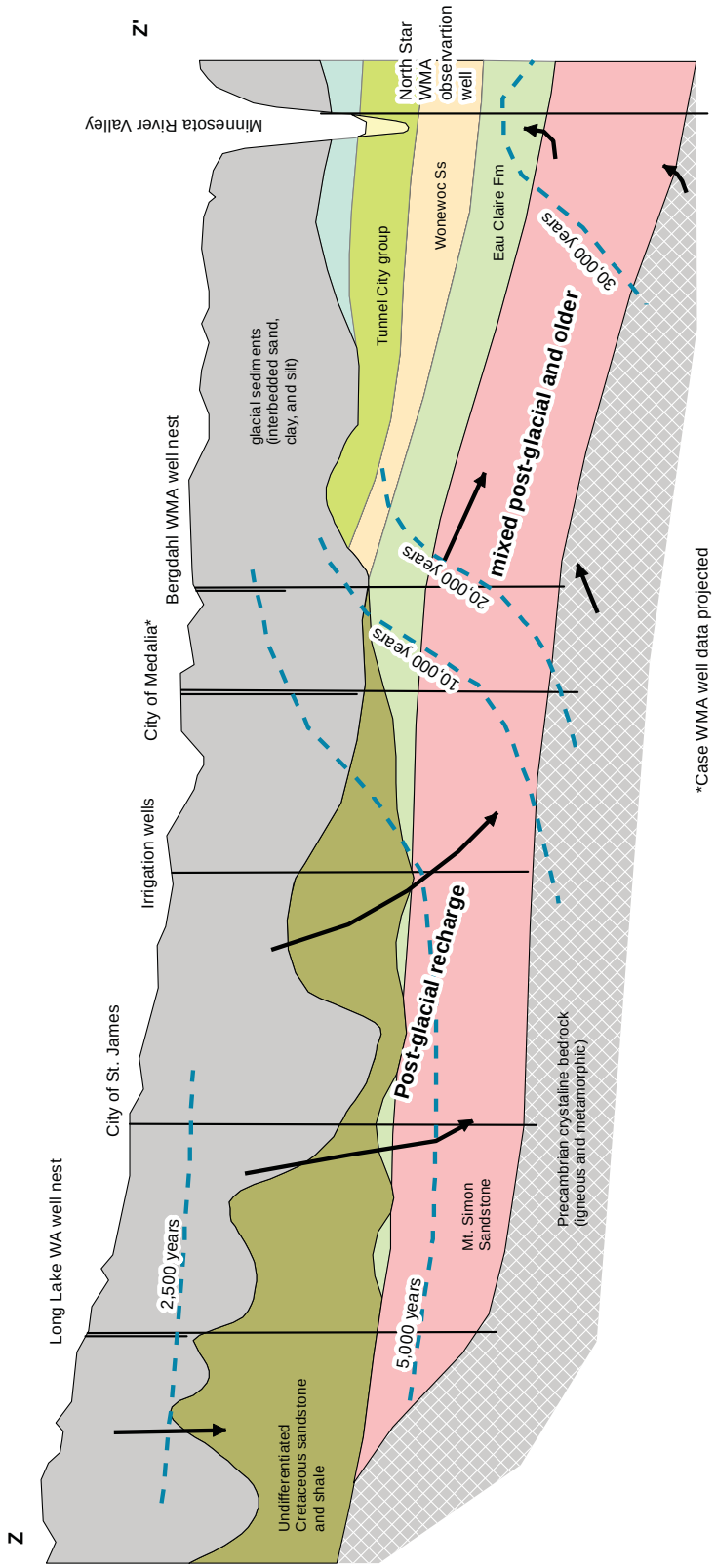


Figure 29 Cross section Z-Z'
Mt. Simon recharge and discharge

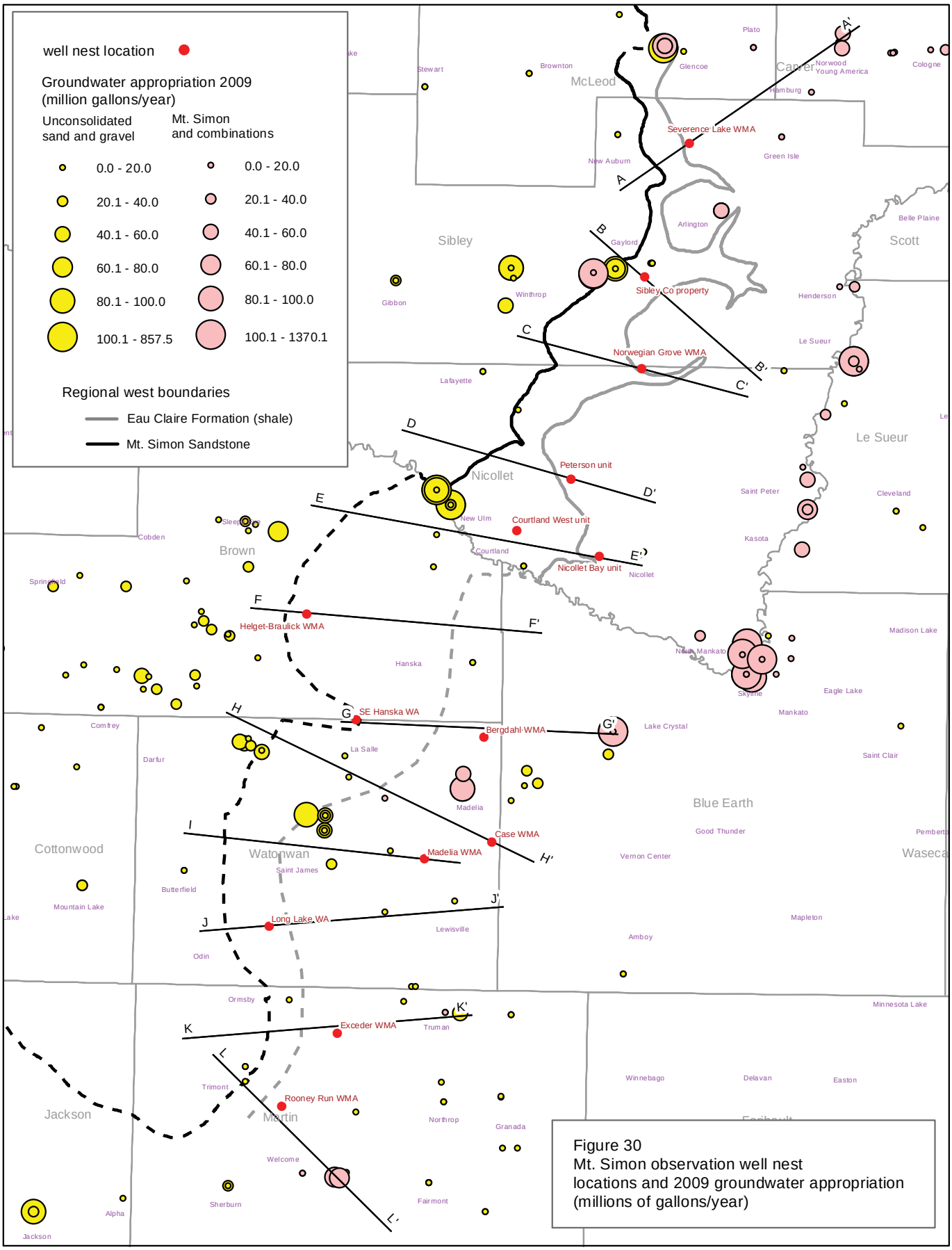
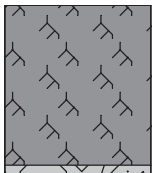
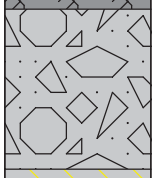
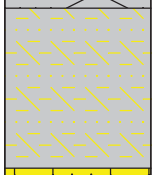
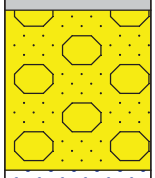
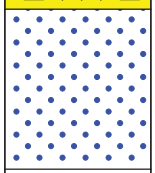
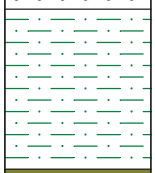
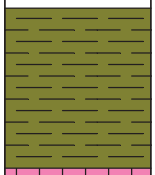
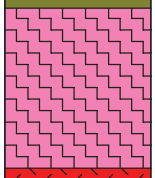


Figure 30
Mt. Simon observation well nest locations and 2009 groundwater appropriation (millions of gallons/year)

Appendix A

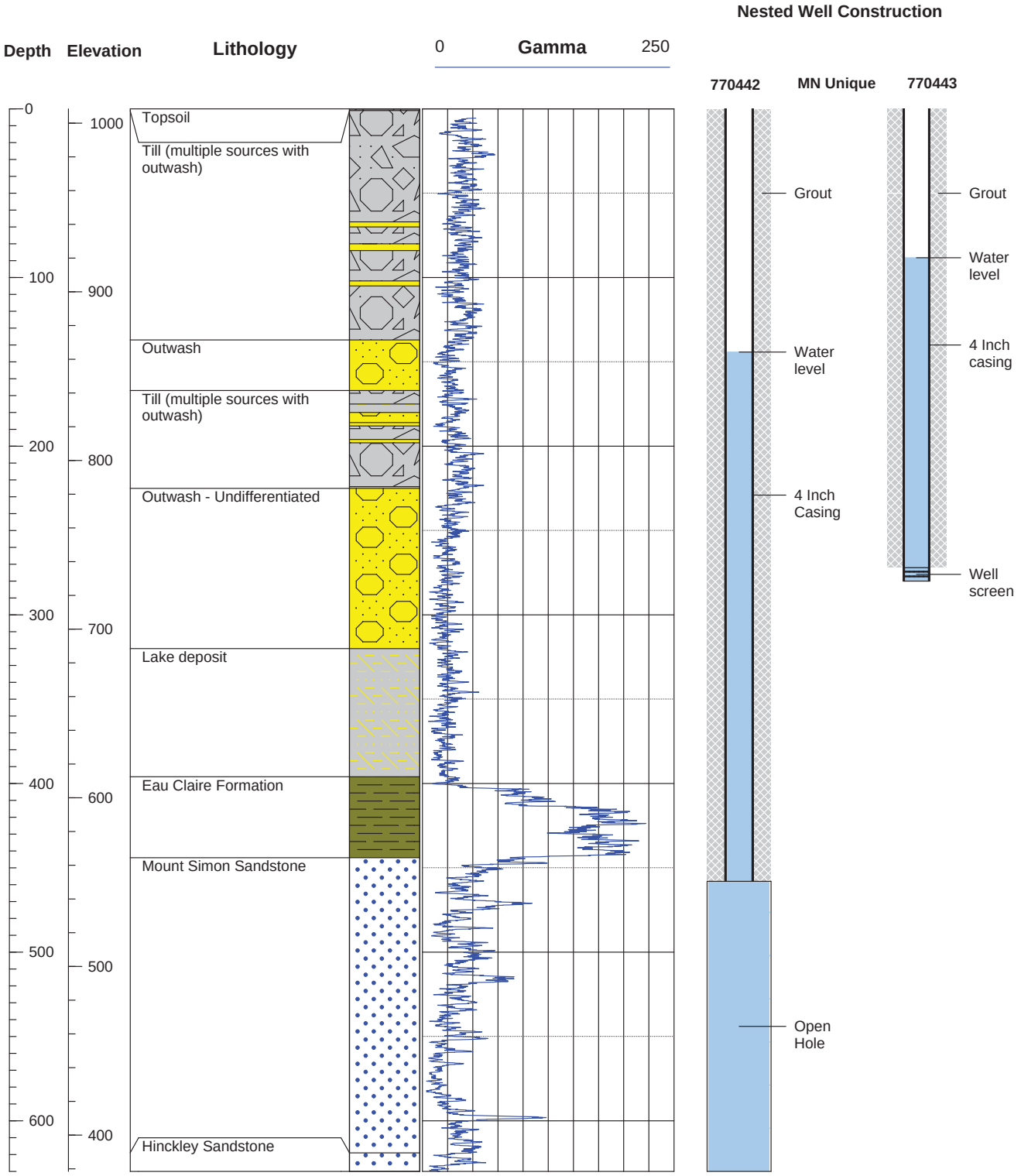
Geological Log Legend

Lithologic Description	Lithologic Symbol
Top Soil	
Till	
Lake Deposit	
Outwash	
Sandstone	
Sandstone and shale	
Shale	
Quartzite	
Igneous or metamorphic bedrock	

Geological / Geophysical Logs and Well Construction Diagrams

Site Name Severance Lake WMA

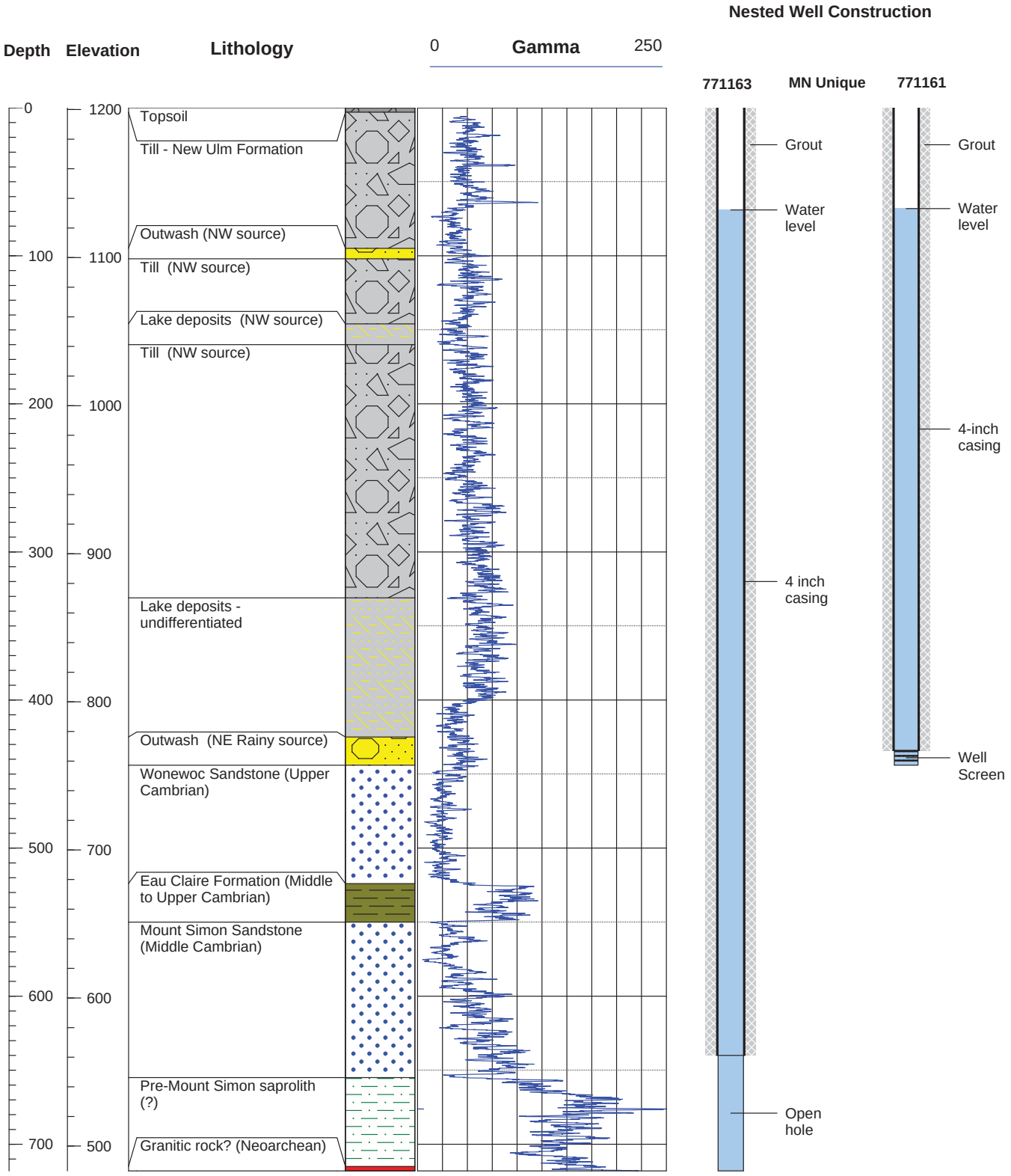
County Sibley



Geological / Geophysical Logs and Well Construction Diagrams

Site Name Rooney Run WMA

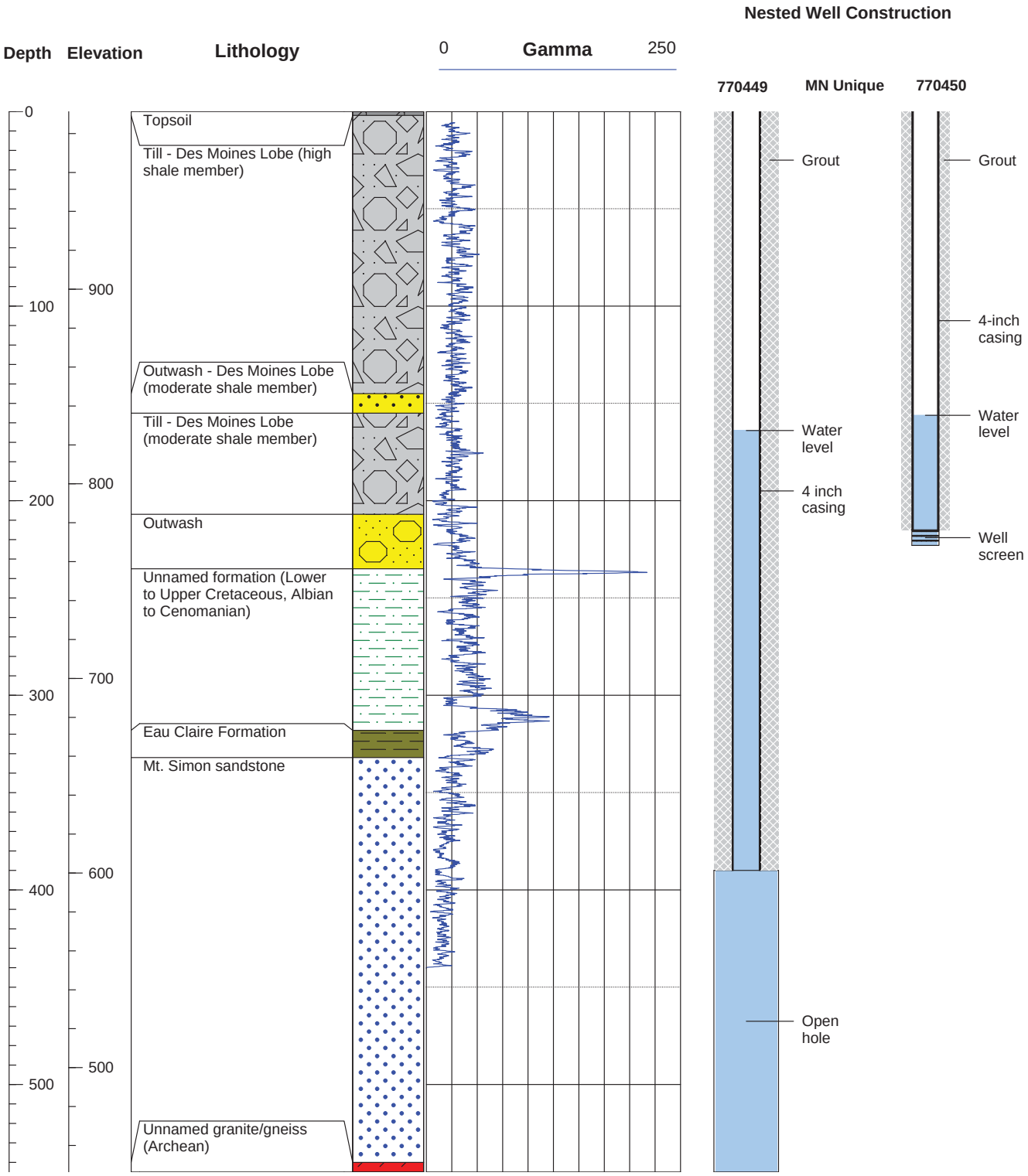
County Martin



Geological / Geophysical Logs and Well Construction Diagrams

Site Name Swan Lake WMA Peterson Unit

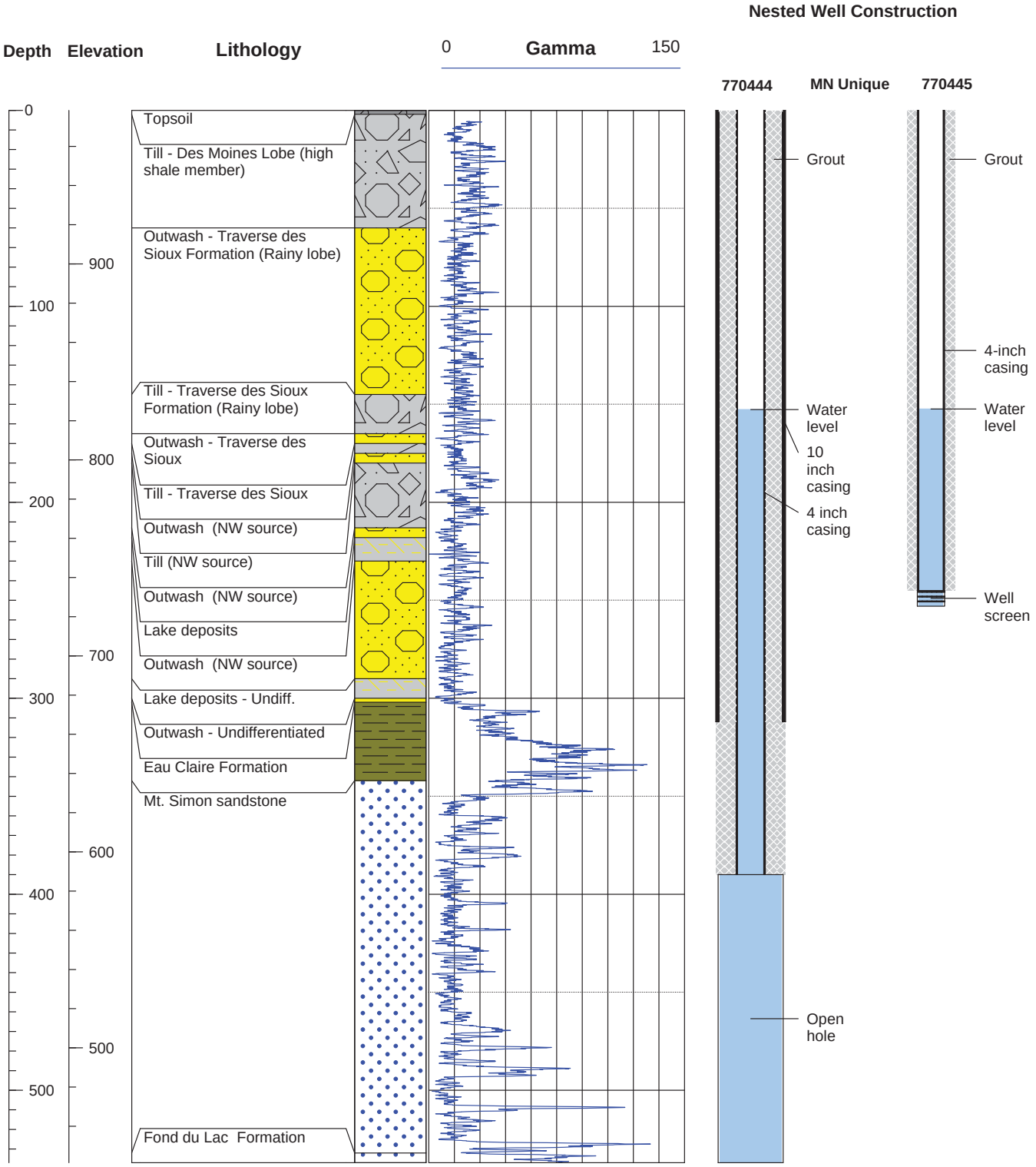
County Nicollet



Geological / Geophysical Logs and Well Construction Diagrams

Site Name Norwegian Grove WMA

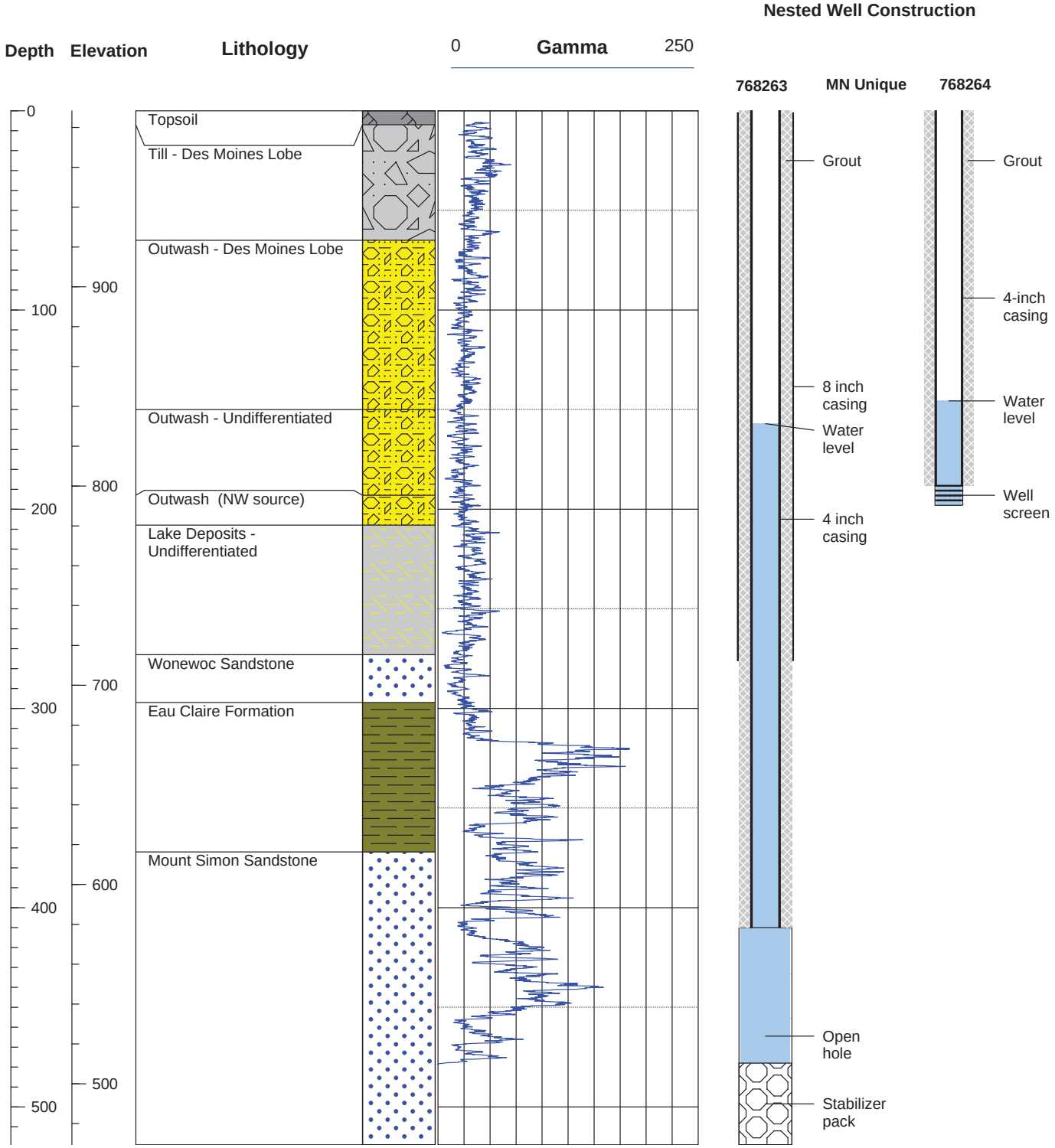
County Nicollet



Geological / Geophysical Logs and Well Construction Diagrams

Site Name Swan Lake WMA - Nicollet Bay Unit

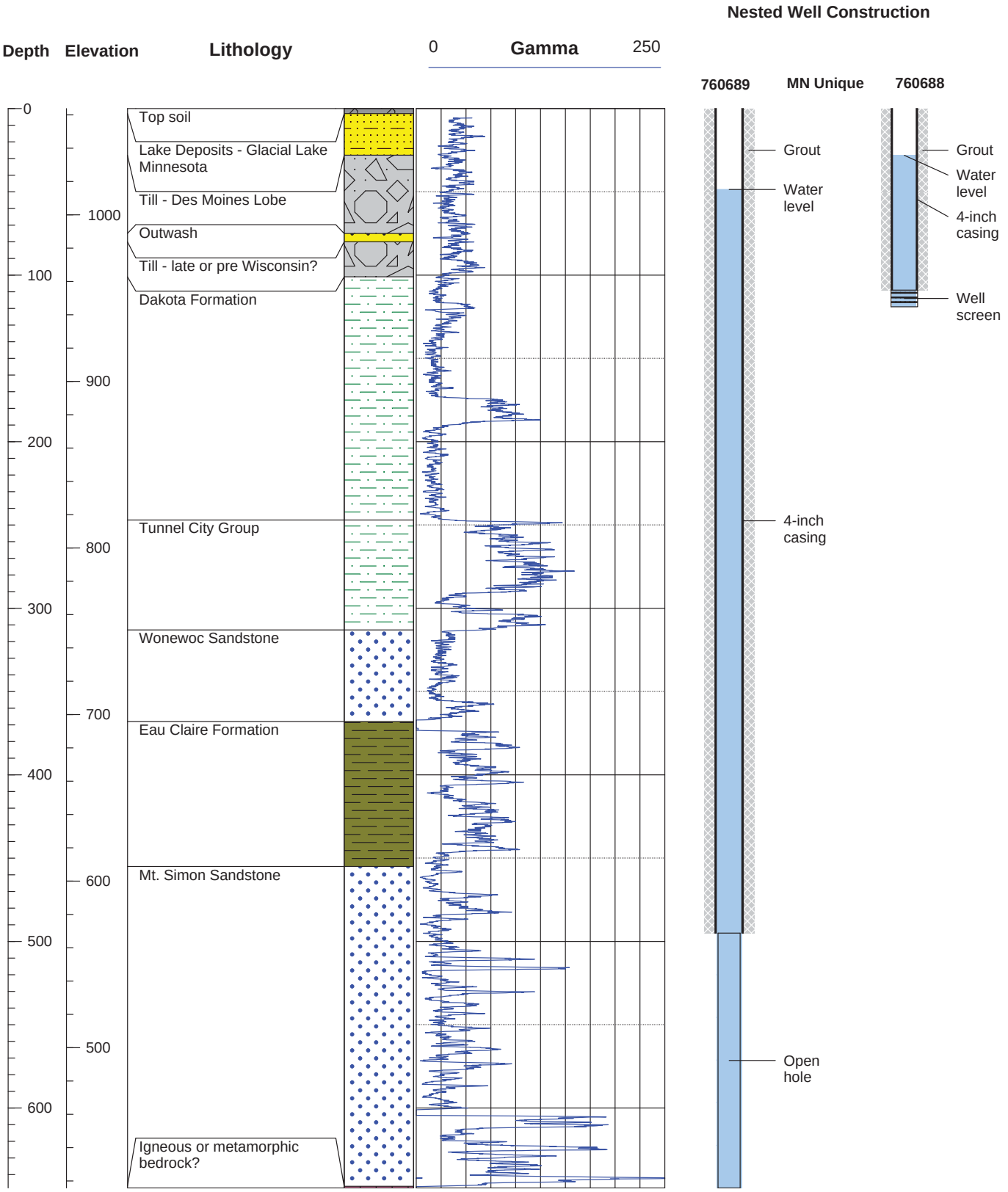
County Nicollet



Geological / Geophysical Logs and Well Construction Diagrams

Site Name Madelia WMA

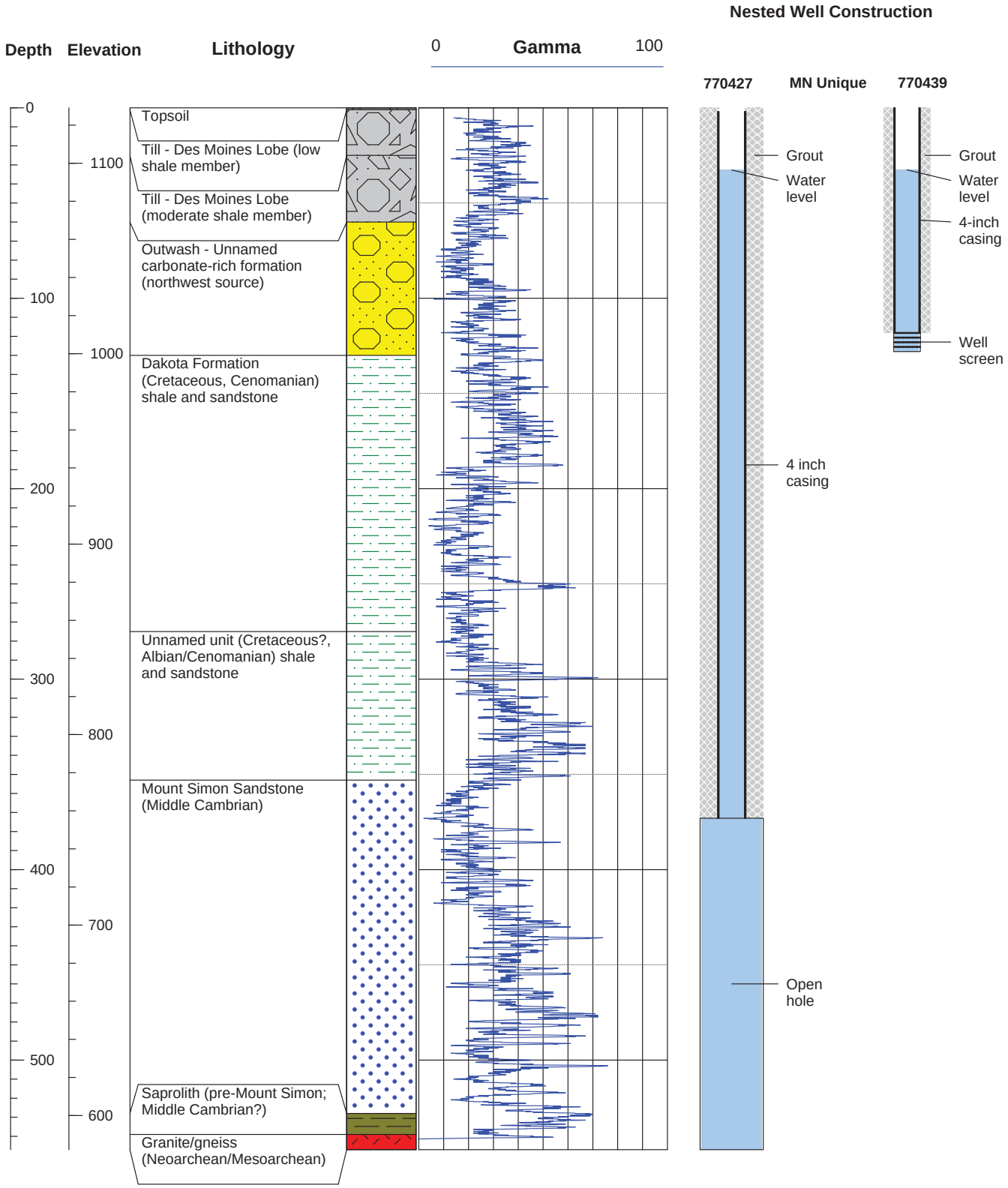
County Watonwan



Geological / Geophysical Logs and Well Construction Diagrams

Site Name Long Lake WA

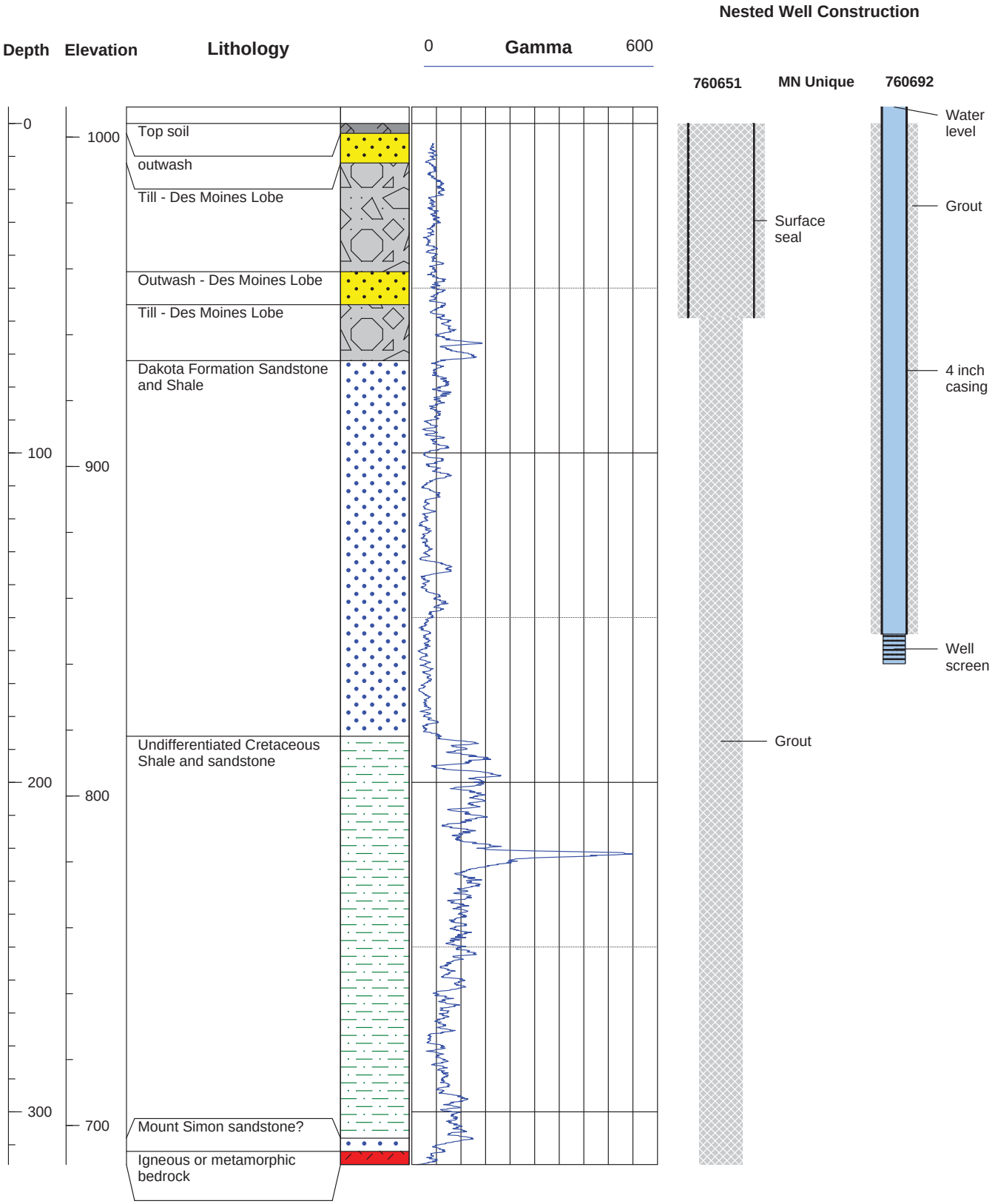
County Watowan



Geological / Geophysical Logs and Well Construction Diagrams

Site Name Lake Hanska WA

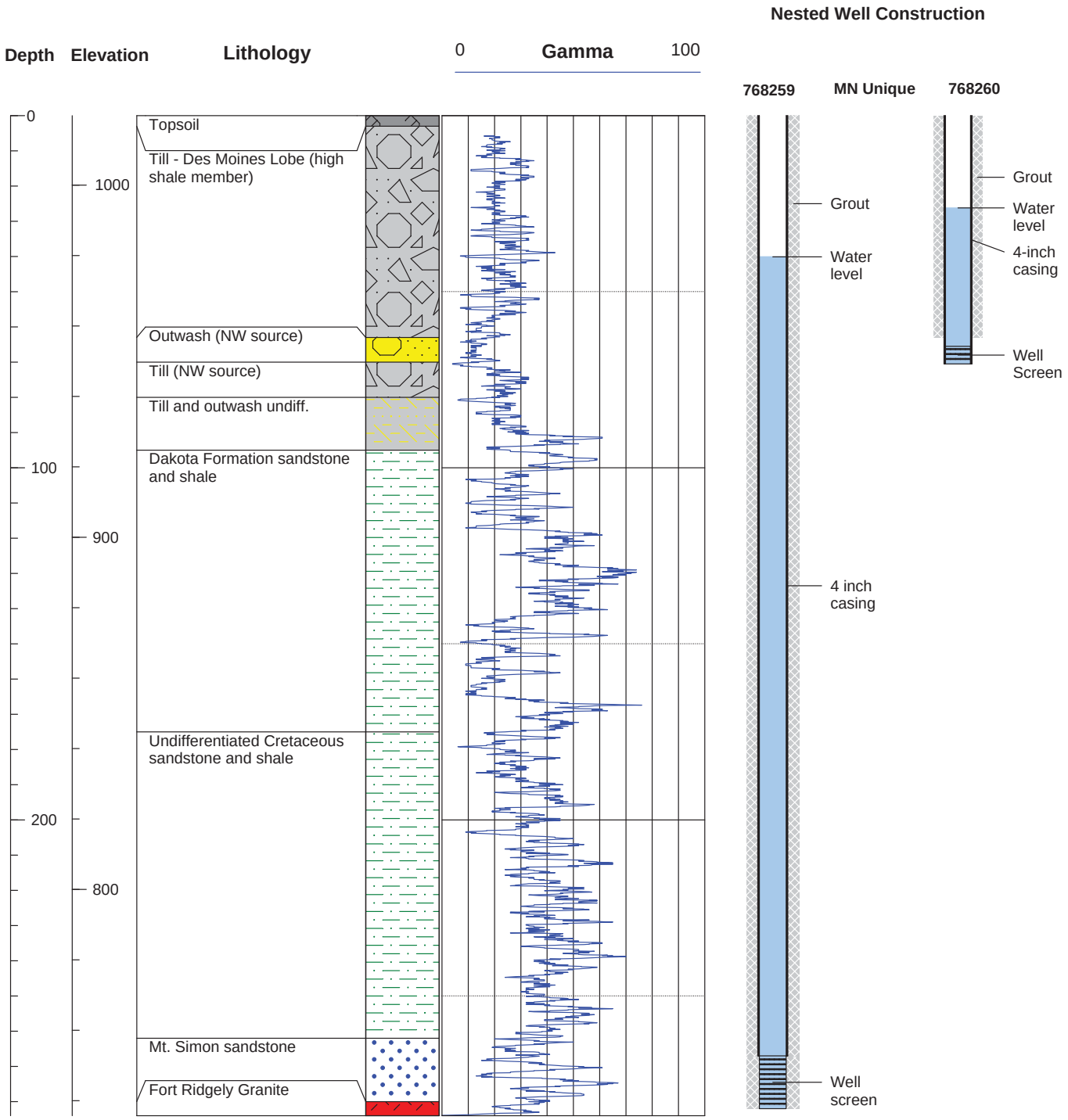
County Brown



Geological / Geophysical Logs and Well Construction Diagrams

Site Name Helget Braulick WMA

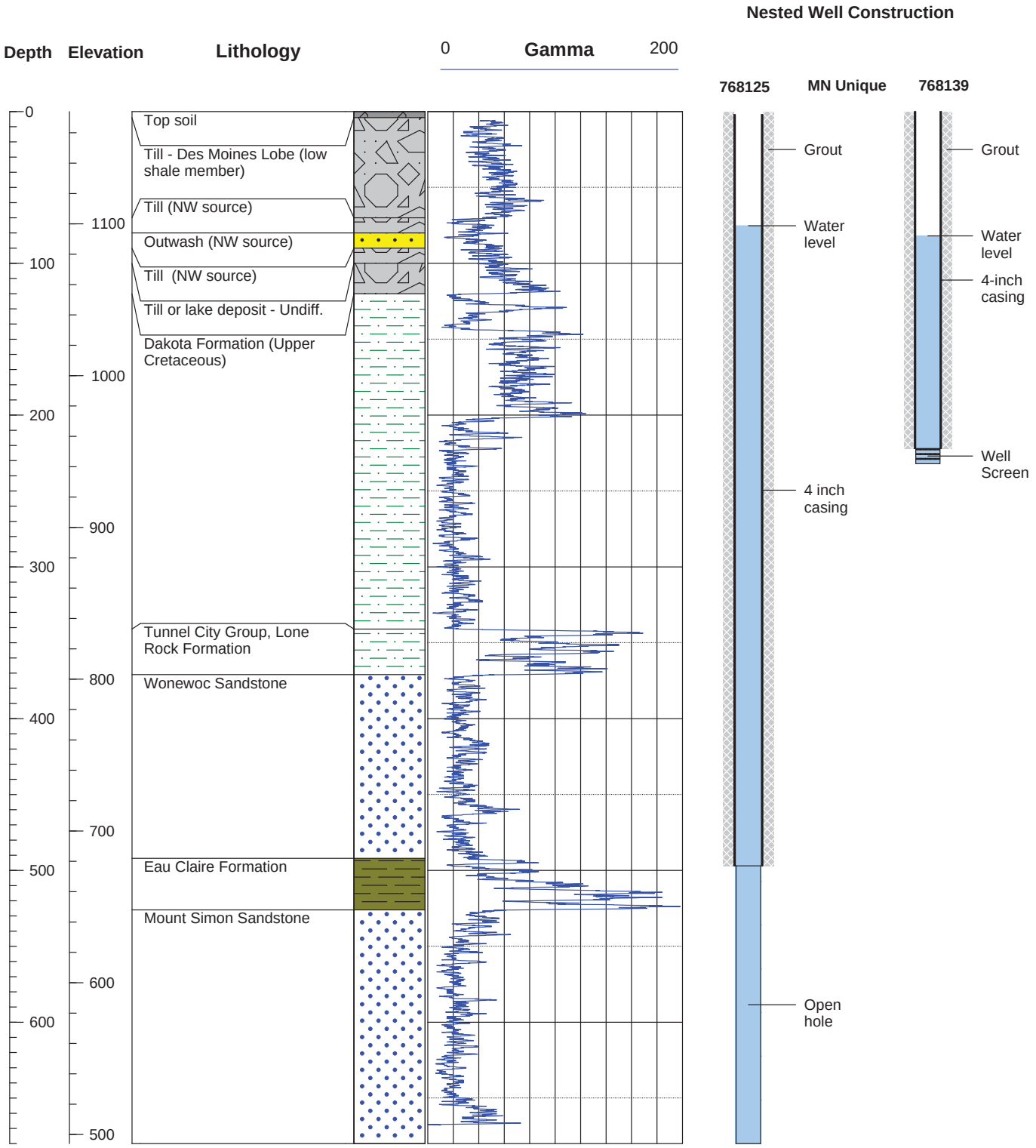
County Brown



Geological / Geophysical Logs and Well Construction Diagrams

Site Name Exceder WMA

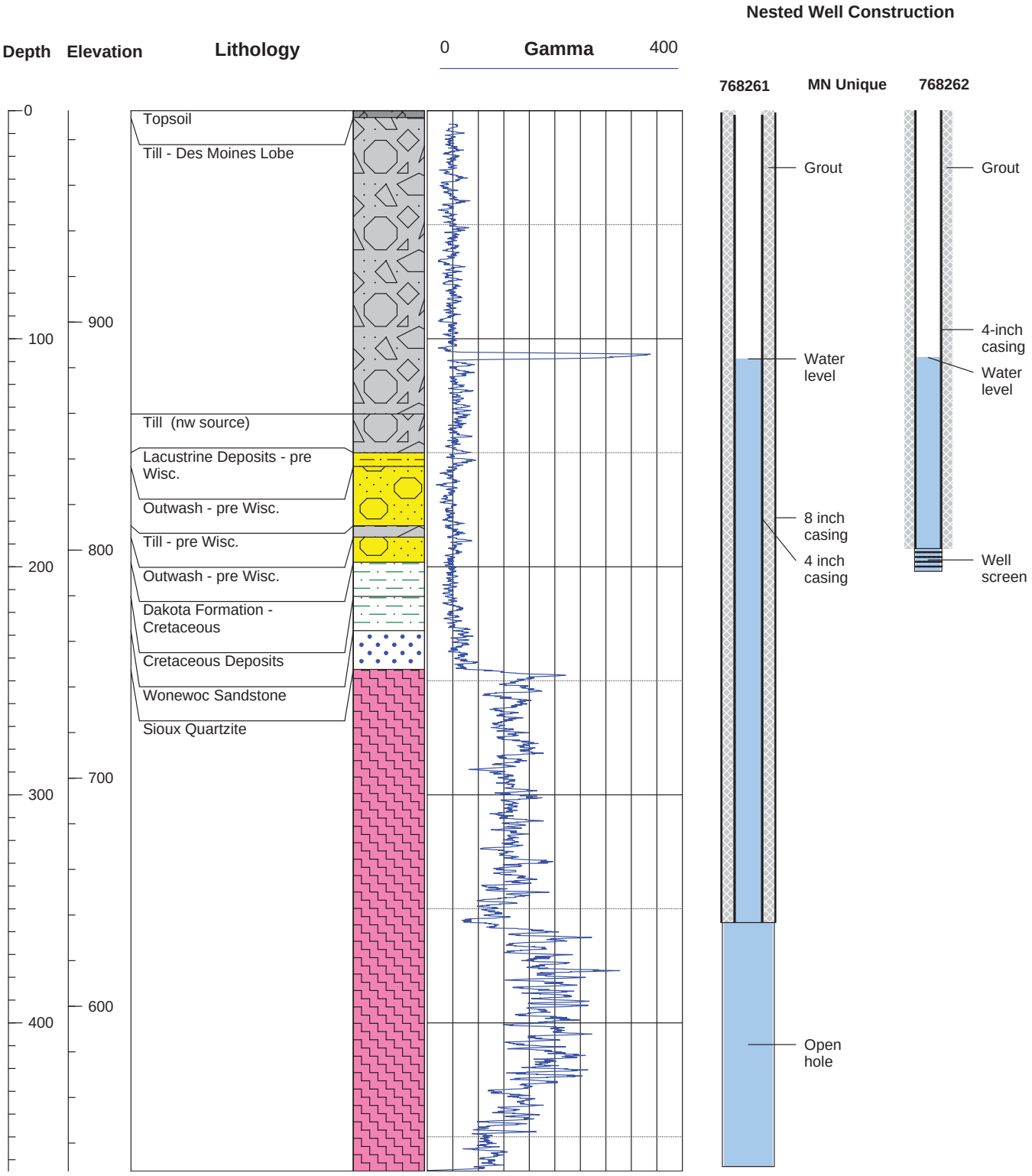
County Martin



Geological / Geophysical Logs and Well Construction Diagrams

Site Name Swan Lake WMA - Courtland West Unit

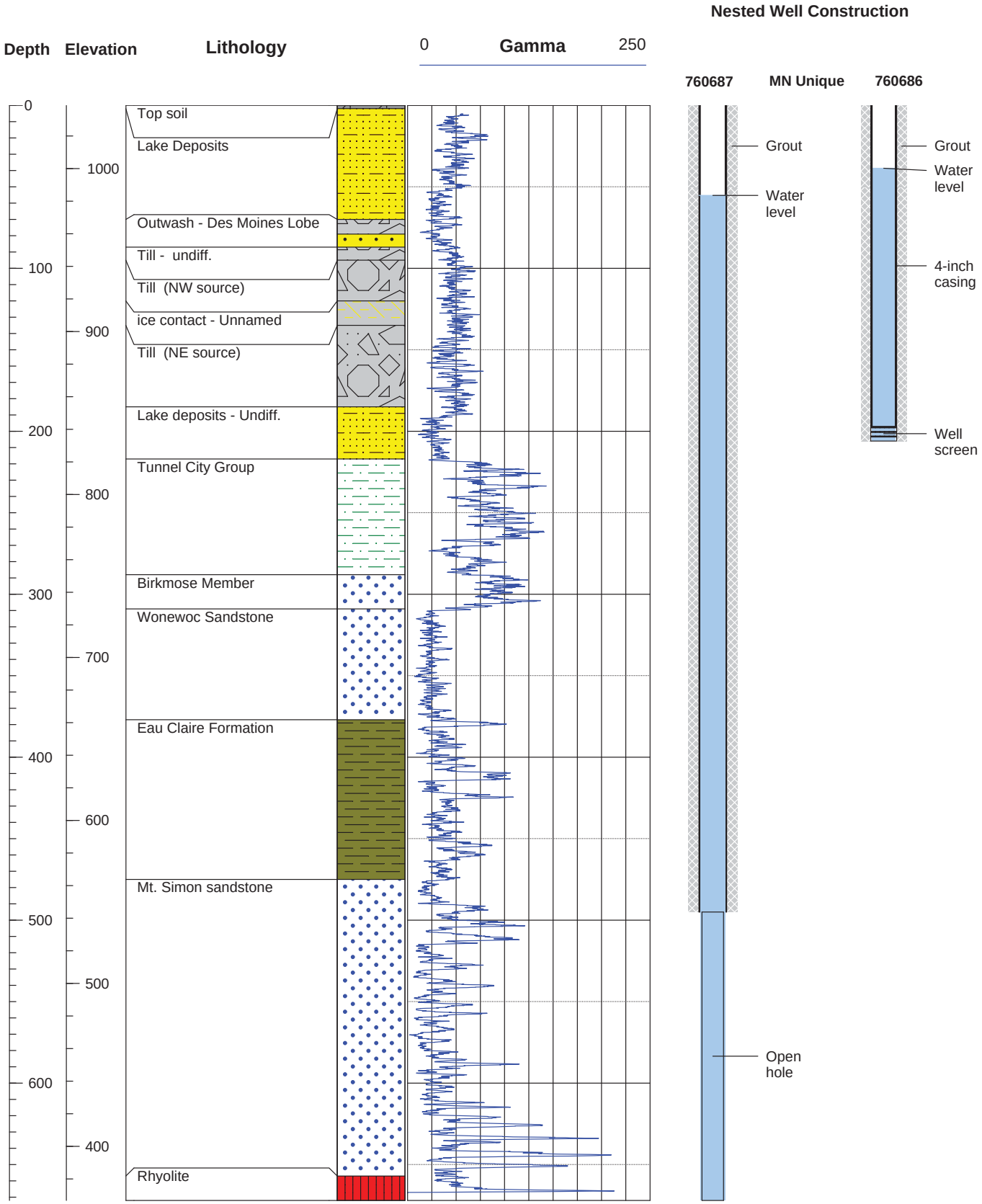
County Nicollet



Geological / Geophysical Logs and Well Construction Diagrams

Site Name Case WMA

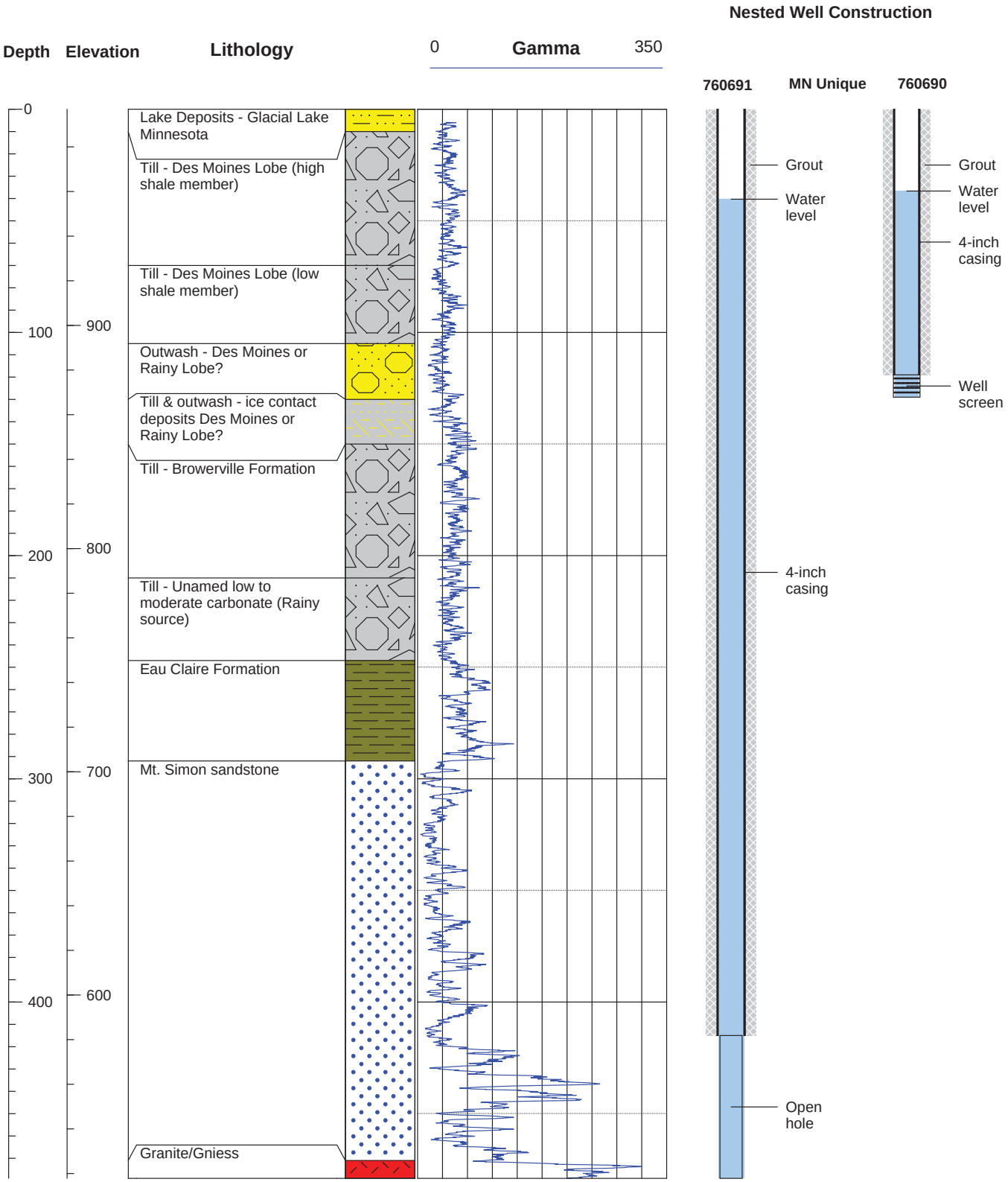
County Watonwan



Geological / Geophysical Logs and Well Construction Diagrams

Site Name Bergdahl WMA

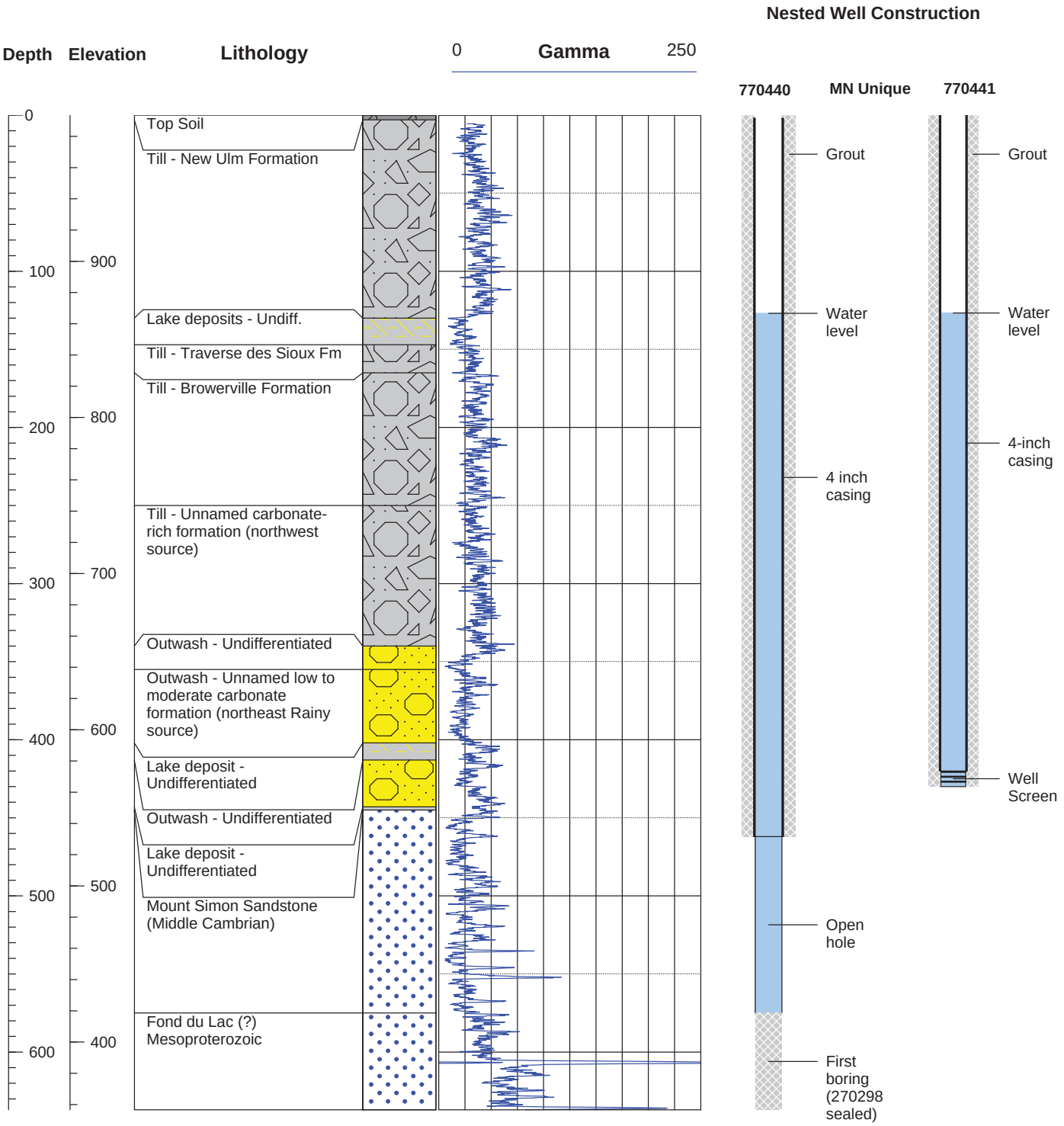
County Watonwan



Geological / Geophysical Logs and Well Construction Diagrams

Site Name Sibley County Landfill

County Sibley



2008 Project Abstract
For the Period Ending June 30, 2011

PROJECT TITLE: South-Central MN Groundwater Monitoring and County Geologic Atlases
PROJECT MANAGER: Dale Setterholm
AFFILIATION: Regents of the University of Minnesota; Dept: Minnesota Geological Survey
MAILING ADDRESS: Regents: 450 McNamara Center 200 Oak Street SE Minneapolis MN 55455; Geological Survey: 2642 University Ave. W. St. Paul MN 55114
CITY/STATE/ZIP:
PHONE: 612-627-4780
E-MAIL: sette001@umn.edu
WEBSITE: http://www.geo.umn.edu/mgs/
FUNDING SOURCE: Environment and Natural Resources Trust Fund

LEGAL CITATION: ML 2008, Chap.367, Sec.2, Subd.4(h).

Appropriation Language: $1,600,000 is from the trust fund for collection and interpretation of subsurface geological information and acceleration of the county geologic atlas program. $706,000 of this appropriation is to the Board of Regents of the University of Minnesota for the Geological Survey to begin county geologic atlases in three counties. $894,000 of this appropriation is to the commissioner of natural resources to investigate the physical and recharge characteristics of the Mt. Simon aquifer. This appropriation represents a continuing effort to complete the county geologic atlases throughout the state. This appropriation is available until June 30, 2011, at which time the project must be completed and final products delivered, unless an earlier date is specified in the work program.

APPROPRIATION AMOUNT: $706,000

Overall Project Outcome and Results

County geologic atlases are created to support water and mineral resource management. An atlas provides maps and associated databases at scales appropriate for land use planning and water management decisions. An atlas greatly improves our ability to monitor the resource, to predict the effects of pumping, and to respond effectively to contamination. This project created atlases for Blue Earth, Nicollet, and Sibley counties in paper, digital, and web-accessible formats. They will be published as MGS C-24, C-25, and C-26, and workshops will be held to train users.

Geologic maps describe the distribution of earth materials. The materials determine where water can enter the ground (become ground water), where it can be taken from the ground (aquifers), and how aquifers connect to rivers, lakes, and wetlands. Each geologic atlas contains the below parts.

Database map: shows the location of all well records, borings, scientific drilling, natural exposures, and geophysical measurements used to support all the maps in the atlas. The data itself is also provided.

Surficial Geology map: this map shows the earth materials immediately beneath the soil zone, and describes their composition and ability to convey water. The surface described by this map is the interface between human activities and ground water. Its character determines to a great degree the sensitivity of ground water to contamination.

Glacial Stratigraphy and Sand Distribution Model: A series of maps show the location, depth, and thickness of sand or gravel bodies (aquifers) in glacial materials. This map is useful in finding a water source, determining pumping effects, and in understanding the results of water monitoring.

Bedrock Geology map, bedrock topography map: These maps describe the location and type of bedrock present, and its ability to host and transmit groundwater. Where a sequence of sedimentary rocks are present the contacts between layers are mapped as digital surfaces and this enables numerical simulations of the ground water system that can predict the effects of pumping before wells are drilled.

Through this project, MGS also provided support to the DNR Mt. Simon monitoring well project by examining and describing samples, conducting downhole geophysical surveys, and providing interpretations of the geologic units penetrated by these wells.

Project Results Use and Dissemination

Geologic atlases are created to support informed decision-making. They are applied to wellhead protection, water appropriation decisions, well field design, onsite water treatment designs, facility siting, monitoring, and remediation of contamination. The atlases are printed for those who don't use computers and for use in the field. They are also provided in several digital formats for electronic use including geographic information systems. When the atlases are complete we hold workshops in the county to explain the products and their uses.

Environment and Natural Resources Trust Fund 2008 Work Program Final Report, and Trust Fund 2009 Work Program

Date of Report: 7/19/11 Work Program
Date of Next Status Report: 6/30/11

	M.L. 2008	M.L. 2009
Date of Work program Approval:	June 10, 2008	June 16, 2009
Project Completion Date:	June, 30 2011	June 30, 2012

I. PROJECT TITLE: South-Central MN Groundwater Monitoring and County Geologic Atlases; and County Geologic Atlas Acceleration

Project Manager: Dale Setterholm
Affiliation: Regents of the University of Minnesota; Dept: Minnesota Geological Survey
Mailing Address: Regents: 450 McNamara Center
200 Oak Street SE
City / State / Zip : Minneapolis MN 55455
Geological Survey: 2642 University Ave. W.
City / State / Zip : St. Paul MN 55114

Telephone Number: 612-627-4780
E-mail Address: sette001@umn.edu
FAX Number: 612-627-4778
Web Page address: http://www.geo.umn.edu/mgs/

Location: Nicollet, Blue Earth, Sibley Counties; Anoka and Wright Counties

	M.L. 2008	M.L. 2009	Total
Total Trust Fund Project Budget:	**$1,600,000**	**$2,695,000**	**$4,295,000**
DNR Total	*$894,000*	*$1,875,000*	*$2,769,000*
MGS Total	*$706,000*	*$820,000*	*$1,526,000*
MGS Trust Fund Appropriation	**$706,000**	**$820,000**	**$1,526,000**
Minus Amount Spent:	**$706,000**	**$653,995**	**$1,359,995**
MGS Equal Balance:	**$0**	**$166,005**	**$166,005**

Legal Citation:
ML 2008, Chap.367, Sec.2, Subd.4(h).
Appropriation Language: $1,600,000 is from the trust fund for collection and interpretation of subsurface geological information and acceleration of the county geologic atlas program. $706,000 of this appropriation is to the Board of Regents of the University of Minnesota for the Geological Survey to begin county geologic atlases in three counties. $894,000 of this appropriation is to the commissioner of natural resources to investigate the physical and recharge characteristics of the Mt. Simon aquifer. This appropriation represents a continuing effort to complete the county geologic atlases throughout the state. This appropriation is available until June 30, 2011, at which time the project must be completed and final products delivered, unless an earlier date is specified in the work program.

Legal Citation: ML 2009, Chap.143, Sec.2, Subd.3(b)
Appropriation Language: $2,695,000 is from the trust fund for collection and interpretation of subsurface geological information and acceleration of the county geologic atlas program. $820,000 of this appropriation is to the Board of Regents of the University of Minnesota for the geological survey to continue and to initiate the production of county geologic atlases. $1,875,000 of this appropriation is to the commissioner of natural resources to investigate the physical and recharge characteristics of the Mt. Simon aquifer. This appropriation represents a continuing effort to complete the county geologic atlases throughout the state. This appropriation is available until June 30, 2012, at which time the project must be completed and final products delivered, unless an earlier date is specified in the work program.

II. FINAL PROJECT SUMMARY FOR 2008 PROJECT, AND PROJECT SUMMARY AND RESULTS FOR 2009 PROJECT:

M.L. 2008

Overall Project Outcome and Results

County geologic atlases are created to support water and mineral resource management. An atlas provides maps and associated databases at scales appropriate for land use planning and water management decisions. An atlas greatly improves our ability to monitor the resource, to predict the effects of pumping, and to respond effectively to contamination. This project created atlases for Blue Earth, Nicollet, and Sibley counties in paper, digital, and web-accessible formats. They will be published as MGS C-24, C-25, and C-26, and workshops will be held to train users.

Geologic maps describe the distribution of earth materials. The materials determine where water can enter the ground (become ground water), where it can be taken from the ground (aquifers), and how aquifers connect to rivers, lakes, and wetlands. Each geologic atlas contains the below parts.

Database map: shows the location of all well records, borings, scientific drilling, natural exposures, and geophysical measurements used to support all the maps in the atlas. The data itself is also provided.

Surficial Geology map: this map shows the earth materials immediately beneath the soil zone, and describes their composition and ability to convey water. The surface described by this map is the interface between human activities and ground water. Its character determines to a great degree the sensitivity of ground water to contamination.

Glacial Stratigraphy and Sand Distribution Model: A series of maps show the location, depth, and thickness of sand or gravel bodies (aquifers) in glacial materials. This map is useful in finding a water source, determining pumping effects, and in understanding the results of water monitoring.

Bedrock Geology map, bedrock topography map: These maps describe the location and type of bedrock present, and its ability to host and transmit groundwater. Where a sequence of sedimentary rocks are present the contacts between layers are mapped as digital surfaces and this enables numerical simulations of the ground water system that can predict the effects of pumping before wells are drilled.

Through this project, MGS also provided support to the DNR Mt. Simon monitoring well project by examining and describing samples, conducting downhole geophysical surveys, and providing interpretations of the geologic units penetrated by these wells.

Project Results Use and Dissemination

Geologic atlases are created to support informed decision-making. They are applied to wellhead protection, water appropriation decisions, well field design, onsite water treatment designs, facility siting, monitoring, and remediation of contamination. The atlases are printed for those who don't use computers and for use in the field. They are also provided in several digital formats for electronic use including geographic information systems. When the atlases are complete we hold workshops in the county to explain the products and their uses.

M.L. 2009

The 2009 project will initiate Part A County Geologic Atlases by the Minnesota Geological Survey for Anoka County and Wright County.

These projects will create both short and long-term benefits for the people and natural resources of the region. The information generated by these projects will be immediately useful to water management scientists, planners, drillers, consultants, industrial users, and municipal officials for understanding and assessing local ground water conditions for protection and wise use.

III. A. PROGRESS SUMMARY AS OF *12/01/09*:

M.L. 2009

MGS staff have supplied the staff of Anoka and Wright counties with maps and copies of all well construction records that need accurate locations. Those staff were trained and MGS has monitored their progress for quality control. Both counties report 90% completion on the nearly 10,000 wells for each county, and both expect to complete their work by the end of 2009. Anoka County will submit paper maps with well locations to be digitized at MGS. Wright County will submit a GIS file of digital locations. This project is also supporting the final production and printing of the Benton and Chisago geologic atlases. Many of the map products have been through review and are in editing. The subsurface products are last in line and have been interrupted by the drilling program for the ML 2008 project. All products are expected to go to printing in January, 2010.

III. B. PROGRESS SUMMARY AS OF *6/30/10*:

M.L. 2009

The staff at Wright and Anoka counties have established accurate locations for nearly all of the 9,500 previously unlocated well records. Anoka County is working to resolve conflicting location data for a small number of wells, and when added to the wells previously located by MGS, the database will contain nearly 26,000 wells. Interpretation of the well records will continue as mapping progresses. Wright County has completed their locating effort, and MGS is troubleshooting any location conflicts. Bedrock interpretations have been done, but changes will be made as the mapping progresses. Interpretation of Quaternary materials is about half done.

This project also supported the final production and printing of the Benton and Chisago geologic atlases. The atlases have been printed and a DVD of digital versions completed for each county. These have been delivered to the counties and to LCCMR. A workshop will be held in each county in the fall or early winter to familiarize users with the products.

Amendment Request (8/10/10)

The wages and benefits, and cost of printing these publications exceeded the result budget by $32,944. This is caused by the long time gap between budgeting of this work and when it actually took place. The cost of printing is determined by a bidding process and cannot be estimated more accurately ahead of time. The result is two modern geologic atlases at a cost to LCCMR of $491,944, or $245,972 each. Over the last 20 years atlas costs have averaged $314,180 per county, so we are pleased with this result. To balance the budget we have reduced wages and benefits for Result 3B by $32,994 which covers the overage in Result 5 and an overage of $50 to repair the flowmeter in Result 3B. This is a relatively small change to the funds available for Result 3B and we do not anticipate it will have a significant impact on our progress.

Amendment Approved (8/10/10)

III. C. PROGRESS SUMMARY AS OF *12/31/10*:

M.L. 2009

The Anoka County Geologic Atlas is about 50% complete, congruent with the halfway point of the grant period. The CWI database for the county now contains more than 24,000 wells including nearly 10,000 wells for which the county established locations. Geologic interpretations of these well records are also complete. Both the surficial geologic map and the bedrock geologic map were accepted as STATEMAP projects which brought in $68,525 in additional funds. The surficial geologic map is about 60% complete and the bedrock map slightly closer to completion. Both will be ready for submission to the USGS by July 1. Progress on the subsurface Quaternary mapping includes the completion of 4 rotary sonic core

holes, and 15 Giddings probe holes. Examination and analysis of the samples is underway.

The Wright County Geologic Atlas is also about 50% complete, as expected. The CWI database now has more than 10,000 well records with digital locations. There was a problem with the county locations on some wells and MGS is re-locating about 500 wells to remedy this problem. The surficial geologic map has contacts drawn, soils classified, and a peat layer is under construction. The Quaternary subsurface effort includes 6 rotary sonic core holes just completed and description and analysis of the core is underway. We have also developed a new GIS routine that uses the CWI data to quickly predict the distribution of aquifer materials and create a model to guide the geologists as they map. Preliminary versions of the bedrock geology and topography are complete and and structure contours are done for the major unconformities. These will be revised as necessary when the final locations of the 500 wells are established.

Amendment Request (1/19/11)

The current budget for the 2008 grant has just over $29,000 remaining for result 3, and over $58,000 remaining for result 4. Our costs on result 4 have been lower than expected due to changes in the number of holes DNR drilled, and changes in the construction of those wells that precluded some of the downhole logging we planned. We still have some work to do on that activity, but it won't spend down the remaining $58,000 completely. On the other hand, the remaining funds in result 3 are insufficient to complete the mapping we intend to do. This is not unexpected, as the budget was $630,200 and we took on 3 CGAs (typically costing more than $300,000 each). We have garnered additional support from the USGS STATEMAP program and this, along with some efficiency and technology, has allowed us to nearly complete these atlases. If we could apply any funds not needed for result 4 to completing the tasks in result 3 I expect we can get very close to completing those atlases with the exception of printing costs. I would likely utilize funds from the 2010 grant to pay for printing. Each of my grants recognizes the uncertainties at the time of application (which counties, how many wells, drilling costs, etc.) and promises progress, not completion. Each grant also allows for application of funds to unfinished work from previous grants. I am requesting permission to utilize funds from the result 4 budget toward result 3 activities as needed. I also request permission to transfer funds among categories (ex: wages and benefits, travel, supplies) as necessary to best utilize the remaining funds to fulfill the project goals. It is not possible to predict these transfers accurately, but they will likely mostly move funds from excess travel or supply funds to other categories, and mostly from result 4 to result 3.

Amendment Approved (1/20/11)

III. D. PROGRESS SUMMARY AS OF *7/19/11*:

<u>Final Progress Summary M.L. 2008</u>

The databases (well construction records, borings, outcrop descriptions) and corresponding maps are complete. The maps of the bedrock geology, bedrock topography, depth-to-bedrock, and bedrock structure are also complete. The maps of the surficial geology are in completed form, but may be revised to match the subsurface glacial geology products. All of these maps have been editing and are ready for printing. The products that describe the subsurface glacial geology of Blue Earth and Nicollet counties are the only products not completed. The closely-spaced cross-sections are complete, and the GIS staff will use these to create the digital surfaces that define the sand bodies (aquifers). We expect this work to be complete in this quarter. Then printing of all the maps and creation of a DVD with all the products and data will take place and be followed by workshops to introduce the products and train users. These activities will be financed with funds from the M.L. 2010 grant. The $630,200 available for this activity is significantly less than the $1,050,000 we would expect three atlases to require (estimated at $350,000 each). However, we expect to complete these atlases at significantly less than that amount. We have been aided by USGS STATEMAP cost-sharing of some project elements in the amount of $88,356.

M.L. 2009

The Anoka County Geologic Atlas has progressed as scheduled. Both the bedrock geologic map and the surficial geologic map were cost-shared by the USGS STATEMAP program ($68,525) and this allowed them to be completed recently. Work is now focused on the subsurface glacial geology products that explain the glacial history of the area and map potential aquifers. That mapping has been accepted for cost-sharing by the Great Lakes Geologic Mapping Coalition, and it will be completed by the end of June 2012.

The County Well Index database for the Wright County Geologic Atlas has needed some extra attention due to some location errors introduced by county staff. MGS staff have corrected these errors and we are adding new instructions to the manual we use to train county staff for this work. The surficial geologic map is in draft stage as is the bedrock geologic map. The latter will be completed now that the database has been finalized. Work has been initiated on the subsurface Quaternary products. We still expect this project to finish in about 12 months.

IV. OUTLINE OF PROJECT RESULTS*:*

Result 1: Groundwater level monitoring guidance document (to be completed by DNR, separate work program)

Result 2: Test drilling, monitoring well installation, sampling, laboratory analysis, water level measurement (to be completed by DNR, separate work program)

Result 3: Initiate County Geologic Atlases

M.L. 2008

Initiate Part A County Geologic Atlases for Blue Earth, Nicollet, and Sibley Counties. Note: all components listed below may not be completed within the time frame and budget of this project, but substantial progress in all three counties is anticipated.

M.L. 2009

Initiate Part A County Geologic Atlases for Anoka County and Wright County. Note: all components listed below may not be completed within the time frame and budget of this project, but substantial progress in both counties is anticipated.

Description:

- create geologic maps, illustrations, and databases in print and GIS formats.
- location, boundaries, size, and hydrologic characteristics of aquifers and the materials that confine them in these counties.
- these maps are essential information in efforts to protect and wisely allocate ground water and they support these related activities and programs:
  - ground water monitoring, wellhead protection, ground water allocation, well construction, wellfield design, facility siting, permitting, application of agricultural best management practices, remediation, and management of ground water dependent surface water features (springs, fens, lakes, rivers).
- products:
  - maps of bedrock geology, surficial geology, subsurface Quaternary geology, bedrock topography, and thickness of glacial deposits
  - database of well construction records to support the mapping, describe water use, and to help resolve well problems; scientific test drilling as necessary

Summary Budget Information for Result 3:

	M.L. 2008	M.L. 2009	Total
Trust Fund Budget:	**$630,200**	**$728,056**	**$1,358,256**
Amount Spent:	**$657,088**	**$562,051**	**$1,219,139**
Balance:	**$-26,888**	**$166,005**	**$139,117**

Deliverable	Completion Date	Budget	Status
1. M.L. 2008: CWI databases for 3 counties	6/30/09	$19,040	complete
2. M.L. 2008: geologic maps	6/30/11	$610,600	underway
3. M.L. 2009: CWI databases for 2 counties	6/30/10	$ 18,000	complete
4. M.L. 2009: geologic maps	6/30/12	$728,056	underway

Completion Date: M.L. 2008*:* 6/30/11; M.L. 2009: 6/30/12

M. L. 2008 Result 3 Status as of 12/1/08: Efforts are focused on collection and compilation of new and existing data, especially establishing accurate, digital locations for water wells so that the information they contain can be used to support geologic maps. We are also examining, describing, and interpreting drill cuttings and other existing samples.

M. L. 2008 Result 3 Status as of 6/30/09: CWI databases are complete and field and laboratory studies to collect, generate, and compile geologic data are underway. Mapping based on landform analysis and CWI data are also well underway. Progress is on schedule.

M. L. 2008 Result 3 Status as of 12/01/09: CWI databases are up to date, field studies are nearly complete, and laboratory analyses are about half done. This winter the surficial and bedrock maps will be drafted, a drilling program completed, and the subsurface analysis will be initiated.

M. L. 2009 Result 3 Status as of 12/1/09: Both Wright and Anoka county staff have established locations for about 90% of the wells that need accurate locations. MGS provided training, materials, and quality control monitoring. The flowmeter repair was accomplished at expected cost, and the acquisition of the truck and Giddings soil probe is underway. The truck has been purchased (not yet billed) and the soil probe will be mounted in the next two weeks (billed and paid).

M.L. 2008 Result 3 Status as of 6/30/10: CWI databases are effectively complete. The bedrock geologic maps are complete (Sibley and Nicollet) or in review (Blue Earth). The surficial geologic map is complete for Sibley County, and final field work underway in Blue Earth county. Compilation of the Nicollet and Blue Earth surficial maps should be complete mid-winter. Mapping of the subsurface geology of the Quaternary units is underway. It may be complete by the end of this grant. Editing and printing are likely to take place after this grant has expired.

M.L. 2009 Result 3 Status as of 6/30/10: With databases nearly complete, field work, laboratory work, and mapping are underway. Shallow drilling to support the surficial mapping has begun and will continue this field season. The bedrock mapper has examined existing drill cuttings and geophysical boring logs and is currently interpreting the drillers logs in CWI. Map compilation will follow. The new Giddings drilling machine and truck were purchased and are operable. The borehole camera purchase will take place in the next 2 to 4 weeks.

M.L. 2008 Result 3 Status as of 12/31/10: The database, surficial geology, and bedrock geology products have passed review and are in editing and pre-print stages. The mapping of subsurface Quaternary aquifers is underway and on schedule for completion by the end of the grant period.

M.L. 2009 Result 3 Status as of 12/31/10: The Anoka and Wright CGAs are about 50% complete. The CWI databases including geologic interpretations are complete except for relocation of about 500 wells. The Anoka surficial and bedrock maps were accepted as STATEMAP projects which brought in $68,525 in additional funds. The surficial and bedrock geologic map are about 60% complete in both counties. Progress on the subsurface Quaternary mapping includes the completion of rotary sonic core holes, and Giddings probe holes. Examination and analysis of the samples is underway. The borehole camera has been purchased and deployed.

M.L. 2008 Final Report Summary: The database products are complete. The surficial geology maps are complete, but may be revised to be fully compatible with the subsurface products. The bedrock products (geologic map, topographic map, structure contours, digital surfaces) are complete. The subsurface Quaternary products are complete for Sibley and Nicollet counties, and nearly complete in Blue Earth County. In that county the closely-spaced cross-sections are just being finalized and digital surfaces and maps will be derived from them. Finally, the map package will be printed, a DVD of all files prepared, both delivered to the counties, and then a workshop held to introduce the products and train users. These last activities will be financed by the M.L. 2010 grant to MGS as stated in its work program.

M.L. 2009 Result 3 Status as of 6/30/11: *For Anoka County*: The database is complete. The surficial and bedrock maps are complete. The subsurface Quaternary products (sand body aquifer models, stratigraphic column, cross-sections) are underway and will be cost-shared by the Great Lakes Geologic Mapping Coalition ($36,736). *For Wright County*: The database is complete. Draft versions of the surficial and bedrock geologic maps are complete, and may be revised as additional data and products are obtained. The subsurface Quaternary products (sand body aquifer models, stratigraphic column, cross-sections) are underway.

Result Status as of 12/1/11:

Result Status as of 6/30/12:

M.L. 2009 Final Report Summary:

Result 4: MGS support for DNR Drilling Program
Description: MGS will process, examine, interpret, and archive samples from the DNR test drilling. MGS will also conduct downhole geophysical logging of selected test holes to observe aquifer properties.

Summary Budget Information for Result 4:

	M.L. 2008	M.L. 2009	Total
Trust Fund Budget:	**$75,800**	**$0**	**$75,800**
Amount Spent:	**$48,912**	**$0**	**$48,912**
Balance:	**$26,888**	**$0**	**$26,888**

Deliverable	Completion Date	Budget	Status
1. report to DNR	6/30/11	$75,800	complete

Completion Date: M.L. 2008: 6/30/10

Result 4 Status as of 12/1/08: MGS provided DNR with geophysical logs in the vicinity of their new drilling to facilitate siting the holes, and interpreting the samples

and new geophysical surveys. We also provided downhole logging of 2 of the 3 holes drilled so far. MGS has processed and archived the samples delivered by DNR and also conducted textural analysis of one of the two sample sets delivered. We have conducted downhole logging of 8 “holes of opportunity” in the project area to support mapping. We failed to differentiate the cost of these activities from the cost of activities under result 3 so far, however the activity in this area has been minimal. We will recover this data and include it in our next report.

Result 4 Status as of 6/30/09: The MGS sediment lab has received 12 sets of drill cuttings from DNR which have been processed, described, and archived. Textural analyses have been performed on some of these holes. MGS has conducted downhole geophysical surveys at 14 DNR drill sites, traveling 2,635 miles. A natural gamma survey is conducted at every site, and depending on the drill hole condition other surveys such as SP, resistivity, multitool, and caliper have been conducted. Some holes are logged with the drill rods in place to establish how to construct the well to observe the Mt. Simon aquifer, and then logged again after the well is constructed to get improved data without interference from the drilling tools.

Result 4 Status as of 12/1/09: MGS staff traveled to 4 more DNR drill sites and conducted downhole geophysical surveys. Drill cuttings were collected and returned to the MGS lab for description and storage. Interim reported to DNR has provided them with the information necessary to construct observation wells. Some holes were logged through the drill rods and will be relogged in the well casing at some time.

Result 4 Status as of 6/30/10: MGS examined the drill cuttings and geophysical logs from 15 DNR drill holes to interpret the stratigraphic intervals intersected by these holes. The cost estimate for this work was based on an expectation that 9 rotasonic holes and 25 reverse-circulation holes would need support. The construction of the 15 holes drilled also greatly reduced the opportunity for flow-logging. These changes in scope have reduced the associated effort and costs considerably. We still anticipate conducting some flow-logging later this season, but not of a scope that would utilize all the remaining funds. These funds could be utilized to support the work of Result 3 and bring us closer to finishing the atlases, or could be applied to support of more drilling by DNR this year.

Amendment Request (8/10/10)

In this amendment we have decreased the budget for supplies because DNR did not do any rotasonic coring and no core boxes were necessary. We increased the travel budget as some of the holes required more than one trip, and DNR relied on MGS for more logging than anticipated. The net effect on the budget for this result is zero.

Amendment Approved (8/10/10)

Result 4 Status as of 12/31/10: MGS received 11 new cutting sets from the DNR observation well drilling program (phase 2, drilled in the north and west suburbs) since July 1, 2010. Student workers have processed 10 of these sets and the most

recent set is on the shelf drying. It will be processed in the next few weeks. We also performed downhole logging on most of these holes. Five of the Phase 1 holes, in Watonwan and Martin counties were flow-logged in November, 2010. A report of the results of the flow-logging is currently in preparation, and is expected to be completed by March, 2011.

Final Report Summary: MGS received 12 new cuttings sets from the second phase of DNR drilling. These have been processed and some have been described and interpreted. MGS delivered a report of descriptions and interpretations to DNR on 9/10/10. This report, Cuttings Summary for the Minnesota Department of Natural Resources South-Central Drilling Program by Alan R. Knaeble, Gary N. Meyer, and John H. Mossler, is MGS Open-file Report 10-06 and can be accessed at ftp://mgssun6.mngs.umn.edu/pub4/ofr10_06/Scentral%20drilling%20rpt10_06.pdf . The report on flow-logging is in draft form and will be delivered to DNR in the next month or two. This report will have findings worthy of publication, and MGS may publish this report, or incorporate these results into a more comprehensive report later.

Result 5: Production and Printing of the Benton and Chisago County Geologic Atlases

Description:

- Take the geologic maps and databases from 2007 work program through the technical review, editing, production, and printing phases
- products:
  - printed maps of bedrock geology, surficial geology, subsurface Quaternary geology, bedrock topography, and thickness of glacial deposits
  - A CD or DVD package of digital versions of the products in several formats appropriate for the varying technology levels of users

Summary Budget Information for Result 5:

	M.L. 2008	M.L. 2009	Total
Trust Fund Budget:	**$0**	**$91,944**	**$91,944**
Amount Spent:	**$0**	**$91,944**	**$91,944**
Balance:	**$0**	**$0**	**$0**

Deliverable	Completion Date	Budget	Status
1. printed maps and DVD	6/30/10	$91,944	complete

Completion Date: M.L. 2009: 6/30/10

Result 5 Status as of 12/1/09: Most of the map products have been reviewed and are in the editing and production stage. The subsurface products are not yet

complete and will be delayed slightly by the drilling program for M.L. 2009. All products are expected to go to the printer by the end of January.

Result 5 Status as of 6/30/10: The Benton and Chisago County Geologic Atlases have been completed and delivered to the counties and to the LCCMR. The counties each received 1,000 copies of the printed atlases, and a DVD containing all the digital files and associated databases.

Final Report Summary: The Benton and Chisago County Geologic Atlases have been completed and delivered to the counties and to the LCCMR. The counties each received 1,000 copies of the printed atlases, and a DVD containing all the digital files and associated databases.

V. TOTAL TRUST FUND PROJECT BUDGET:

M.L. 2008

Personnel: approx. 6 fte from approx. 15 staff	$510,412
Contracts: rotasonic test drilling; approx. 10 holes, 3-4 per county	$125,000
Equipment/Tools/Supplies	$ 18,060
(core boxes $5100, lab/field supplies $9500 (sample bags/envelopes, beakers, chemicals, repairs), drill parts $1100, photocopy/scan/plotter $500, field maps $350, lab analyses $1500)	
Acquisition, including Easements:	$ 0
Travel:	$52,528
Other:	$ 0
2008 TRUST FUND PROJECT BUDGET:	$706,000

Explanation of Capital Expenditures Greater Than $3,500: *none*

M.L. 2009

Personnel: approx. 6 fte from approx. 15 staff	$570,216
Contracts: drilling (approx. 6 or 7 holes $75,000) printing $22,000	$ 97,101
Equipment/Tools/Supplies	$ 98,883
($86,000 capital equip below; $3500 core box, lab/field supplies $7000, copy/scan/plot $400, field maps $300, lab analyses $1600)	
Travel:	$ 54,000
Other:	$ 0
2009 TRUST FUND PROJECT BUDGET:	$820,200

Explanation of Capital Expenditures Greater Than $3,500:

Soil Probe and carrier truck: $62,000

The Minnesota Geological Survey relies primarily on water well records for subsurface geologic data. This is augmented by 1 to 3 rotasonic test borings approximately 250 feet deep, and 100 to 200 shallow borings less than 25 feet deep. The shallow borings are drilled with a truck mounted auger owned by MGS. This

project will purchase a new auger and truck to augment our current equipment. The acceleration of the program requires a second set of equipment.

Repair of a downhole flow meter tool: $9,000

MGS lowers several types of measuring probes into water wells or test borings to record physical properties of the surrounding earth materials, or the water in the borehole and adjacent aquifers. Our flowmeter probe was damaged during previous use and these funds will repair it for use on this project and future atlases.

Downhole Video Camera and Recorder $15,000

A downhole video camera provides us with the ability to see geologic strata in uncased intervals of wells or test borings. This is useful in interpreting the geology, and also in assessing the suitability of the hole for deploying the downhole flow meter or other tools. Seeing the conditions in advance will help us avoid tool loss or damage in holes with obstructions or problematic construction.

VI. OTHER FUNDS & PARTNERS:

A. Project Partners:

M.L. 2008

Minnesota Geolgical Survey, total from 2008 appropriation	$706,000
Nicollet County (well location verification)	in-kind contribution
Blue Earth County (well location verification)	in-kind contribution
Sibley County (well location verification)	in-kind contribution

M.L. 2009

Minnesota Geolgical Survey, total from 2009 appropriation	$820,200
Anoka County (well location verification)	in-kind contribution
Wright County (well location verification)	in-kind contribution

B. Project Impact and Long-Term Strategy:

County Geologic Atlases provide information essential to sustainable management of water resources. Atlases are completed or underway for 25 of Minnesota's 87 counties. The products also support and enhance the activities of other agencies such as ground water monitoring, wellhead protection, ground water allocation, well construction, wellfield design, facility siting, permitting, application of agricultural best management practices, remediation, and management of ground water dependent surface water features (springs, fens, lakes, rivers).

C. Other Funds Proposed to be Spent during the Project Period:

M.L. 2008

The USGS STATEMAP Program has granted MGS $88,356 toward completion of the surficial geologic map of Sibley County and the bedrock geologic maps of Nicollet and Sibley counties. These grants were leveraged by using the LCCMR grant as a match.

M.L. 2009
Proposals will be made for similar matches to selected products of the 2009 appropriation. Update: The USGS Statemap Program accepted the Anoka surficial and bedrock maps as projects and will contribute $68,525 in additional funds.

D. Spending History: LCMR provided funds for the Mankato State University, Water Resource Center to create and publish geologic atlases in the project area covered by the 2008 work plan.

VII. DISSEMINATION:

Geologic maps and databases prepared by the Minnesota Geological Survey will be available in GIS and other electronic formats on the MGS website, and in print.

VIII. REPORTING REQUIREMENTS:

Periodic work program progress reports will be submitted not later than 12/1/08, 7/1/09, 12/1/09, 7/1/10, 12/1/10, 6/30/11, 12/1/11, 6/30/12 **A final work program report and associated products will be submitted between June 30 and August 1, 2009 and again between June 30 and August 1,2010 as requested by the LCCMR**

IX. RESEARCH PROJECTS:

Attachment A: Budget Detail for 2008 Projects -

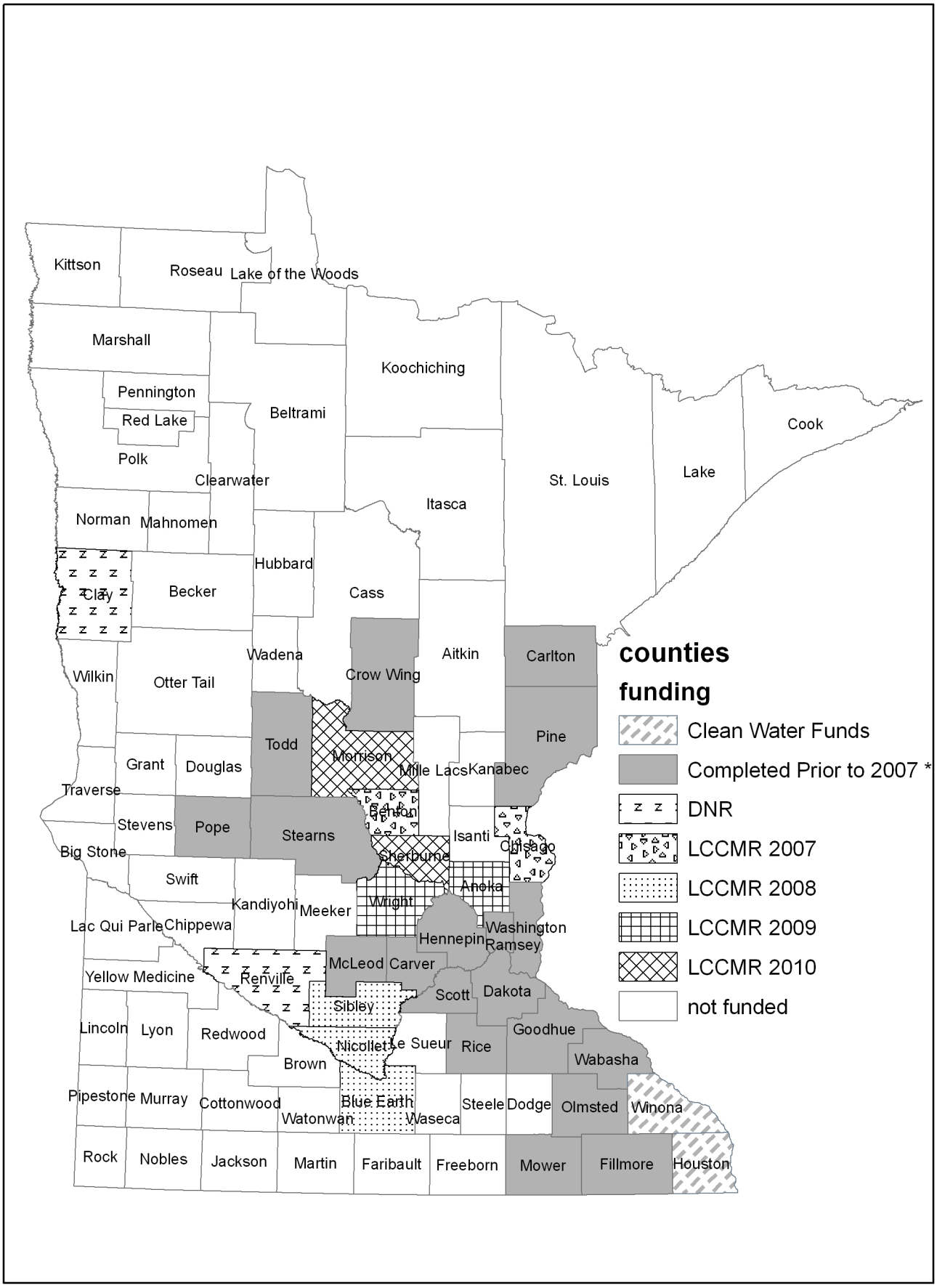
Project Title: South-Central Minnesota County Geological Atlases

Project Manager Name: Dale Setterholm, MGS

Trust Fund Appropriation: $ 706,000

2008 Trust Fund Budget	**Result 3 (MGS) Budget:**	**Revised Result 3 Budget** 8/9/10	**Amount Spent** (6/30/2011)	**Balance** *(6/30/2011)*	**Result 4 (MGS) Budget:**	**Revised Result 4 Budget** 8/9/10	**Amount Spent** (6/30/2011)	**Balance** *(6/30/2011)*	**TOTAL BUDGET**	**TOTAL BALANCE**
	Part A County Geologic Atlases: Blue Earth, Nicollet, and Le Sueur Counties				*MGS support for DNR Drilling*					
BUDGET ITEM				0				0		
PERSONNEL: wages and benefits	~~$440,450~~	$449,336	$498,264	-$48,928	~~$69,962~~	$69,962	$44,977	$24,985	$519,298	-$23,943
Contracts									$0	$0
Other contracts *rotosonic drilling (Result 3)*	~~$125,000~~	$116,114	$116,114	$0	~~$0~~	$0		$0	$116,114	$0
Printing	~~$0~~	$0	$0	$0	~~$0~~	$0		$0	$0	$0
Supplies *(xeroxing, maps and publications, kraft envelopes, sample bags, sieves, banding for core samples)*	~~$12,750~~	$22,750	$16,751	$5,999	~~$5,310~~	$1,500	$191	$1,309	$24,250	$7,307
Travel expenses in Minnesota	~~$52,000~~	$42,000	$25,959	$16,041	~~$528~~	$4,338	$3,743	$595	$46,338	$16,636
COLUMN TOTAL	**~~$630,200~~**	**$630,200**	**$657,088**	**-$26,888**	**~~$75,800~~**	**$75,800**	**$48,912**	**$26,888**	**$706,000**	**$0**

Status of County Geologic Atlases



2006-1008 Project Abstract
For the Period Ending June 30, 2010

PROJECT TITLE: Lake Superior Research
PROJECT MANAGER: Steven M. Colman
AFFILIATION: Large Lakes Observatory, UMD
MAILING ADDRESS: 2205 E. 5th St.
CITY/STATE/ZIP: Duluth, MN 55812
PHONE: 218-726-6979
FAX: 218-726-6979
E-MAIL: scolman@d.umn.edu
WEBSITE www.d.umn.edu/llo

FUNDING SOURCE: Environment and Natural Resources Trust Fund and Great Lakes Protection Fund
LEGAL CITATION: M.L. 2006, Chap. 243, Sec. 20, Subd. 6
M.L. 2008, Chap. 367, Sec. 2, Subd. 4(i)
APPROPRIATION AMOUNT: 2006: $295,000
2008: $68,000

Overall Project Outcome and Results

There is a surprising lack of study and understanding of the ecosystems of the Great Lakes and their properties, especially in the deepwater basins. We know more about many marine systems than we know about the Great Lakes. With current concerns about the environmental health of the Great Lakes, studies supported through this project aimed to contribute to alleviating some of the unknowns. A series of studies were conducted that research the condition, functioning, and processes of Lake Superior, its sediments, and its ecosystem including:

- Studies related to the entire living ecosystem, from top predator fish down to picoplankton.
- Studies of the circulation of the lake using numerical models and oceanographic instrumentation.
- Studies of the water column including the balance between CO_2 production and oxygen consumption, the processes related to the fate of organic matter and nutrients, and the effect of these and other water column processes on primary producers.
- Studies of the transport and delivery of organic and inorganic materials to the lake floor as sediments that accumulate in deep waters of the lake and the erosion, transport, and storage of coarse-grained sediment in coastal waters.

In all of these studies, we took a holistic, “physics to fish” approach, examining the interactions between physical and biological processes.

We conducted a total of 24 field projects, with project funds going primarily to the cost of using of our research ship for an aggregate of 53 days at sea. Project funds leveraged other funding as most of these studies were small pilot projects, extensions to projects funded from other sources, and projects to collect preliminary data often required for proposals to the national science agencies. The projects have a common theme of understanding the dynamics of Lake Superior, its sediments, and its ecosystem. Through these studies, we hope to provide Minnesotans, from lay citizens to environmental managers, a better understanding of how Lake Superior works and how it might change in response to climate change and human activity.

Project Results Use and Dissemination

We have now collected a wealth of environmental data for Lake Superior. A significant part of those data have already been used for larger research proposals to the National Science Foundation and other agencies, some of which have already been successful in bringing new federal funding into the state. Plans are for the results of studies supported through this project to be published in peer-reviewed journals where they will be available to Minnesota managers and regulators. With other funding, we are in the process of developing a system called the Global Great Lakes Data and Modeling Center, which will allow incorporation and assimilation of existing data, new data like those collected in this project, and ongoing real-time observational data. The Data and Modeling Center will allow numerical models to be run and compared in real time using the different data sets and make all data readily available though an internet interface.

Trust Fund 2006 and 2008 Final Report

Date of Report: April 16, 2010
Trust Fund 2006 and 2008 Final Report
Date of Work program Approval: June 13, 2006
Project Completion Date: Oct. 31, 2009

I. PROJECT TITLE: Lake Superior Research

Project Manager: Steven M. Colman
Affiliation: Large Lakes Observatory, UMD
Mailing Address: 2205 E. 5th St.
City / State / Zip : Duluth, MN 55812
Telephone Number: 218-726-8522
E-mail Address: scolman@d.umn.edu
FAX Number: 218-726-6979
Web Page address: www.d.umn.edu/llo

Location: Western Lake Superior, map attached to original work plan.

Total ENRT Project Budget:	**ENRT 2006 Appropriation:**	**$** 295,000
	ENRT 2008 Appropriation:	**$** 86,000
	Minus Amount Spent:	**$** 381,000
	Equal Balance:	**$** 0

Budget detail: Included in text of Results and Budget Spreadsheet.

Legal Citation: **M.L. 2006, Chap. 243, Sec. 20, Subd. 6**
M.L. 2008, Chap. 367, Sec. 2, Subd. 4(i)

2006 Appropriation Language:
$133,000 in fiscal year 2006 and $134,000 in fiscal year 2007 are appropriated to the Board of Regents of the University of Minnesota for the Large Lakes Observatory for research on Lake Superior waters. $28,000 in fiscal year 2007 from the Great Lakes protection account under Minnesota Statutes, section 116Q.02, is appropriated to the Board of Regents for the same purpose. This appropriation is available until June 30, 2009, at which time the project must be completed and final products delivered, unless an earlier date is specified in the work program.

2008 Appropriation Language:
$86,000 is from the Great Lakes protection account to the Board of Regents of the University of Minnesota for the Large Lakes Observatory for research on Lake Superior waters. This appropriation is added to Laws 2006, chapter 243, section 20, subdivision 6, Lake Superior research. This appropriation is available until June 30, 2011, at which time the project must be completed and final products delivered, unless an earlier date is specified in the work program.

II. and III. FINAL PROJECT SUMMARY AND RESULTS:

Overall Project Outcome and Results
There is a surprising lack of study and understanding of the ecosystems of the Great Lakes and their properties, especially in the deepwater basins. We know more about many marine

systems than we know about the Great Lakes. With current concerns about the environmental health of the Great Lakes, studies supported through this project aimed to contribute to alleviating some of the unknowns. A series of studies were conducted that research the condition, functioning, and processes of Lake Superior, its sediments, and its ecosystem including:

- Studies related to the entire living ecosystem, from top predator fish down to picoplankton.
- Studies of the circulation of the lake using numerical models and oceanographic instrumentation.
- Studies of the water column including the balance between CO_2 production and oxygen consumption, the processes related to the fate of organic matter and nutrients, and the effect of these and other water column processes on primary producers.
- Studies of the transport and delivery of organic and inorganic materials to the lake floor as sediments that accumulate in deep waters of the lake and the erosion, transport, and storage of coarse-grained sediment in coastal waters.

In all of these studies, we took a holistic, "physics to fish" approach, examining the interactions between physical and biological processes.

We conducted a total of 24 field projects, with project funds going primarily to the cost of using of our research ship for an aggregate of 53 days at sea. Project funds leveraged other funding as most of these studies were small pilot projects, extensions to projects funded from other sources, and projects to collect preliminary data often required for proposals to the national science agencies. The projects have a common theme of understanding the dynamics of Lake Superior, its sediments, and its ecosystem. Through these studies, we hope to provide Minnesotans, from lay citizens to environmental managers, a better understanding of how Lake Superior works and how it might change in response to climate change and human activity.

Project Results Use and Dissemination

We have now collected a wealth of environmental data for Lake Superior. A significant part of those data have already been used for larger research proposals to the National Science Foundation and other agencies, some of which have already been successful in bringing new federal funding into the state. Plans are for the results of studies supported through this project to be published in peer-reviewed journals where they will be available to Minnesota managers and regulators. With other funding, we are in the process of developing a system called the Global Great Lakes Data and Modeling Center, which will allow incorporation and assimilation of existing data, new data like those collected in this project, and ongoing real-time observational data. The Data and Modeling Center will allow numerical models to be run and compared in real time using the different data sets and make all data readily available though an internet interface.

IV. OUTLINE OF PROJECT RESULTS*:*

As noted above, project results to date include data collection activities aimed at a better understanding of the condition, functioning, and processes of Lake Superior, its sediments, and its ecosystem. The original three Results were part of funding in FY 2006, and they have been completed for more than a year. In early 2008, a new project, listed below as Result 4, was proposed and planned as described in that Result section. This Result has also been completed, as described below.

Result 1: Field research 2006

Description: A portfolio of research activity was conducted on Lake Superior in the summer of 2006. As mentioned in the Project Summary, these studies are small pilot studies, extensions to projects funded from other sources (see section VI-B), and activities to collect preliminary data often required for proposals to the National Science Foundation. The studies have a common theme of understanding the dynamics of Lake Superior, its sediments, and its ecosystem. All studies have been peer reviewed either by a funding agency or by a committee of scientists that use the RV Blue Heron, commonly both.

Costs paid for with Environment and Natural Resources Trust (ENRT) funds were entirely for field activities, observations, and data collection on board the RV Blue Heron, accounted for at the ship's day rate of $4654. The day rate includes crew, technician and ship manager salaries; insurance; and operational costs (fuel, food, garbage, dock fees, etc.). Total of cost of activities listed above was $65,156. Other sources of project funding (in some case, the main funding for the project) are listed with the individual projects.

Summary Budget Information for Result 1:	**ENRT Budget**	**$ 65,156**
	Expended	**$ 65,156**
	Balance	**$ 0**

Completion Date: Oct. 31, 2006

Final Report Summary: Research activities included:

1. (Wattrus, PI) June 4th-6th, in conjunction with an NSF-funded cruise. An acoustic survey of the western arm of Lake Superior to image the paleo-shorelines associated with earlier (Minong/Houghton) lowstands of the lake. Two days of ship time ($9,308) were paid with ENRT funds, and the National Science Foundation (NSF paid for an additional day, along with support for equipment usage and data analyses. Results: The paleo-shoreline features were located and imaged. The data are also being used to map the size and dimensions of the sediment fan associated with the Nemadji River.
2. (Hrabik, PI) July 26th – August 1st, in conjunction with a MN DNR-funded cruise for fish stock assessments. Four days of ship time ($18,616) were paid with ENRT funds. Two additional days were paid for by MN DNR. Results: These fish stock assessments, in cooperation with the MN DNR, are part of a long term monitoring program; this operation provided the monitoring data for 2006. In addition, with the additional ship time, Dr. Hrabik used both traditional trawling gear as well as hydroacoustic equipment to test the ability of hydroacoustic survey tools to accurately assess fisheries stock when compared to more traditional survey methods (trawls). Results of the comparison are being analyzed.
3. (Wattrus, PI) August 17th-18th. An acoustic survey of the distal sediment fan associated with the Silver Bay mine-tailings delta. Two days of ship time ($9,308) were paid with ENRT funds. Results: This was a pilot study to prepare for a future Sea Grant proposal. Data were collected to determine where the finer sediments derived from the delta turbidity currents have been deposited. These sediments have been mapped and will provide the necessary preliminary data for the Sea Grant proposal.
4. (Hrabik, PI) August 23rd-24th. Mysis nocturnal migration study. Two days of ship time ($9,308) were paid for with ENRT. This study was designed to collect preliminary data for a future NSF grant proposal. Results: The project used trawling to collect fish during the day, at night, and at dusk (for acoustic target id and diet information). The project also collected mysis using plankton tows at a variety of depths to

establish their density at depth during the day and at night. These data are now being analyzed to clarify some of the mysteries related to mysis migrations and the extent to which cisco feed on them during the day, dawn and dusk, as well as night periods.

5. (Brown, PI) October 5th. Supplemental operations for Brown's Sea Grant project. His project uses data from moored instruments to develop a more detailed understanding of biological gas cycling on daily as well as seasonal timescales. One day of ship time ($4,654) paid with ENRT funds. Results: This project supplemented a full two year Sea Grant project and allowed additional limnological data to be collected. These data have been analyzed and are being compiled for an MS thesis and eventual publication in a scientific journal.
6. (Colman, PI) Research activities and training for a variety of graduate, undergraduate, and minority students, using real world problems on Lake Superior. Cruises occurred on July 7th, September 14th and 16th, and October 2nd, 3rd, and 4th. Faculty in charge of the cruise included Drs. Branstrator, Johnson, and Shannon, and Ms. Hardwig and Sharp. Three days of ship time, $13,962. Results: Successful training a research experiences for a variety of students, some of whom are training as future researchers on Lake Superior.

Result 2: Field research 2007

Description: A portfolio of research activity was conducted on Lake Superior in the summer of 2007. As mentioned in the Project Summary, these studies are small pilot studies, extensions to projects funded from other sources (see section VI-B), and activities to collect preliminary data often required for proposals to the National Science Foundation. The studies have a common theme of understanding the dynamics of Lake Superior, its sediments, and its ecosystem. All studies have been peer reviewed either by a funding agency or by a committee of scientists that use the RV Blue Heron, commonly both.

Costs were entirely for field activities, observations, and data collection on board the RV Blue Heron, accounted for at the ship's day rate of $5385. The day rate includes crew, technician and ship manager salaries; insurance; and operational costs (fuel, food, garbage, dock fees, etc.). Total of cost of activities listed above was $110,390.

Summary Budget Information for Result 2:	**ENRT Budget**	**$ 110,390**
	Expended	**$ 110,390**
	Balance	**$ 0**

Completion Date: Oct. 31, 2007

Final Report Summary: Research activities for 2007 included:

1. Austin, PI, June 5th-7th and September 17th-19th – Deployment of a large meteorological buoy off of the North Shore. Six days of ship time, $32,310. Results: four months of data were collected including standard meteorological parameters as well as CO_2 content of the atmosphere and the water column. The fact that the LLO meteorological buoy has been successfully deployed and recovered was noted in a recently submitted National Science Foundation proposal and the buoy's data will be used in the funded project. Additionally, LLO's meteorological buoy was highlighted in a recently submitted GLOS (Great Lakes Observing System) proposal to NOAA (National Oceanic & Atmospheric Administration).
2. Hrabik, PI, May 15th-17th, July 24th – 26th and October 21st-23rd – ENRT funds paid for supplemental operations for Hrabik's SeaGrant project: a study of diurnal vertical

migration of Mysis, prey fish and predatory fish. Four and one-half days of ship time, $24,232, paid by ENRT funds with the remaining time paid by the Minnesota SeaGrant program. Results: Data were collected by trawling, plankton tows, hydroacoustic surveys and surveys using the Triaxus underwater towed vehicle. Hrabik obtained funding through SeaGrant using data collected during his 2006 ENRT funded cruise. This study will help clarify some of the mysteries related to mysis migrations and their interactions with prey and predatory fish during the day, dawn and dusk as well as night periods.

3. Hrabik, PI, August 4th-10th– Fish stock assessment in cooperation with the MN & WI DNR: additional operations in a cooperative project using funds from ENRT, the MN DNR and the WI DNR. Using traditional trawling gear as well as hydroacoustic equipment, Dr. Hrabik tests the ability of hydroacoustic survey tools to accurately assess fisheries stock when compared to more traditional survey methods (trawls). Three days of ship time, $16,155, paid by ENRT funds with the remaining time paid by the MN and WI DNR. Results: These fish stock assessments, in cooperation with the MN and WI DNR, are part of a long term monitoring program. This operation provided the monitoring data for 2007.
4. Minor, PI, August 26th – Preliminary sampling of dissolved organic carbon (DOC), dissolved inorganic carbon (DIC), and particulate organic carbon (POC) from the Lake Superior water column. One day of ship time, $5,385. Results: Dr. Minor collected a water column profile of DOC, DIC and POC and is undertaking radiocarbon analyses to investigate Lake Superior's carbon cycle. The data support a currently funded Grant-in-Aid award and will be used in a February, 2008, National Science Foundation proposal.
5. Sterner, PI , July 30th-August 1st, October 5th-7th, November 7th-9th – ENRT paid for supplemental operations for Sterner's Sea Grant project: a study of primary production and grazing dynamics in Lake Superior. Two days of ship time, $10,770, paid by ENRT with the remaining time paid by the Minnesota SeaGrant program and the University of Minnesota's Office of the Vice President for Research. Results: Data were collected using our CTD/water sampling system and by using a free-floating buoy system. Ultimately, this study will improve estimates of lake wide primary productivity and make the first estimates of grazing on phytoplankton and bacterioplankton. The resulting data will be used in subsequent proposals to the National Science Foundation and SeaGrant.
6. Wattrus, PI, October 12th – Geophysical survey of underwater (drowned) beach ridges formed during the Houghton Lowstand. One half-day of ship time, $2,693. Results: This work was a continuation of the 2006 Wattrus ENRT/NSF funded survey of the paleo-shorelines associated with a previous lowstand of Lake Superior. The survey was used to identify likely sediment coring sites to collect sediment to help date the lowstands. The resulting data will be used as preliminary results for an NSF proposal that will seek funding to further delineate paleo-shorelines for Lake Superior.
7. Colman, PI - Research activities and training for a variety of graduate and undergraduate students using real world problems on Lake Superior. Cruises occurred on May 1st and 19th, July 6th, September 11th, and October 8th, 9th and 10th. Faculty in charge of the cruises included Drs. Branstrator, Danz, Gallup, Little, Morton and Ricketts and Ms. Sharp. Three and a half days of ship time, $18,848. Results: Successful training and research experiences for a variety of students, some of whom are training as future researchers on Lake Superior.

Result 3: Field research 2008

Description: A portfolio of research activity was conducted on Lake Superior in the summer of 2008. As mentioned in the Project Summary, these studies are small pilot studies, extensions to projects funded from other sources (see section VI-B), and activities to collect preliminary data often required for proposals to the National Science Foundation. The studies have a common theme of understanding the dynamics of Lake Superior, its sediments, and its ecosystem. All studies have been peer reviewed either by a funding agency or by a committee of scientists that use the RV Blue Heron, commonly both.

Costs are entirely for field activities, observations, and data collection on board the RV Blue Heron, accounted for at the ship's day rate of $5,556. The day rate includes crew, technician and ship manager salaries; insurance; and operational costs (fuel, food, garbage, dock fees, etc.). Total of cost of activities listed above is $119,454, which was charged during the field season.

Summary Budget Information for Result 3:		
	ENRT Budget	**$ 119,454**
	Expended	**$ 119,454**
	Balance	**$ 0**

Completion Date: Oct. 31, 2008

Final Report Summary: Research activities for 2008 included:

1. Austin, PI, June 13th-16th – Deployment of a meteorological buoy off of the North Shore and three subsurface buoys throughout the rest of Lake Superior. One day of ship time, $5,556. Results: five months of data were collected including standard meteorological data as well as fluctuations in water column temperature. On the basis of data from 2008 and previously years (also ENRT supported), Austin was recently funded by the National Science Foundation (NSF) for three more years of data collection using the meteorological buoy and the subsurface buoys. Data from the North Shore meteorological buoy was available to the public online while the buoy was deployed.
2. Brown, PI, August 28th-29th – Preliminary sampling of waters in the western arm of Lake Superior to determine dissolved oxygen content for calculations of deep water respiration. Two days of ship time, $11,112. Results: Brown was able to determine that coastal deep water oxygen content is higher than off-shore deep water oxygen content in late summer. This indicates that near shore deep water respiration is higher than off-shore deep water respiration, which brings into question previous calculations of Lake Superior primary productivity. These data will be used in future proposals submitted to NSF and the Sea Grant program.
3. Hrabik, PI, May 28th-30th, July 23rd-25th, and October 23rd-25th – ENRT paid for supplemental operations for Hrabik's Sea Grant study of diurnal vertical migration of Mysis, prey fish, and predatory fish.. The project required nine days on board the Blue Heron during 2008, of which ENRT paid for 3.5 days. The remaining ship time necessary for the project were paid by the Minnesota Sea Grant program. Three and one-half days of ship time, $19,446. Results: data were collected by trawling, plankton tows, hydroacoustic surveys and surveys using the Triaxus underwater towed vehicle. Hrabik obtained funding through Sea Grant on the basis of data collected during his 2006 ENRT-funded cruise. This study will help clarify some of the mysteries related to mysis migrations and their interactions with prey and predatory fish during the day, dawn and dusk, as well as night periods.

4. Hrabik, PI, August 6th-12th – Fish stock assessment in cooperation with the DNR: additional operations in a cooperative project using funds from ENRT, the MN DNR and the WI DNR. Using traditional trawling gear as well as hydroacoustic equipment, Dr. Hrabik is testing the ability of hydroacoustic survey tools to accurately assess fisheries stock when compared to more traditional survey methods (trawls). Three days of ship time, $16,668. Four additional days of ship time were paid by MN and WI DNR. Results: These fish stock assessments, in cooperation with the MN and WI DNR, are part of a long term monitoring program. This operation provided the monitoring data for 2008.
5. McNeill, PI, August 26th - Supplemental operations for McNeill's NSF project: 'Singlet oxygen's role in the photochemical-biochemical degradation of dissolved organic carbon.' The study intends to determine the impact of oxygen on microbial use of organic matter in Lake Superior. One half-day of ship time, $2,778. Results: McNeill was able to extend the data set he has collected over the last six years. His current NSF grant has ended so this cruise was extremely valuable for maintaining continuity in his data set, strengthening any future proposals.
6. Minor, PI, May 20th-23rd and September 23rd-26th- Undertook preliminary sampling of the Lake Superior water column to determine dissolved organic carbon (DOC), dissolved inorganic carbon (DIC) and particulate organic carbon (POC) content. Minor is undertaking radiocarbon analyses of these various forms of carbon to investigate Lake Superior's carbon cycle. Two days of ship time, $11,112. Results: Dr. Minor used data from this and previously ENRT-funded cruises in a successful NSF proposal to continue these measurements throughout the lake through 2010.
7. Sterner, PI, April 29th-May 1st, July 30th-August 1st and September 16-18th - ENRT paid for supplemental operations for Sterner's Sea Grant project: a study of primary production and grazing dynamics in Lake Superior. Two and one half days of ship time, $13,890, paid by ENRT, with the remaining time paid by the Minnesota Sea Grant program and the University of Minnesota's Office of the Vice President for Research. Results: Data were collected using our CTD/water sampling system and by using a free-floating buoy system. Ultimately, this study will improve estimates of lake wide primary productivity and make the first estimates of grazing on phytoplankton and bacterioplankton. The resulting data will be used in subsequent proposals to the National Science Foundation and Sea Grant.
8. Werne, PI, May 20th-23rd and September 23rd-26th – Supplemental operations for Werne's NSF project: 'Linking archaeal membrane lipids and ecology in great lakes: Understanding the TEX86 paleotemperature proxy'. Werne's project proposes to better understand crenarchaeota, an aquatic organism that is poorly understood, but whose membrane structures might be useful in reconstructing past lake temperature. Four and one half days of ship time, $25,002. Results: ENRT funding allowed for an extension of this NSF funded project. By allowing Werne to extend his project by deploying and recovering moorings during 2008, additional data were collected which may be useful in getting additional funding from NSF.
9. Colman, PI - Research activities and training for a variety of graduate and undergraduate students using real world problems on Lake Superior. Cruises occurred on May 6th, September 11th, 13th, 20th, and October 1st. Faculty in charge of the cruises were Drs. Gallup, Johnson and Werne and Ms. Sharp. Two and half days of ship time, $13,890. Results: Successful training and research experiences for a variety of students, some of whom are training as future researchers on Lake Superior.

Result 4: Buoy observations on Lake Superior in 2008-09

Description: This result was added to the Project in January, 2008, as a result of a supplemental application for funds from the Great Lakes Protection Account (see supplemental appropriation language). Jay Austin, the PI, deployed a large meteorological buoy off of the North Shore as well as three subsurface moorings in Eastern, Central and Western Lake Superior. The meteorological buoy measures standard meteorological parameters (humidity, wind speed, air temperature, cloudiness), as well as water temperature at multiple depths in the water column. The subsurface moorings measure water temperature at multiple depths. Using this information, in conjunction with satellite data (indicating, for example, the extent of ice cover) Austin will, among other things, gain a better understanding of the relationship between ice cover and water temperature in Lake Superior. This, in turn, will give us a better understanding of the effect of regional climate on lake temperature and lake level. Data collected from this buoy and moorings will be used to augment a NSF-funded project Austin currently is conducting and a GLOS (Great Lakes Observing System) project in which Austin is participating. Both of these related proposals are currently active, and the work described here is an extension of research that has been peer reviewed in two published scientific journal articles.

Costs are for 12 days of ship time for field activities, observations, and data collection on board the RV Blue Heron, accounted for at the ship's day rate of $5,556, totaling $66,672. The day rate includes crew, technician and ship manager salaries; insurance; and operational costs (fuel, food, garbage, dock fees, etc.). An additional cost is approximately 16 weeks of technician salary and benefits ($19,328), before and after the field operations, for mobilizing and demobilizing the buoys. Total of cost of activities listed above is $86,000.

Summary Budget Information for Result 4:	**ENRT Budget**	**$ 86,000**
	Expended	**$ 86,000**
	Balance	**$ 0**

Result Status as of March 1, 2010: Completed.

Final Report Summary:

During 2008 the supplemental funds paid for ship time on June 13-16th (three days), September 3rd-6th (four days) and October 30th (one half day). Seven and one half ship days: $41,670. Five months of data were collected including standard meteorological data as well as fluctuations in water column temperature. Data from the North Shore meteorological buoy was available for five months to the public online while the Meteorological buoy was deployed. The subsurface buoys were redeployed in September and will be collecting data under the ice during the winter. In addition, technician salary and benefits ($19,328) were accrued for mobilization and demobilization of the buoys.

During 2009, we used four and one half additional ship days ($25,002) on this project to deploy and recover the meteorological buoys and a total of seven subsurface buoys. As a result of these two seasons of data collection on Lake Superior, we now have an unparalleled set of observations of physical properties of the water column through the changing seasons. This is especially true of the temperature field of the water column, which drives the overall circulation of the lake. We also have some of the first continuous measurements of in-situ ice extent and thickness anywhere in the world. These data are currently being analyzed and promise to lead to a new understanding of seasonal changes in Lake Superior.

V. TOTAL ENRT PROJECT BUDGET:

All Results: Personnel: $19,328
All Results: Equipment: $ 0
All Results: Development: $ 0
All Results: Acquisition: $ 0
All Results: Other: Field observations and data collection costs $ 361,672

TOTAL ENRT PROJECT BUDGET: $381,000

Explanation of Capital Expenditures Greater Than $3,500: none

VI. OTHER FUNDS & PARTNERS:

A. Project Partners:

1. Several partners from the Large Lakes observatory at the University of Minnesota Duluth, including Steven Colman, Nigel Wattrus, Jay Austin, Elizabeth Minor, Thomas Johnson, Erik Brown, and Josef Werne.
2. Several partners from science Departments at the University of Minnesota Duluth, including Donn Branstrator, Thomas Hrabik, Timothy Demko, James Miller, Angela Sharp Nick Nanz, Christina Gallup, and Amanda Little.
3. Several partners from science departments at the University of Minnesota Twin Cities, including Robert Sterner, James Cotner, Christopher McNeill

The partners are involved with different projects at different times. The distribution of funds to the project Principle Investigator is listed with each project above.

B. Other Funds being Spent during the Project Period:

Summary of other funds related to the projects listed for Results 1-4, with sources and approximate amounts. These projects either (1) were funded as a result of pilot projects funded by the ENRT grant, (2) were enhanced and expanded by ENRT funding of field operations, or (3) are related to and ran concurrently with the ENTR project. They include:

1. National Science Foundation, $ 3,100,000
2. Minnesota Sea Grant, $380,000
3. Minnesota Dept. of Natural Resources, $210,000
4. Great Lakes Observing System (GLOS), $52,000

C. Required Match (if applicable): Not applicable

D. Past Spending: None

E. Time: Appropriation language extends project until June 30, 2011.

VII. DISSEMINATION:

Plans are for the results of all of these projects to be published in peer-reviewed journals and presented at national meetings. The results will also be presented to state environmental managers where appropriate. The results will also be available on the web site of the Large Lakes Observatory (www.d.umn.edu/llo).

VIII. REPORTING REQUIREMENTS:

Periodic work program progress reports will be submitted not later than:
Dec. 31, 2006 (submitted)

May 31, 2007 (submitted)
Dec. 31, 2007 (submitted)
May 31, 2008 (submitted)
Jan. 15, 2009 (submitted)
April 16, 2010 (this report, final)

IX. RESEARCH PROJECTS:

Research projects are listed along with a brief description in the Outline of Project Results (Section IV).

Attachment A: Budget Detail for 2005 Projects - **Summary and a Budget page for each partner (if applicable)**

Proposal Title: *Fill in your proposal title and Proposal # (A-01)*

Project Manager Name: *Fill in your name.*

LCMR Requested Dollars: $ *Fill in the dollar amount you are requesting.*
1) See list of non-eligible expenses, do not include any of these items in your budget sheet
2) Remove any budget item lines not applicable

2005 LCMR Proposal Budget	**Result 1 Budget:**	**Result 1 Budget, revised:**	**Amount Spent** *(12/31/06)*	**Balance** *(4/21/08)*	**Result 2 Budget:**	**Result 2 Budget, revised:**	**Amount Spent** *(12/31/07)*	**Balance** *(4/21/08)*	**Result 3 Budget:**	**Result 3 Budget, revised:**	**Amount Spent** *(10/31/08)*	**Balance** *(10/31/08)*	**Result 4 Budget:**	**Amount Spent** *(11/01/09)*	**Balance** *(6/25/09)*	
	Field research 2006				*Field research 2007*				*Field research 2008*				*Field research 2008-9*			TOTAL FOR BUDGET ITEM
BUDGET ITEM																
PERSONNEL: Staff Expenses, wages, salaries													**14,496**	**14,496**	**0**	**14,496**
PERSONNEL: Staff benefits –													**4,832**	**4,832**	**0**	**4,832**
Contracts																
Professional/technical *(with whom?, for what?)*																
Other contracts *(with whom?, for what?) list out: personnel, equipment,*																
Other direct operating costs *(for what? – be specific)*																
Equipment / Tools *(what equipment? Give a general description and cost)*																
Office equipment & computers - NOT ALLOWED unless unique to the project																
Other Capital equipment *(list specific items)*																
Land acquisition *(how many acres)*																
Land rights acquisition *(less than fee)*																
Printing																
Other Supplies *(list specific categories)*																
Travel expenses in Minnesota																
Travel outside Minnesota *(where?)*																
Construction *(for what?)*																
Other land improvement *(for what?)*																
Other: Field observations and data collection on board the RV Blue Heron at the ship's day rate of $4654 (increasing after 1st yr). Includes crew, technician and ship manager salaries; insurance; and operational costs (fuel, food, garbage, dock fees, etc.)	**67,483**	**65,156**	**65,156**	**0**	**113,759**	**110,390**	**110,390**	**0**	**113,758**	**119,454**	**119,454**	**0**	**66,672**	**66,672**	**0**	**361,672**
COLUMN TOTAL	**67,483**	**65,156**	**65,156**	**0**	**113,759**	**110,390**	**110,390**	**0**	**113,758**	**119,454**	**119,454**	**0**	**86,000**	**86,000**	**0**	**381,000**

2008 Project Abstract
For the Period Ending June 30, 2011

PROJECT TITLE: Updating the National Wetlands Inventory in Minnesota
PROJECT MANAGER: Steve Kloiber
AFFILIATION: Minnesota Department of Natural Resources
MAILING ADDRESS: 500 Lafayette Road North, Box 25
CITY/STATE/ZIP: St. Paul, MN 55155
PHONE: 651-259-5164
E-MAIL: steve.kloiber@state.mn.us
WEBSITE: http://www.dnr.state.mn.us/eco/wetlands/nwi_proj.html
FUNDING SOURCE: Environment and Natural Resources Trust Fund
LEGAL CITATION: M.L. 2008, Chap. 367, Sec. 2, Subd. 5(a)

APPROPRIATION AMOUNT: $550,000

Overall Project Outcome and Results
Over the past 100 years, about half of Minnesota's original 22 million acres of wetlands have been drained or filled. Some regions of the State have lost more than 90 percent of their original wetlands. Urban development, agricultural drainage, mining, road construction, and utility projects result in additional losses each year. The National Wetland Inventory (NWI) is the only comprehensive inventory of wetlands for Minnesota, but it is inaccurate in many places because it is 25-30 years out-of-date. Updating the NWI is a key component of the State's strategy to monitor and assess wetlands in support of efforts to assure healthy wetlands and clean water for Minnesota.

This project is the first phase of a multi-phase effort to update the NWI for all of Minnesota. Under this project, the project team:

(1) developed wetland mapping standards and quality control objectives to assure that the final product can meet the broad array of data needs for various stakeholders,
(2) developed a request for proposal that incorporates these standards and objectives,
(3) acquired high-resolution, spring, leaf-off, digital aerial photography for northeastern and east-central Minnesota (22,500 square miles),
(4) developed updated wetland mapping procedures for northeastern and east-central Minnesota that incorporate modern high-resolution digital imagery, radar imagery, and LiDAR elevation data,
(5) provided training to DNR and Ducks Unlimited staff (total of six people) on the application of the updated wetland mapping procedures, and
(6) performed initial data processing for updating NWI maps for east-central Minnesota and northern Koochiching County.

Subsequent phases of this project are focused on producing updated NWI maps for five different regions of Minnesota; east-central, southern, northeastern, central-lakes, and northwestern. These subsequent phases will also include the continuation of the imagery acquisition for the southern, northeastern, and central-lakes regions.

Project Results Use and Dissemination

The wetland mapping standards and quality assurance objectives developed through this project are presented in reports found on the project website (http://www.dnr.state.mn.us/eco/wetlands/nwi_proj.html). Imagery acquired as part of this project are freely available to the public through the Minnesota Geospatial Information Office website (http://www.mngeo.state.mn.us/chouse/wms/geo_image_server.html). The imagery for northeastern Minnesota receives an average of about 62,000 requests per month and the imagery for east-central Minnesota receives an average of more than 300,000 requests per month. Wetland mapping procedures based on pilot studies in northeast and east-central Minnesota are contained in two separate reports. Three hard copies and one electronic copy on CD have been submitted with the final project report to LCCMR. Presentations and workshops have been provided by the University of Minnesota regarding the updated wetland mapping methods as described above.

Environment and Natural Resources Trust Fund 2008 Work Program
Final Report

Date of Report: August 31, 2011 *(Final Report)*
Date of Work program Approval: June 17, 2008
Project Completion Date: June 30, 2011

I. PROJECT TITLE: **Updating the National Wetlands Inventory in Minnesota**

Project Manager: Steve Kloiber
Affiliation: Minnesota Dept. of Natural Resources
Mailing Address: 500 Lafayette Road, Box 25
City / State / Zip: St. Paul, MN 55155
Telephone Number: 651-259-5164
E-mail Address: steve.kloiber@state.mn.us
FAX Number: 651-296-1811
Web Page address:

Location: Acquisition of spring, leaf-off imagery was conducted for northeastern and east-central Minnesota (see figure 1) Pilot tests for wetland mapping were conducted for two selected sites representing different land cover types: Chanhassen, MN (urban/suburban) and the Fond du Lac Reservation (forested). Initial data processing for updating wetland maps was conducted for east-central Minnesota and northern Koochiching County.

Total Trust Fund Project Budget:	**Trust Fund Appropriation:**	$	550,000
	Minus Amount Spent:	$	542,476
	Equal Balance:	$	7,533

Legal Citation: M.L. 2008, Chap. 367, Sec. 2, Subd. 5(a)

Appropriation Language:
$550,000 is from the trust fund to the commissioner of natural resources to begin updating the National Wetlands Inventory through standards development, mapping, training, and imagery acquisition. This is the first phase of an overall effort to update the inventory statewide. This appropriation is available until June 30, 2011, at which time the project must be completed and final products delivered, unless an earlier date is specified in the work program.

II. and III. FINAL PROJECT SUMMARY:
Over the past 100 years, about half of Minnesota's original 22 million acres of wetlands have been drained or filled. Some regions of the State have lost more than 90 percent of their original wetlands. Urban development, agricultural drainage, mining, road construction, and utility projects result in additional losses each year. The National

Wetland Inventory (NWI) is the only comprehensive inventory of wetlands for Minnesota, but it is inaccurate in many places because it is 25-30 years out-of-date. Updating the NWI is a key component of the State's strategy to monitor and assess wetlands in support of efforts to assure healthy wetlands and clean water for Minnesota.

This project is the first phase of a multi-phase effort to update the NWI for all of Minnesota. Under this project, the project team:

(1) developed wetland mapping standards and quality control objectives to assure that the final product can meet the broad array of data needs for various stakeholders,
(2) developed a request for proposal that incorporates these standards and objectives,
(3) acquired high-resolution, spring, leaf-off, digital aerial photography for northeastern and east-central Minnesota (22,500 square miles),
(4) developed updated wetland mapping procedures for northeastern and east-central Minnesota that incorporate modern high-resolution digital imagery, radar imagery, and LiDAR elevation data,
(5) provided training to DNR and Ducks Unlimited staff (total of six people) on the application of the updated wetland mapping procedures, and
(6) performed initial data processing for updating NWI maps for east-central Minnesota and northern Koochiching County.

Subsequent phases of this project are focused on producing updated NWI maps for five different regions of Minnesota; east-central, southern, northeastern, central-lakes, and northwestern. These subsequent phases will also include the continuation of the imagery acquisition for the southern, northeastern, and central-lakes regions.

IV. OUTLINE OF PROJECT RESULTS*:*

Result 1: Standards Development and Quality Control

Description: The first result of the project focuses on clearly defining mapping objectives (e.g. minimum mapping unit, classification detail, positional accuracy, etc.) to assure the final product can meet the broad array of data needs for the project partners and other stakeholders. This task involves establishing an inter-agency technical advisory committee (TAC) to develop mapping standards and specifications that can be used to review options for map production. The TAC will be consulted throughout the project to provide technical feedback on data deliverables and quality control. A series of meetings will also be held involving end-users around the state to identify data needs. This project component will also entail development of a Request for Proposal for updating the NWI data in the initial 13-county project of east-central Minnesota area. A project coordinator will be hired by the DNR (0.65 FTE, funded over two years) to be responsible for convening and coordinating the efforts of the TAC, completing the deliverables for this Result, and coordinating the completion of Results 2 and 3. Additional tasks under this Result will include purchasing a computer specifically for this project and travel for stakeholder outreach, consultation with other wetland mapping professionals, and training.

Summary Budget Information for Result 1:	**Trust Fund Budget:**	**$85,080**
	Amount Spent:	**$80,682**
	Balance:	**$4,398**

Deliverable	**Completion Date**	**Budget**	**Status**
1. Data standards & specs	03/2010	$54,140	Complete
2. Prepare RFP & contract	09/2010	$30,940	Complete

Final Report Summary: The DNR hired a project manager to oversee the NWI update project. A technical advisory committee comprised of wetland and GIS mapping experts from various federal, state, and regional agencies was formed to provide advice and provide guidance on technical issues.

A comprehensive project plan was developed covering all phases of a complete, state-wide update of the NWI for Minnesota. A web-based survey was created to obtain input from end users of the NWI data in order to determine what their requirements are for an update of the NWI. Several individuals responding to the survey were contacted for detailed follow-up interviews. Information gained from the survey and interviews was incorporated into a document describing the user requirements for the NWI update. A detailed literature review was also performed on quality assurance procedures for wetland mapping. This information was used to develop a quality assurance project plan for the NWI update. The comprehensive project plan, the user requirements document, and the quality assurance project can all be found on the project website (http://www.dnr.state.mn.us/eco/wetlands/nwi_proj.html). This information was all summarized and presented to the technical advisory committee for review. Results were also presented at a stakeholder meeting held at Fort Snelling State Park (February 25, 2010) and at the Minnesota Wetland Professionals Annual Conference (January 19, 2011), to solicit feedback. Comments received were used to refine these documents.

The information from the user requirements document and the quality assurance plan were then incorporated into a formal request for proposal (RFP) for wetland mapping that was reviewed by the technical advisory committee. The final RFP provides a clear, detailed technical description of the wetland mapping standards for the NWI update. The RFP was noticed in the State Register in July 2010 to select a contractor to update the NWI for the first phase project area, 13 counties in east-central Minnesota. The NWI update work is currently underway, funded by the ENTRF through a subsequent grant.

The remaining balance of $4,398 for this result is largely due to lower than estimated costs for travel and equipment.

Result 2: Data Acquisition

Description: This Result focuses on acquisition of both imagery and field data. Funds for imagery acquisition will be directed toward obtaining high-resolution, leaf-off imagery for the high-priority mapping areas including three counties in northeast Minnesota and thirteen counties in east-central Minnesota. To preserve the imagery data, a data storage device will be purchased by the Minnesota DNR and copies of the data are also stored

off-site at the Minnesota Geospatial Information Office (MnGeo). This Result also includes the collection of field validation data to coincide with the imagery acquisition. At least 500 sites will be visited by the Univ. of Minn. Remote Sensing and Geospatial Analysis Laboratory (UMN) to provide an independent check on the accuracy of updated wetland maps created from the imagery. The cost of field data acquisition is $82,000.

Summary Budget Information for Result 2:	**Trust Fund Budget:**	**$196,344**
	Amount Spent:	**$194,007**
	Balance:	**$2,337**

Deliverable	**Completion Date**	**Budget**	**Status**
1. Statewide, high resolution, Summer CIR imagery	08/2008	$0	Complete
2. Spring leaf-off imagery for northeastern MN	08/2009	$10,867	Complete
3. Spring leaf-off imagery for east-central MN	12/2010	$77,018	Complete
4. Field validation data collection for northeast and east-central MN	12/2010	$89,107	Complete
5. Data storage for imagery	1/2011	$19,352	Complete

Final Report Summary: This task originally had only one deliverable and that was to partner with the USDA Farm Service Agency on a statewide summer aerial imagery acquisition project (1-meter spatial resolution) by providing funding to add color-infrared data to the acquisition. Through negotiations with the State, FSA agreed to add the color-infrared data at no cost to this project. This allowed the NWI project to redirect funding to acquiring spring imagery which is also important for accurately mapping wetlands.

A work plan amendment was approved to add the acquisition of spring leaf-off imagery (half-meter and one-foot spatial resolution) for northeastern Minnesota (15,400 square miles) and east-central Minnesota (7,100 square miles). The areas for which spring aerial imagery was acquired are shown in figure 1. This imagery was collected digitally with four spectral bands; blue, green, red, and near-infrared. Positional accuracy of the imagery was tested and found to be accurate within ±11.5 feet. This imagery is being made publicly available through a web mapping service provided by the Minnesota Geospatial Information Office. The imagery for northeastern Minnesota receives an average of about 62,000 requests per month and the imagery for east-central Minnesota receives an average of more than 300,000 requests per month. Matching funds provided

by federal, state and local partners covered 86% of this imagery acquisition costs. We were able to leverage $79,642 from the Environmental and Natural Resources Trust Fund to garner $495,672 in matching funds. Garnering matching funds for imagery acquisition was significantly enhanced by having funding from the Environmental and Natural Resources Trust Fund to serve as seed funding.

The success in attracting matching funds allowed further expansion of the goals for this result. Another amendment was requested and granted to acquire a network attached storage device and off-site data back-up for the State's investment. This amendment also included a task to acquire field validation data for northeastern and east-central Minnesota. This data will be used to assess the accuracy of the updated NWI maps in these areas. The UMN completed acquisition of the field validation data for both east-central Minnesota (975 points) and northeast Minnesota (1508 points). The data was delivered to the DNR in the form of GIS data files along with photos of each site. The data will not be shared with the wetland mapping contractor in order to preserve the integrity of a blind accuracy assessment.

The remaining balance of $2,337 for this result is largely due to lower than expected costs for image acquisition and data storage.

Result 3: Methods Development

Description: The goal of this Result is to develop cost-effective and reliable mapping methods that meet the requirements of the Minnesota National Wetlands Inventory (NWI) update project. The methods development effort will be led by the University of Minnesota Remote Sensing and Geospatial Analysis Laboratory.

Specific steps:

1. Pilot area selection – Minnesota contains a wide range of ecoregions, including mixed boreal forest, glaciated plains, western corn-belt plains, north central hardwoods, and the driftless area. These ecoregions contain different types of wetlands; for example, the "prairie potholes" of the western corn-belt plains and the forested wetlands of the boreal forest region. To develop mapping methods that account for these varied wetland types, representative pilot areas will be selected in the different ecoregions of the state. Areas for which appropriate data are already available will be favored.

2. Mapping methods assessment -- The science of wetland mapping is in flux. New image data types and approaches show promise for improving upon previous methods. A variety of image data types and mapping approaches will be evaluated for their suitability for wetland mapping in the pilot areas and the state as a whole. This process will result in mapping methods tailored to the different wetland types in Minnesota. Specific data types and mapping methods to be evaluated include:
   a. Radar image data – Radar data is particularly sensitive to soil moisture. Radar signals are also able to penetrate forest canopy. As such, radar data are well suited to identify wetlands that do not have standing water and also forested wetlands that might otherwise be obscured by forest canopy. The Canadian government has begun using radar data in combination with color infra-red

imagery for mapping wetlands as a part of the Canadian Wetland Inventory. The cost for radar imagery will be $6000.

b. LiDAR image data – Data from light detection and ranging (LiDAR) provides highly detailed elevation data for ground features. The inclusion of LiDAR data in the mapping process can assist in identifying areas that may contain wetlands. LiDAR data are currently available for some locations in Minnesota. This data was evaluated to determine the increase in wetland mapping accuracy, if any, that is provided by using LiDAR data.
c. NAIP image data – In the summer of 2008, the USDA National Agricultural Image Program (NAIP) will collect high-resolution, digital aerial images for Minnesota. The normal procedure in wetland mapping calls for using images collected during the period between snow-melt and leaf emergence, so as to be able to identify forested wetlands before they are covered by tree canopies. The NAIP images are not acquired during this optimal period; however, NAIP images could still be of use to wetland mapping efforts. The NAIP images will be evaluated to determine whether they are suitable for wetland mapping in the pilot areas either alone or in combination with other data types (e.g. radar data).
d. Image segmentation – A developing image analysis technique called image segmentation will be evaluated. Traditional image processing techniques are used to discriminate different cover types based on analysis of image pixels. Image segmentation involves partitioning an image into groups of adjacent pixels (segments) based upon spectral properties, shape, and texture. Image segmentation may be useful for wetland mapping in areas where the spectral parameters of wetland versus non-wetland areas are similar but the texture is different.
e. Wetland probability maps – The current MN NWI delineates wetlands with polygons, so an area is either wetland or it is not. This is problematic for two reasons. First, natural wetlands rarely have such sharp boundaries. Depending on geologic setting and land use, the wetland to non-wetland transition may be very gradual, exhibited by dryer and dryer soil and slowly changing vegetative species the further one moves from the center of a wetland. Second, due to the gradual edge of some wetlands, determining where to draw the polygon boundary may be difficult. A wetland probability map is a continuous surface representing the likelihood that a particular image pixel is a wetland. The probabilities are derived from factors such as slope, elevation, aspect, soil type, and vegetative species present. The main advantage of using a probability map is that wetland boundaries are flexible and can be identified based on the needs of a particular application. Wetland probability maps were created for the pilot areas and were compared with wetland boundaries derived from traditional mapping approaches. If the probability maps are accurate and valuable, it may be possible to use this technique to assist with the statewide mapping, depending on data availability.

Some of the above data types are available for parts of the state, while some will have to be newly acquired.

Existing data sets

There are several LiDAR data sets for Minnesota – particularly in the Metro area. Some of these are available at no cost and some are subject to “cost recovery” programs. No

new LiDAR imagery is planned to be acquired as a part of this effort. The Metropolitan Council has spring leaf-off, four-band imagery for the Twin Cities Metropolitan Area from 2005 with a 0.6-m resolution. These images are available at no cost to MetroGIS partners. The DNR has scanned film-based CIR photos at high resolution under fall leaf color conditions for the forested portions of the State. The time period varies by location.

New data acquisition
NAIP/FSA will be collecting 1-meter resolution 3-band, color imagery for Minnesota in 2008. A fourth band in the near infrared is a possible add-on. Also, we can request acquisition of imagery in the forested regions to occur during leaf-off conditions. The cost will be between $70,000 and $200,000 for adding the NIR band. We will acquire Radarsat images for this project. These will be Fine-Scale (8-meter), C-band, 50-km x 50-km images at a cost of $4000/image. There is a possibility of obtaining limited, free imagery through the USFWS.

3. Mapping of pilot areas -- Updated wetland inventory maps will be created for the pilot areas using the data type(s) and mapping method that provide the highest accuracy for each area. These inventory maps will be provided to stakeholders and the public on an interim basis until the statewide NWI update is complete. An additional 600-square mile area will be mapped to full national wetland mapping standards by the DNR with assistance and guidance from the UMN and Ducks Unlimited.

4. Protocol development -- The best performing wetland mapping protocols will be identified. Specific protocols will be recommended for the different areas of the state. The protocols and instructions will be documented and released to the mapping team and other appropriate parties.

5. Training workshop for mapping team -- A workshop will be held in which the mapping team will be trained in the use of the wetland mapping protocols to increase mapping efficiency and accuracy. Additional hands-on training will be conducted. The mapping team's performance will be assessed and improved until it reaches the level required for this project. From 2-4 DNR employees will be trained through an on-the-job program to develop updated wetland inventory maps that meet the national wetland mapping standards.

6. Technical support during mapping -- During the duration of funding support to the University of Minnesota, support to the mapping team will be provided to resolve technical issues that may occur during mapping. These issues could involve protocol clarifications, modifications, and additions.

Summary Budget Information for Result 3: **Trust Fund Budget: $268,576**
Amount Spent: $267,778
Balance: $798

Deliverable	**Completion Date**	**Budget**	**Status**
1. Wetland maps for two pilot areas	12/2009	$101,146	Complete
2. Wetland mapping protocols	09/2010	$115,134	Complete

3. Training workshop for mapping team	10/2010	$5,380	Complete
4. Training for RA staff and wetland map for third pilot	6/30/11	$46,916	Nearly Complete

Final Report Summary:
The University of Minnesota Remote Sensing and Geospatial Analysis Laboratory conducted two pilot tests on wetland mapping methods; one for an urban/suburban area (Chanhassen, MN) and one for a northern-forested areas (the Fond du Lac Reservation). This work also included a literature review and additional information on wetland mapping methods was also obtained through surveys and interviews of national wetland mapping experts. Reports documenting recommendations for wetland mapping procedures for urban/suburban areas and forested areas were provided.

The recommended methods employ a combination of object-oriented image analysis, automated classification (e.g. RandomForest™ or CART™ classifiers), and manual photo-interpretation. Image segmentation of high-resolution, 4-band, aerial photography from both spring and summer are used to extract wetland and upland feature boundaries. The geometry and spectral characteristics from the extracted features are combined with additional data including satellite radar, airborne LiDAR derived DEMs, and soils data to train an automated classification algorithm. Results from the Chanhassen pilot indicate that the initial automated wetland classification separates wetlands from uplands with an overall accuracy rate of about 93% and assigns wetland class with an overall accuracy rate of about 86%. Results for the Fond du Lac pilot show somewhat weaker predictive power, but further research is underway to improve the predictive power for the forest area wetland probability model. The recommendations conclude that the automated classification output should be further processed through manual photo-interpretation to create the final update wetland inventory. New wetland maps were completed for two pilot areas: Chanhassen, MN and the Fond du Lac area near Cloquet, MN (see UMN report). These data will be made available to the production wetland mapping contractor for incorporation into the final NWI update.

A workshop was held at the University of Minnesota to share information about wetland mapping technology with the vendor selected for wetland mapping updates in the second phase grant (Ducks Unlimited). This workshop included presentations on wetland classification, using LiDAR and radar data for mapping wetlands, discussions of available imagery and GIS data, and identifying issues that remain to be resolved regarding wetland mapping methods.

The wetland mapping methods developed by the University of Minnesota were subsequently adapted by the DNR and its wetland mapping contractor (Ducks Unlimited) for wetland mapping efforts in east-central Minnesota. Remaining project funds were redirected through an approved work program amendment to the DNR Resource Assessment Office to provide support for efforts to update the NWI maps for east-central Minnesota and northern Koochiching County. This area was selected because the original NWI data for it were not very accurate and it was the only region for which we had both recent spring, leaf-off imagery as well as LiDAR elevation data.

DNR Resource Assessment acquired available LiDAR elevation data for wetland mapping areas in east-central MN and northern Koochiching County project areas. Additional elevation data from other sources were incorporated as needed. These elevation data were processed to create multiple derivative products including slope, curvature, topographic position index, and compound topographic position index. Satellite radar data from Radarsat2 was also acquired and processed.

The LiDAR and radar derived products for east-central MN were provided to Ducks Unlimited to develop a wetland probability model using the RandomForest™ classification algorithm. Information from this process was transferred back to DNR Resource Assessment, so that the same process could be applied to the northern Koochiching County project area. DNR Resource Assessment also partnered with Ducks Unlimited to acquire field data to train and validate wetland probability models.

Due to an unforeseen delay in the technology transfer and a delay in hiring a staff position at DNR Resource Assessment, the wetland probability layer for the northern Koochiching County project area was not completed by June 30. This work will be completed by the DNR at its own cost and made available as specified under the LCCMR work program.

V. TOTAL TRUST FUND PROJECT BUDGET:

Staff or Contract Services: $357,316 [$104,399 for 0.65 FTE Project Coordinator at DNR (unclassified, new hire); $46,917 for service level agreement with DNR Resource Assessment Office for mapping support services; $206,000 for contract with Univ. of Minnesota to evaluate mapping technologies]
Equipment: $22,809
Travel: $7,000
Imagery Acquisition: $80,875 (Acquisition of high-resolution, 4-band, spring leaf-off aerial imagery for east central and northeastern Minnesota (see map)).
Field Data Acquisition: $82,000

TOTAL TRUST FUND PROJECT BUDGET: $550,000

Explanation of Capital Expenditures Greater Than $3,500:

VI. OTHER FUNDS & PARTNERS:

A. Project Partners:

Joe Knight, Ph.D., of the University of Minnesota, Remote Sensing Laboratory will receive $206,000 for this project for Result 3.

Other unfunded partners for this project include the Minnesota Pollution Control Agency, the Minnesota Board of Water and Soil Resources, the U.S. Fish and Wildlife Service, the Metropolitan Council, and the Minnesota Dept. of Administration, Land Management Information Center.

B. Other Funds Proposed to be Spent during the Project Period: The full cost of acquiring statewide, high-resolution, summer leaf-on aerial imagery for this project is $1.37 million. Of this cost, the Farm Services Agency will fund $900,000; other state sources will provide $450,000. We were also able to leverage $79,642 from the Environmental and Natural Resources Trust Fund to garner $495,672 in matching funds for spring, leaf-off imagery acquisition. Matching funds came from a variety of sources including; National Geospatial Intelligence Agency (via U.S. Geological Survey), Metropolitan Council, Minnesota Pollution Control Agency, National Oceanographic and Atmospheric Administration, St. Louis County, and Metropolitan Mosquito Control District.

The unfunded partners listed above will provide approximately $20,000 of in-kind staff time in support of this project.

C. Past Spending: In-kind staff time devoted to planning for this project amounts to approximately $5,000.

D. Time: This is the first phase of a long-term project to update the National Wetlands Inventory for all of Minnesota. The second phase of this project was funded through ENTRF starting July 1, 2010 and funds for a third phase will be made available on July 1, 2012. Three additional phases are anticipated to complete the statewide update of the NWI by 2019.

VII. DISSEMINATION: The comprehensive project plan, the user requirements document, and the quality assurance plan developed for this project are found on the project website (http://www.dnr.state.mn.us/eco/wetlands/nwi_proj.html). Imagery acquired for this project is freely available to the public through the Minnesota Geospatial Information Office (http://www.mngeo.state.mn.us/chouse/wms/geo_image_server.html). Wetland mapping procedures based on pilot studies in northeast and east-central Minnesota are contained in two separate reports. Three hard copies and one electronic copy on CD have been submitted with the final project report to LCCMR. Presentations and workshops have been provided by the University of Minnesota regarding the updated wetland mapping methods as described above.

VIII. REPORTING REQUIREMENTS:
Periodic work program progress reports were submitted on January 2009, July 2009, January 2010, July 2010, and January 2011. A final work program report and associated products was be submitted August 31, 2011 as requested by the LCCMR.

IX. RESEARCH PROJECTS: N/A

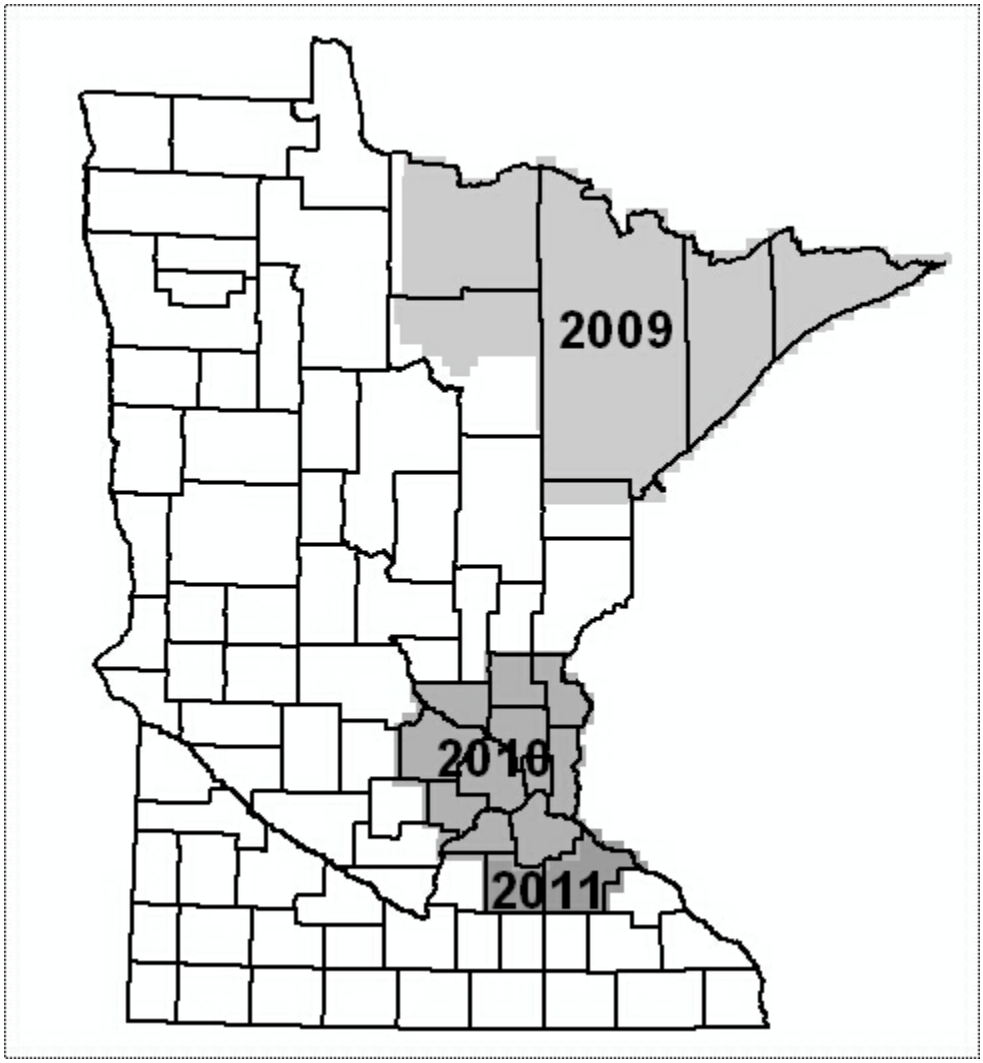


Figure 1: A map showing the areas for which high-resolution, spring, leaf-off imagery was acquired for this project.

Attachment A: Final Budget Detail for 2008 Project

Project Title: Updating the National Wetlands Inventory in Minnesota

Project Manager Name: Steve Kloiber

Trust Fund Appropriation: $550,000

1) See list of non-eligible expenses, do not include any of these items in your budget sheet

2) Remove any budget item lines not applicable

2008 Trust Fund Budget	**Result 1 Budget:**	**Amount Spent** *(12/31/10)*	**Balance** *(12/31/10)*	**Result 2 Budget:**	**Amount Spent** *(12/31/10)*	**Balance** *(12/31/10)*	**Result 3 Budget:**	**Amount Spent** *(12/31/10)*	**Balance** *(12/31/10)*	**TOTAL BUDGET**	**TOTAL BALANCE**
	Standards Development and Quality Control			Imagery Acquisition			Methods Development				
BUDGET ITEM											
PERSONNEL: wages and benefits 0.65 FTE for Project Manager position at DNR	73,080	73,080	0	15,660	15,660	0	62,576	61,778	798	151,316	799
Contracts											
Methods Assessment -- Contract with Univ. of Minnesota, Remote Sensing Laboratory to evaluate various mapping technologies and identify the most cost-effective methods for this project.			0			0	206,000	206,000	0	206,000	0
Imagery acquisition -- Contracts for imagery for northeastern and east-central Minnesota. And imagery back-up from MnGeo.			0	80,875	79,750	1,125			0	80,875	1,125
Field Validation Data Collection -- Contract with Univ. of Minnesota, Remote Sensing Laboratory to collect field validation data for east-central and northeast MN.			0	82,000	82,000	0			0	82,000	0
Office equipment & computers - computer and GIS software unique to this project	5,000	4,770	230	17,809	16,597	1,212			0	22,809	1,442
Travel expenses in Minnesota -- Coordination with stakeholders and partners, training	5,000	2,832	2,168			0			0	5,000	2,168
Travel outside Minnesota -- Training and coordination with other wetland mapping professionals; locations unknown at this time	2,000	0	2,000			0			0	2,000	2,000
COLUMN TOTAL	**$85,080**	**$80,682**	**$4,398**	**$196,344**	**$194,007**	**$2,337**	**$268,576**	**$267,778**	**$798**	**$550,000**	**$7,533**

Quality Assurance Plan for the National Wetland Inventory Update of Minnesota

May 19, 2010

Minnesota Department of Natural Resources
Division of Ecological Resources
500 Lafayette Road North
St. Paul, MN 55155

Acknowledgements

Funding for this project was provided by the Minnesota Environment and Natural Resources Trust Fund as recommended by the Legislative-Citizen Commission on Minnesota Resources (LCCMR). The Trust Fund is a permanent fund constitutionally established by the citizens of Minnesota to assist in the protection, conservation, preservation, and enhancement of the state's air, water, land, fish, wildlife, and other natural resources.

This document was prepared by the Minnesota Department of Natural Resources (MNDNR) with input and guidance from an interagency technical advisory committee. The agencies represented on the technical advisory committee include:

Member	Organization
Doug Norris	Minnesota Dept. of Natural Resources
Brian Huberty	U.S. Fish and Wildlife Service
Nancy Read	Metropolitan Mosquito Control District
Mark Gernes	Minnesota Pollution Control Agency
Les Lemm	Board of Water and Soil Resource
Twyla Hill	Minnesota Department of Agriculture
Dr. Joe Knight	University of Minnesota – Remote Sensing Lab
Susanne Maeder	Land Management Information Center
Steve Eggers	U.S. Army Corp of Engineers

Questions about this document should be directed to the MNDNR project manager, Steve Kloiber, at 651-259-5164 (steve.kloiber@state.mn.us).

Table of Contents

Acknowledgements i
1. Document Scope and Relationship to Other Documents 1
2. Project Background 1
3. Project Organization and Roles 1
4. Quality Assurance Objectives 2
4.1. Accuracy 2
4.2. Completeness 4
4.3. Comparability 4
4.4. Reproducibility 5
5. Data and Methods 7
5.1. Primary Data 7
5.2. Ancillary Data 7
5.3. Mapping Methods 7
6. Quality Assurance Procedures 8
6.1. Documentation 8
6.2. Training 8
6.3. Contractor Review 8
6.4. Stakeholder Review 8
6.5. MNDNR Review 9
6.6. Automated Data Quality Checks 9
6.7. Field Validation 9
6.8. Audits and Reporting 9
6.9. Corrective Action 9
7. References 10
Appendix A – Specifications for Imagery Acquisition A-1
Appendix B – Quality Control Procedures for NWI Data Production B-1
Appendix C - Procedure for In-Office Review of NWI Data C-1
Appendix D - Procedure for Field Validation of NWI Data D-1

1. Document Scope and Relationship to Other Documents

This document serves as the quality assurance project plan for the statewide update of the National Wetlands Inventory (NWI) for Minnesota. This plan is a supporting element of the Comprehensive Project Plan and is incorporated into this plan by reference.

2. Project Background

Wetland inventories are an essential tool for effective wetland management, protection, and restoration. Such inventories provide baseline information for assessing the effectiveness of wetland policies and management actions. These data are used at all levels of government, as well as by private industry and non-profit organizations for wetland regulation and management, land use and conservation planning, environmental impact assessment, and natural resource inventories. The NWI is the only comprehensive wetland inventory for Minnesota. This projects aims to update and improve the NWI for Minnesota.

There are two main issues driving the need for an update of the NWI. First, the data are 25 to 30 years out of date. Many changes in wetland extent and type have occurred since the original delineation. Second, various limitations in the original methodology and source data resulted in an under representation of certain wetland classes. Without an up-to-date wetland inventory, it is difficult to meet wetland planning and management needs for the state.

Updating the NWI for Minnesota will involve acquisition of new remote sensing data (primarily spring, leaf-off, digital color-infrared imagery), compiling other available GIS data sets (e.g. soils, topography, other imagery), and incorporating these data in an efficient and accurate process to identify and classify wetlands. Wetlands will be classified using the system developed by Cowardin et al. (1979). The data will be captured electronically in GIS format and served to stakeholders and the public for free over the internet. Project management and quality control will be woven throughout this process.

3. Project Organization and Roles

The update of the National Wetland Inventory for Minnesota is a collaborative effort involving federal, state, and local agencies and organizations. The Ecological Resources Division of the Minnesota Department of Natural Resources (MNDNR) is responsible for coordinating this effort. Other key groups include: various end-users of these maps (stakeholders), the University of Minnesota Remote Sensing and Geospatial Analysis Laboratory (UM-RSGAL), a mapping contractor, the U.S. Fish and Wildlife Service, a technical advisory committee, and the MNDNR Enterprise Hydrography Team. The UM-RSGAL is responsible for evaluating methods and for acquiring field validation data. The mapping contractor is responsible for day-to-day wetland map production.

The organizational relationship of these groups is shown in Figure 3.1. The composition and roles of these various groups is discussed further in the Comprehensive Project Plan for the National Wetland Inventory Update of Minnesota.

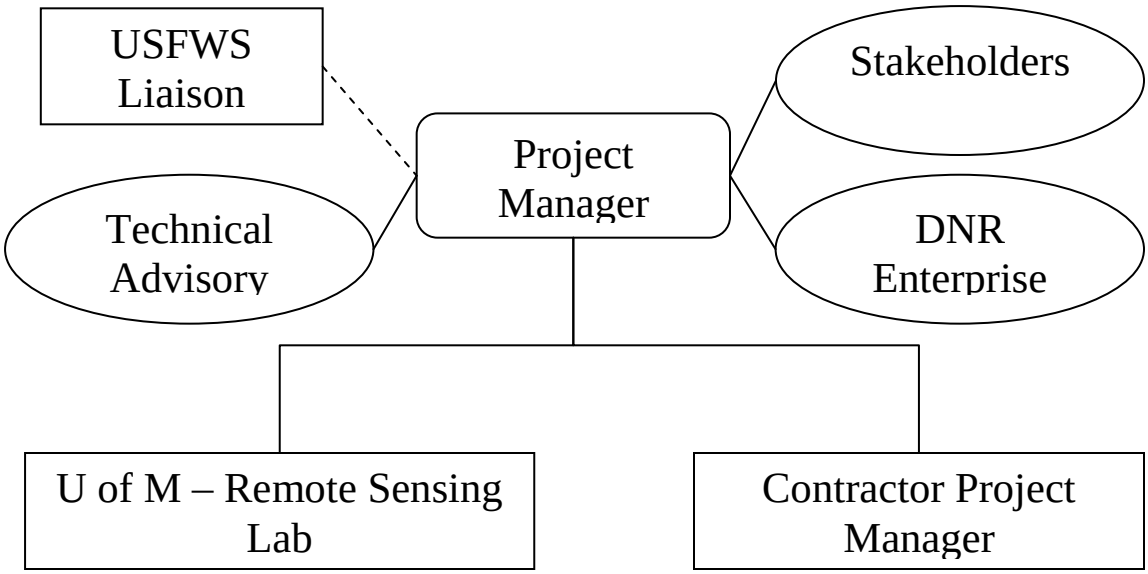


Figure 3.1: Organizational chart for the Minnesota NWI Update

4. Quality Assurance Objectives

4.1. Accuracy

Map accuracy has two main components; positional accuracy and classification accuracy. These accuracy components and the quality assurance objectives for them are discussed below.

4.1.1. Positional Accuracy

Positional accuracy is a measure of how close the mapped position of an object is to the real world position. Displacement of mapped objects can occur in three dimensions (x, y, and z), but the NWI does not have an elevation value. Therefore, positional accuracy is only measured in the horizontal plane (x and y directions).

Horizontal positional accuracy is difficult to test for wetland maps. Horizontal accuracy measures rely on comparing positions of well-defined points in the mapped data and the same points derived from a high-accuracy dataset such as survey grade global positioning system (GPS). Wetlands rarely have well-defined points. Apparent wetland boundaries can change seasonally or annually depending upon climate conditions and other factors.

The federal wetland mapping standard specifies that the primary control of horizontal accuracy will be the positional accuracy control of the base imagery, and that the goal is to have a horizontal (i.e. combined x and y error) root mean square error (RMSE) for base imagery of 5 meters or less. This project will adhere to a higher accuracy standard, the National Map Accuracy Standard for 1:6000 scale maps (FGDC 1998). Imagery acquired for this project will have a circular RMSE of 3.35 meters (11 feet) or less. This is equivalent to having 95% of well-defined points within 5.79 meters (19 feet). Detailed specifications for imagery acquisition are listed in Appendix A.

Accuracy testing methodology for imagery acquired for this project will follow the guidelines and specifications of National Standard for Spatial Data Accuracy (NSSDA) as described by the FGDC (1998). Twenty (20) to 40 high accuracy GPS points (sub-meter) will be collected for ground-control targets to test the positional accuracy of the base imagery for each image acquisition phase.

In addition, to ensure that wetland boundaries are reasonably coincident with the base imagery, we require that well-defined boundaries (e.g. water-land boundaries) should also fall within 5.79 meters (19 feet) of the boundary position as shown on the base imagery 95% of the time (root mean square error of 3.35 meters (11 feet)). This goal will be assessed by comparing randomly selected well defined wetland boundaries to their location on the imagery.

4.1.2. Wetland/Upland Classification Accuracy

Map classification accuracy is a measure of whether the objects or features of a map have been correctly identified. There are two types of errors that can occur. Errors of omission occur when an object that should be included in a mapped class is not included. Errors of commission occur when an object should not be included in a mapped class, but it is included. Map accuracy can be described relative to the omission error rate, the commission error rate, or a combination of these two. The producer's accuracy is equal to 100 percent minus the omission error rate in percent. The user's accuracy rate is equal to 100 percent minus the commission error rate in percent.

The NWI uses a hierarchical map classification developed by Cowardin et al. (1979). Therefore, as it pertains to the NWI, classification accuracy can be calculated for different levels. At the highest level, it simply tests the accuracy of the discrimination between wetland and upland (non-wetland). The primary quality assurance goal for wetland/upland classification accuracy is dictated by the federal wetland mapping standard (FGDC 2009). This standard states:

> *"Ninety-eight percent of all wetlands visible on an image, at the size of the TMU or larger shall be mapped regardless of the origin (natural, farmed, or artificial)."*

The TMU is the targeted mapping unit, which is the smallest size wetland that can be consistently mapped and classified. For the Lower 48 States, the TMU must be 0.5 acres or smaller.

The federal standard recognizes the potential limitation of the available data by basing the goal on what is visible on an image. The goal of this project is to ensure that the NWI update meets this federal standard of a 98% producer's accuracy goal for wetland features. In addition, the wetland maps must also have a user's accuracy of no less than 92%. Evaluation of this goal will be conducted by comparing wetland maps to a set of validation points developed by independent image analysis by an experienced image analyst at the MNDNR.

For reporting purposes, wetland maps produced for this project will also be compared to an independently collected dataset of random field validation points. Data points will be collected by a third party and results from the error analysis will be included in the final metadata.

4.1.3. Wetland Type Classification Accuracy

In addition to assessing the classification accuracy at the highest hierarchical level (wetland/upland), this project will also assess the classification accuracy of wetland types. The accuracy goal for wetland types is also dictated by the federal standard, which reads:

> *". . .features that are at least 0.5 acres will be mapped with a demonstrated PA of 98% for feature accuracy and* ***85% for attribute accuracy****, or higher, across each DOQQ, as documented through external quality assessment of samples."*

Therefore, the accuracy goal for wetland types is to achieve an 85% overall classification accuracy (counting both errors of omission and commission) for wetlands at the Cowardin class level (Cowardin 1979). The same independent validation dataset developed from image analysis by the MNDNR for use in wetland/upland assessment will also be used for the wetland type classification assessment.

The same third-party, field validation effort conducted to determine the accuracy of wetland/upland classification accuracy will be used to assess the accuracy of wetland types.

4.2. Completeness

The completeness goal is to have 100% coverage of Minnesota with updated NWI data meeting the quality assurance goals described in this document. A few areas of the state have locally produced wetland maps that are more recent than the original NWI. These maps will be incorporated into this process as ancillary data, but may require additional effort to ensure that these locally produced maps meet the quality assurance objectives for the project.

4.3. Comparability

Data comparability is the degree to which one data set can be compared to another. The updated NWI data shall be internally comparable across Minnesota and externally comparable to data in the National Spatial Data Infrastructure (NSDI) database. However, because the methods, data, and mapping conventions have changed since the original NWI, the NWI update will not be entirely comparable with the original data. Assessment of wetland gains and losses over time is addressed through a separate program known as the wetland status and trends monitoring program.

This project strives for internally comparable data by using reasonably consistent methods for all regions throughout the State, and by maintaining consistent methods over the life time of this project, except where improvements are required for data quality. When method changes are proposed, these changes will be evaluated and documented before being implemented, thereby allowing adequate study to ensure data comparability. Methods employed for the NWI update will be aligned with the federal wetland mapping standard (FGDC 2009) and will be checked by the US Fish and Wildlife Service staff to ensure comparability and compatibility with data in the NSDI.

4.4. Reproducibility

A reproducible process is one that produces the same output given the same inputs. Reproducibility is important to ensuring that the data are comparable, but may, in some situations, have negative impact on accuracy. For example, a fully-automated process tends to be highly reproducible, but it may not fully capture the nuances in the source data that a well-trained photo-interpreter might catch. However, the use of human photo-interpreters introduces a degree of subjective judgment that may not be entirely consistent across all photo-interpreters.

It is anticipated that the final mapping method for the NWI update will be some type of semi-automated process. To the degree possible, elements of the mapping procedure will be automated to ensure reproducibility, but only if doing so does not have a significant negative impact on accuracy. For the elements of the procedure that rely on human photo-interpreters, reproducibility will be maintained by using well-documented standard operating procedures and training. A pilot study will be conducted to determine the feasibility of ensuring reproducibility. Photo-interpreters will be tested using a standard set of source data and results from different interpreters compared to determine the level of variability introduced by human interpreters. In addition, all wetland maps will undergo an internal review for consistency by a senior image analyst.

Table 4.1: Data Quality Objectives for the NWI Update

Data Quality Measure	Basis	Goal
Horizontal Accuracy of Imagery	Comparison to survey grade GPS ground targets	Circular RMSE < 3.35 meters
Accuracy of wetland/upland determination	Comparison to validation points from independent image analysis	98% producer's accuracy & 92% user's accuracy for wetland larger than the TMU and visible on the imagery
Accuracy of wetland/upland determination	Comparison to independent field points	Accuracy reported for producer's accuracy, user's accuracy, and overall accuracy
Accuracy of wetland classification (Cowardin class)	Comparison to validation points from independent image analysis	85% overall accuracy
Accuracy of wetland classification (Cowardin class)	Comparison to field points	Accuracy reported for producer's accuracy, user's accuracy, and overall accuracy
Horizontal Accuracy of Wetland Boundaries	Comparison of well-defined wetland boundaries to imagery	Relative circular RMSE < 3.35 meters
Completeness		Updated maps covering 100% of the state
Comparability	Qualitative	Consistent methods and data used across the state and meeting the federal wetland mapping standard
Reproducibility	Testing photo-interpreters	Maps produced by photo-interpreters for a standard set of data shall agree within +/-10%

5. Data and Methods

5.1. Primary Data

Primary data used for the update of the NWI for Minnesota will be digital aerial imagery and high-resolution digital elevation models from light detecting and ranging (LiDAR). The minimum specifications for this imagery are as follows:

- Spring leaf-off conditions
- Multi-spectral (red, green, blue, and near-infrared)
- Georeferenced and ortho-rectified to remove terrain displacement
- Spatial resolution of 0.5-meter or finer
- No more than 5-years old at the time the wetland interpretation
- A horizontal accuracy with a circular RMSE of 3.35 meters (11.0 feet) or less

Whenever funding allows, imagery will be acquired with the following additional specifications:

- Overlap of 60% to allow full-stereo viewing

Leaf-off images are especially important in forested parts of the state where wetlands can be obscured due to canopy closure. Detailed specifications for imagery acquisition are listed in Appendix A.

In addition, the NWI Update Project will use high-resolution DEMs as a primary source of data for wetland mapping. The Minnesota Legislature recently appropriated $5.6 million to put toward completing LiDAR acquisition for the State. This acquisition is scheduled to be completed in 2012. The project schedule for the NWI update will be designed to take maximum advantage of the statewide LiDAR acquisition project.

5.2. Ancillary Data

A variety of ancillary data may be used to compliment the primary data. Commonly used ancillary data for wetland mapping includes additional imagery from other seasons and years, elevation data, soils maps, hydrography, radar data, and other wetland maps (historic or local). Ancillary data will not be acquired with direct funding from the NWI update project. Therefore, the quality assurance standard for ancillary data is to use the best available data. More information on the available ancillary data can be found in the data availability assessment for the National Wetland Inventory update (MNDNR 2010).

5.3. Mapping Methods

The mapping methods will be developed and documented by the mapping contractor in consultation with the MNDNR project manager and the technical advisory committee for the NWI update. Method development will consider the methods assessment report produced by the University of Minnesota (Knight et al. 2010) and the data availability for Minnesota. Mapping methods will be incorporated into this plan by reference when available.

6. Quality Assurance Procedures

6.1. Documentation

Standard operating procedures for mapping, in-office review, and field validation will be developed and incorporated by reference into this quality assurance plan when available.

Documents Pending

- Quality Control Procedures for NWI Data Production (Appendix B)

Documents Completed

- Procedure for In-Office Review of NWI Data (Appendix C)
- Procedure for Field Validation of NWI Data (Appendix D)

6.2. Training

Two training programs will be developed for this project; 1) training for photo-interpreters and 2) training for field-data acquisition teams. Project staff engaged in these activities will be required to undergo the appropriate training program prior to starting work. All personnel involved in the project, regardless of their responsibilities will be made familiar with the general contents of the project control documents and where to access the current version of these documents for reference.

6.3. Contractor Review

All wetland map tiles (USGS 7.5 minute quadrangle tiles) will undergo an internal review by the mapping contractor's senior image analyst after the initial photo-interpretation, but before being submitted to the MNDNR as draft maps. Maps will be reviewed to ensure quality and completeness of the interpretation. Any map tiles not meeting the quality control objectives outlined in this document (such as capturing 98% of the wetlands visible on the image) will be returned to the primary photo-interpretation staff for revisions.

6.4. Stakeholder Review

Draft maps will be made available to all project stakeholders for review to help identify any inaccuracies. Stakeholder review will be coordinated by the MNDNR project manager. Draft data will be posted to the MNDNR ftp site. A limited number of GPS enabled mobile computing devices will be made available for loan to stakeholders wishing to conduct field reviews who do not otherwise have access to such equipment. A mark-up file will be created to indicate potential additions, deletions, and modifications to wetland boundaries as well as potential classification changes. These mark-up files will be reviewed by the MNDNR project manager and the mapping contractor for potential modifications to the wetland inventory maps.

6.5. MNDNR Review

The MNDNR will also review draft data to check for compliance with the data quality objectives outlined in section 4 of this document. The mapping contractor will address any issues identified in this review of the draft data.

After addressing comments on the draft data from the MNDNR and other project stakeholders, the mapping contractor will prepare and submit a final seamless NWI data set fpr the project area. The MNDNR will perform a final acceptance review on a random sample of the final data. This final data review will be used to calculate the accuracy statistics required by the federal wetland mapping standard (FGDC 2009) as summarized in sections 4.1.2 and 4.1.3 of this document.

6.6. Automated Data Quality Checks

Prior to submitting the final NWI data to the MNDNR, the vendor will use USFWS quality control tools or the equivalent to check the data for internal consistency. These checks are designed to ensure correct topology of the data (i.e. no gaps or overlaps) and that valid attributes have been assigned for all features (e.g. only valid Cowardin codes for Minnesota have been used).

6.7. Field Validation

After the data have been accepted, the UM-RSGAL will use the field observation data to calculate additional accuracy statistics including the user's accuracy, the producer's accuracy and the overall accuracy at both the feature level (wetland/upland) and at the wetland class level. The UM-RSGAL will develop a SOP for the acquisition of field validation data. This SOP will be incorporated in this QA plan by reference when it is available.

6.8. Audits and Reporting

The MNDNR project manager or designee shall periodically review the procedures used by the mapping contractor. This shall include a review to ensure that written procedures remain consistent, clear, and current. QA audits shall also include on-site assessments to ensure that photo-interpretation staff are following written procedures and that deviations from written SOPs are documented.

6.9. Corrective Action

The MNDNR project manager or designee shall keep a log of any issues identified through the QA audit reports described in Section 6.8, as well as the corrective action taken to address these issues. Possible problems requiring corrective action include:

Any non-conformance with the established quality control procedures outlined in the QAP shall be identified and corrected. The MNDNR project manager or designee shall issue a corrective action memorandum for each non-conformance condition and resolution.

7. References

Cowardin L., V. Carter, F. Golet, and E. LaRoe. 1979. Classification of wetlands and Deepwater Habitats of the United States. U.S. Department of the Interior, Fish and Wildlife Service, Washington, DC, USA.

MNDNR (2010). Data Availability for the National Wetland Inventory Update of Minnesota. Minnesota Department of Natural Resources. St. Paul, MN. MNDNR website as accessed on April 20, 2010. http://files.dnr.state.mn.us/eco/wetlands/nwi_data_plan_v3.pdf

FGDC. 1998. Geospatial Positioning Accuracy Standards. Part 3: National Standards for Spatial Data Accuracy. Federal Geographic Data Commission. FGDC website as accessed on April 20, 2010. http://www.fgdc.gov/standards/projects/FGDC-standards-projects/accuracy/part3

FGDC. 2009. FGDC Draft Wetland Mapping Standard. Federal Geographic Data Commission. FGDC website as accessed on April 20, 2010. http://www.fgdc.gov/standards/projects/FGDC-standards-projects/wetlands-mapping/

Knight, J.K, J. Corcoran, L. Rampi, B. Tolcser, and M. Voth. 2010. Wetland Mapping Methods for the Twin Cities Metropolitan Area. Remote Sensing and Geospatial Analysis Laboratory, Department of Forest Resources, University of Minnesota. St. Paul, MN. Project Report to the Minnesota Department of Natural Resources. pp. 57.

Appendix A – Specifications for Imagery Acquisition Date: June 4, 2009

Resolution

The imagery shall be collected at a ground sampling distance of 0.5-meter resolution or finer.

Ground Condition

The imagery shall be collected under spring leaf-off conditions and shall be snow-free and cloud-free as well as free from flood water. Spring leaf-off is defined as the period in spring before leaves of any deciduous tree species have developed to the point where leaf shape can be observed. Snow-free means less than 5% of the ground surface is covered by snow. Minimal snow cover from residual stockpiles and along fence and windrows is acceptable. Cloud free means less than 5% of the image area is affected by clouds our cloud shadows.

Spectral-Bands

The images shall be collected as 4-band multi-spectral digital imagery with spectral bands for red, green, blue, and near-infrared.

Image Processing

At a minimum, the digital imagery will be georeferenced and ortho-rectified to remove topographical displacement and then mosaicked into a digital ortho quarter quad. Optionally, if funding allows, the imagery will also be acquired and delivered as full-stereo images.

Overlap

The imagery shall be acquired with sufficient end lap and/or side lap to prevent any gaps in coverage and to provide all necessary coverage for accurate ortho-rectification and visual interpretation. For stereo coverage, end lap requirements increase to 60%.

Control

Airborne GPS (Global Positioning Systems) and IMU (Inertial Measurement Unit) systems or equivalent technology/methodology will be used to meet these image specifications. The vendor will provide any ground control necessary to meet the specified horizontal accuracy requirements. The MNDNR will use ground control points established by MNDOT for the 2008 NAIP for verification.

Elevation

The vendor will use the best available digital elevation model for the ortho-rectification process. Data resources include the MNDNR DEMs accessible through the MNDNR Data Deli (http://deli.dnr.state.mn.us) and the USGS National Elevation Dataset accessible through the Seamless Data Distribution System at EROS (http://seamless.usgs.gov/).

Horizontal Accuracy

Horizontal accuracy should meet the National Map Accuracy Standard for 1:6,000 scale maps with a circular root mean square error of 3.35 meters. This is equivalent to having 95% of well-defined points within 5.79 meters. Accuracy testing methodology should follow the guidelines and specifications of NSSDA.

Image Quality

Images shall be tonally balanced and image mosaics shall be uniform in contrast without abrupt variations between image tiles. Imagery shall be free of blemishes, scratches, and artifacts that obscure ground feature detail. Pixel resolution shall not be degraded by excessive image smear. DOQQs shall have a tonal range that prevents the clipping of highlight or shadow detail from the image. No more than 2% of the pixels may have a luminosity value in the first five or last five histogram bin values (0 to 4 or 251 to 255). If needed, contrast of the DOQQs should be stretched so that the difference between the 99th percentile of the luminosity histogram value and 1st percentile shall be greater than 120, with a preferred value of greater than 150. All DOQQs shall have a pixel count peak within ±15% of the middle digital value allowed for the bit depth. For an 8-bit depth image, the histogram peak must be between 108 and 148.

Projection

The data shall be provided using the Universal Transverse Mercator, Zone 15 coordinate system using the 1983 North American Datum (UTM-15, NAD83, Meters).

File Format

Digital orthophotos shall be delivered as GeoTIFF with world files delivered as uncompressed, georeferenced quarter quad tiles; and JPEG2000 delivered as compressed county mosaics. Stereo imagery shall be delivered as uncompressed tiff files along with exterior orientations and camera calibration data sufficient for establishing a digital stereo model. Images shall consist of 8 bits per band. Images may be collected at more than 8 bits per band, but shall be resampled to 8 bits per band for image delivery.

Metadata Information

Metadata for this project shall meet the requirements of the Minnesota Geographic Metadata Guidelines (see http://www.mngeo.state.mn.us/chouse/meta.html) or the Federal metadata standard (see http://www.fgdc.gov/metadata/geospatial-metadata-standards). Supplemental metadata information includes the following:

1. Tested Horizontal Accuracy Statement
2. Lineage, including, but not limited to: flight height, photo acquisition dates (and reflights if any), overlap, sidelap, number of flight lines, number of exposures, direction of flight lines, control, resolution, tiling scheme, file sizes, description of the process used to create digital orthophotos, source of DEM, etc.
3. Spatial reference information: projection, ellipsoid, horizontal and vertical datum, horizontal and vertical units, UTM zone number.

Appendix B – Quality Control Procedures for NWI Data Production

This section is to be completed by the contractor or contractors selected for the NWI map production work.

Appendix C - Procedure for In-Office Review of NWI Data

This procedure is designed to validate the accuracy of the updated National Wetland Inventory maps for Minnesota through the comparison of updated NWI maps with independently photo-interpreted wetland data points. This allows for the creation and reporting of statistical accuracy estimates for the maps. A stratified random selection of sites is used for the validation sample set. All sites are assessed from aerial imagery and ancillary GIS data.

Number of Photo-Interpreted Points

Minnesota has 20 wetland types based on an assessment of Cowardin classes from the original NWI. Statewide, this procedure aims to place at least 180 validation points for each of these 20 wetland types, 180 points in cultivated wetlands (which were not typically mapped in the original NWI) and 900 additional point observations for various upland land cover types. In situations where one or more of the 20 wetland types are not present in a region, points that would have been assigned to those types are distributed throughout the types that are present. This final sample of nearly 4500 validation points for the statewide NWI is sufficient to derive robust measures of the accuracy.

Selection of Photo-Interpretation Sites

Validation sites are selected using a stratified-random design. Primary sampling units from Minnesota's wetland status and trends monitoring program (WSTMP) are used as the stratification layer. The stratified sampling scheme distributes points both spatially and between the wetland types. Existing wetland data from the WSTMP are used for an *a priori* stratification scheme. The purpose of this design is to 1) ensure that an adequate number of each wetland class and land cover class are represented, and 2) ensure that a reasonably random sample is selected so that valid statistical inferences can be made.

The sampling design tool for ArcGIS developed by the Biogeography Branch of NOAA was used to create a set of stratified random sampling points. The stratification data layer for this effort was interpreted wetland data from the combined 2006 - 2008 wetland status and trends monitoring program (WSTMP).

Some wetland classes in the WSTMP are aggregated from Cowardin classes. Samples were allocated between strata at the nominal rate of 180 sites per Cowardin wetland class (Table 1). Because some classes are aggregated in WSTMP, it cannot be guaranteed that 180 points will fall within each of the Cowardin classes. Rare wetland classes, with fewer than 20 observations in the validation data set, will be aggregated afterwards with a closely related wetland class for calculating accuracy statistics. In addition, there are 6 upland classes with 180 points allocated to each of these.

Equipment

- WSTMP photo-interpreted wetlands GIS layer
- Recent high-resolution, spring leaf-off digital stereo imagery
- Stereo GIS workstation

- Ancillary GIS data including, but not limited to high resolution LiDAR digital elevation models, detailed soil survey data from USDA, and 2008 summer leaf-on imagery from USDA

Procedure

The MNDNR image analyst will adhere to the following protocol when conducting this analysis.

1) Create a stratified random set of validation points using the sampling design tool for ArcGIS developed by the Biogeography Branch of NOAA and the 2006 – 2008 data from the Minnesota Wetland Status and Trends Program.
2) Using ArcGIS and StereoAnalyst, sequentially assess the correctness of the original WSTMP wetland class for each data point based on the NWI imagery and ancillary data.
3) Split the WSTMP classes, where needed, into the appropriate Cowardin classes (e.g. aquatic bed to PAB, L1AB, L2AB, R2AB, or R3AB) based on interpretation of the imagery.
4) Use the spatial join function of ArcGIS to relate the validation data to the updated NWI polygons (join points to polygons based on points falling within polygons).
5) Create a table with a record for each validation data point containing a field for the wetland class as determined by the QA analyst and a field for wetland class based on the updated NWI.
6) Aggregate rare wetland classes, those with fewer than 20 observations in the validation data set, with closely related wetland classes.
7) Summarize all records into an error matrix and report the errors of omission, errors of commission, and overall accuracy following the method described by Congalton and Green (1999).
8) Calculate the final accuracy metrics using class weights equal to the frequency of occurrence in the updated NWI.

Calculation of Accuracy Statistics

Upon completion of each project phase and subsequently for the state as a whole, classification accuracy estimates are produced by comparing updated NWI maps to the independent validation points developed through this procedure. These estimates describe overall and per class error rates in the NWI maps. Map accuracy is described relative to the omission error rate, the commission error rate, and the overall accuracy (Congalton and Green 1999). Given that validation sites were not distributed according to frequency, the results for each individual class will require a weighted adjustment based on the frequency of occurrence. In addition, the kappa coefficient of agreement, which is a measure of the accuracy of the accuracy of a classification that is adjusted for chance agreement, is computed. Finally, per class and overall accuracy estimator confidence intervals are provided.

Table 1: Sample stratification scheme. One-hundred eighty sites are allocated per Cowardin class.

WSTMP Class	WSTMP Frequency	Cowardin Class Count	Cowardin Classes	NWI Frequency	Samples Sites
Aquatic Bed	2.1%	3	L2AB, PAB, R2AB	0.1%	540
Cultivated Wetland	1.6%	0	f – modifier	0.0%	180
Emergent	23.7%	3	L2EM, PEM, R2EM	43.4%	540
Forested	36.8%	1	PFO	21.8%	180
Scrub-Shrub	19.1%	1	PSS	24.5%	180
Unconsolidated Bottom	2.2%	7	L2RS, L2US; PUB, PUS: R2US, R3US, R4SB	7.9%	1260
Deepwater	14.5%	5	L1UB, R2UB, R3RB, R3UB, L2UB	2.3%	900
Agriculture		1	U		180
Natural Upland		1	U		180
Rural Development		1	U		180
Silviculture		1	U		180
Urban		1	U		180

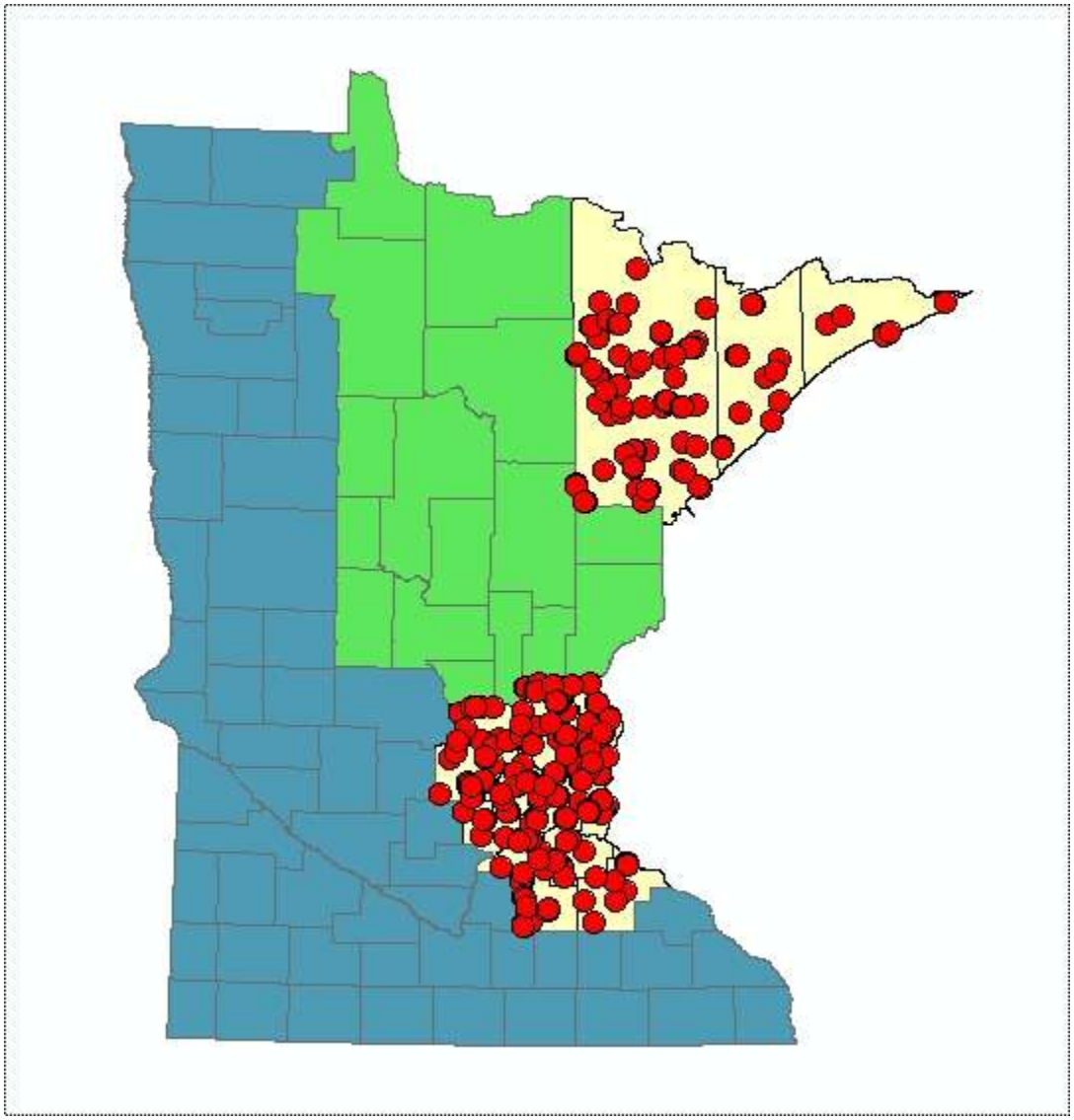


Figure 1: Example overview of the stratified random point distribution for a section of the NWI validation sites.

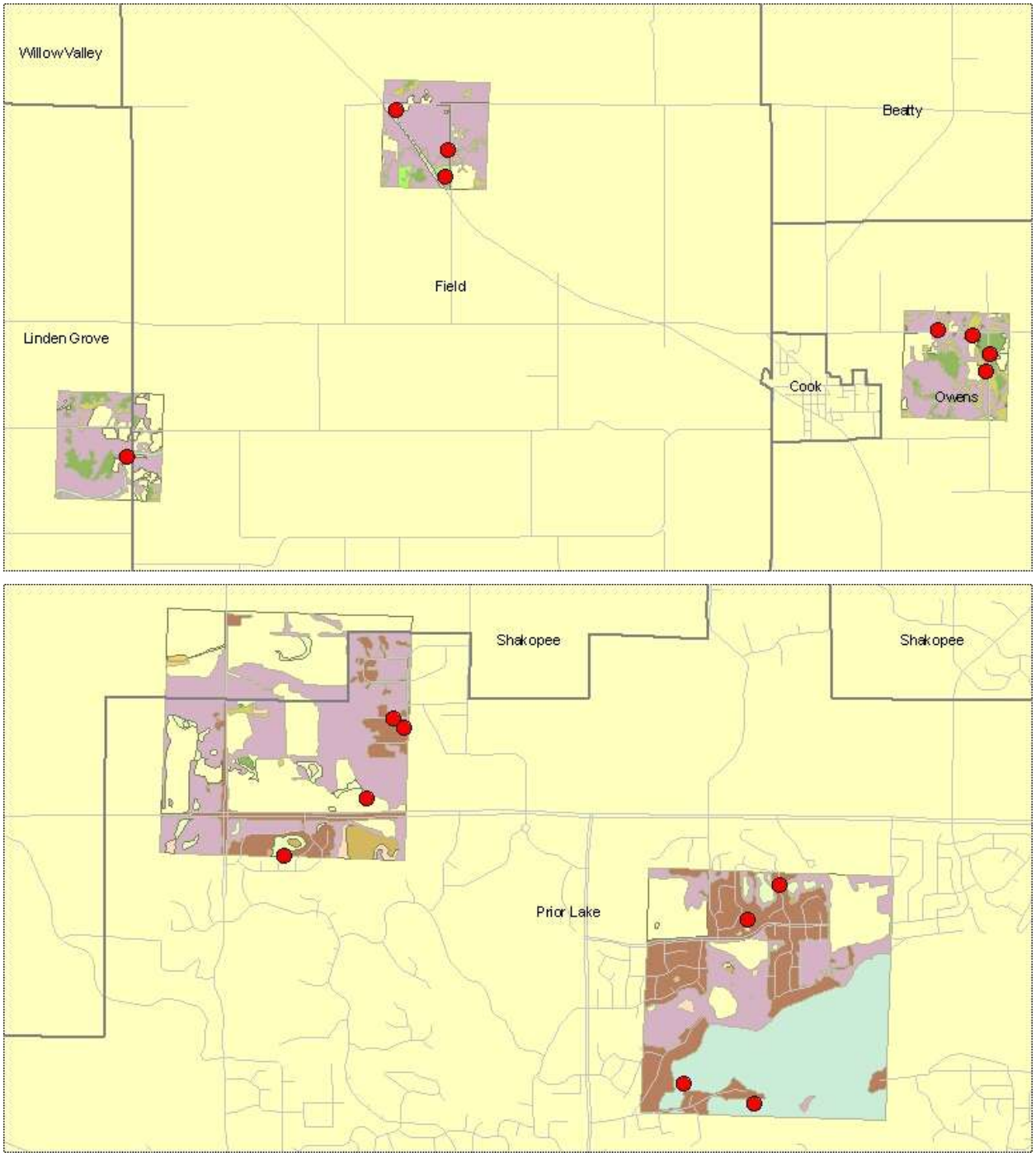


Figure 2: An example close-up of the stratified random point distribution for the NWI validation sites shown in relation to the WSTMP data near Cook, MN in St. Louis County (top) and in Prior Lake, MN in Scott County (bottom). Top and bottom figures are shown at different scales.

References

Buja, K. and C. Menza. 2008. Manual for the Sampling Design Tool for ArcGIS. National Oceanic and Atmospheric Administration, Biogeography Branch, Silver Springs, MD. 17 p.

Congalton, R.G. and K. Green. 1999. Assessing the accuracy of remotely sensed data: principles and practices. CRC/Lewis Press, Boca Raton, FL. 137 p.

Cowardin L., V. Carter, F. Golet, and E. LaRoe. 1979. Classification of wetlands and Deepwater Habitats of the United States. U.S. Department of the Interior, Fish and Wildlife Service, Washington, DC. 79 p.

Appendix D - Procedure for Field Validation of NWI Data
Date: May 19, 2010

This procedure is designed to validate the accuracy of the updated National Wetland Inventory maps for Minnesota. This goal is accomplished through the comparison of independently sampled wetland data with the corresponding locations on the updated NWI maps, which allows for the creation and reporting of statistical accuracy estimates for the maps. A stratified random selection of sites within 200 feet of public roads is used for the validation sample set. All sites are assessed from ground level.

Number of Field Observations

Minnesota has 20 wetland types based on an assessment of Cowardin classes from the original NWI (Table 1). Statewide, this procedure aims to place at least 60 validation sites for each of these 20 wetland types, 60 sites in cultivated wetlands (which were not typically mapped in the original NWI) and 300 additional point observations for various upland land cover types. In situations where one or more of the 20 wetland types are not present in a region, sites that would have been assigned to those types are distributed throughout the types that are present. The pool of validation points will be oversampled by several hundred sites to allow for discarding sites that cannot be safely or practically assessed from ground level. A final sample of 3,000 validation sites (including oversample) is sufficient to derive robust measures of the accuracy of the NWI product.

Timing of Field Observations

Validation data is collected as contemporaneously as possible with the acquisition of the base imagery used for the NWI update to avoid potential problems with changes in wetland extent or type between the acquisition dates. For this procedure, the validation data should be collected within 1 year of the image acquisition, if possible, but no later than 2 years from the imagery acquisition. Field crews will note any signs of potential recent landscape change.

Selection of Field Observation Sites

Validation sites are selected using a modified multi-layer stratified-random sampling design that was implemented using ArcGIS with the Geospatial Modeling Environment extension from Spatial Ecology, LLC (formerly known as Hawth's Tools). A flowchart describing the design is shown in Figure 3.The primary sampling unit is a random selection of 10% of the USGS quadrangles within each study area (Metro and Arrowhead). Secondary sampling units from Minnesota's wetland status and trends monitoring program (WSTMP) are intersected with a buffer (>50 ft, < 200 ft) of the Minnesota Department of Transportation GIS roads layer. The existing wetland data from the WSTMP are used for a tertiary stratification scheme. This stratified random sampling scheme is used to select field observation sites that fall within the range of wetland sizes and also within specified wetland classes and a general upland class. The stratified sampling scheme distributes sites both spatially and between the land cover types and wetland sizes. The purpose of this design is to 1) ensure that an adequate number of each class and wetland size are represented, 2) ensure that a reasonably random sample is selected so that

valid statistical inferences can be made, 3) ensure that sites are likely to be accessible or at least viewable from the ground, and 4) to reduce travel time between sites.

Some wetland classes in the WSTMP are aggregated from Cowardin classes. Samples were allocated between strata at the nominal rate of 20 sites per Cowardin wetland class. Because some classes are aggregated in WSTMP, it cannot be guaranteed that 20 sites will fall within each of the Cowardin classes. Class frequencies will be monitored while sampling is ongoing. Rare classes will be oversampled to the extent possible. Classes that are extremely rare and lack sufficient field samples for statistical validity will be combined with other appropriate classes.

Equipment

- Handheld GPS device (e.g. Trimble Juno SB loaded with Terrasync, sample site database, roads layer, property ownership, recent aerial imagery, and digital camera)
- Binoculars and/or laser range finder (for off-site assessment)
- Waterproof boots or waders, hip boots, or knee boots (as required)
- Personal safety/comfort gear (insect repellent, sunscreen, water, cell phone)

Procedure

Field crews will adhere to the following protocol when navigating to and sampling the field observation sites.

1. Navigate to the roadway nearest to the field site.
2. Use caution and common sense in locating a safe parking site (make sure you can pull far enough off the road).
3. Place sign identifying purpose of work in car window (e.g. “University of Minnesota field work team”)
4. Record coordinates of parked vehicle to enable easy return.
5. Attempt to identify the property owner where the site is located and request entry permission.
6. If permission is given, provide letter describing purpose of work to land owner and navigate using GPS to the sample site. If permission cannot be obtained, determine if the site can be viewed from the road and make assessment from the public right-of-way. Sites that cannot be visited or viewed from the road will be noted, skipped, and another site will be selected at random from the oversample pool.
7. Use the digital field forms to record the following information at the field site:
    a. Date and time of observation
    b. Initials of field crew
    c. Location of observation in GPS coordinates (post-processed for differential correction). Be sure to record the location from which the observation is made even if the site cannot be directly accessed.

d. Ensure that the GPS provides a minimum of 50 continuous position fixes at each site to reduce the PDOP.
e. Determination of wetland or upland
f. For uplands, classification of upland type
g. For wetlands, classification of wetland type (Cowardin class-level)
h. Narrative comments including primary land cover, dominant plant species, land use activities, and any potentially unusual field condition (e.g. flooding, recent landscape change, etc.)
i. Digital photographs of the site at cardinal directions and canopy, if the site can be accessed; otherwise a photo of the site from the roadway

Calculation of Accuracy Statistics

Upon completion of field sampling for each project phase and subsequently for the state as a whole, classification accuracy estimates are produced. These estimates describe overall and per class error rates in the NWI maps. Map accuracy is described relative to the omission error rate, the commission error rate, and the overall accuracy (Congalton and Green 1999). Given that validation sites were not distributed according to frequency, the results for each individual class will require a weighted adjustment based on the frequency of occurrence. In addition, the kappa coefficient of agreement, which is a measure of the accuracy of the accuracy of a classification that is adjusted for chance agreement, is computed. Finally, per class and overall accuracy estimator confidence intervals are provided.

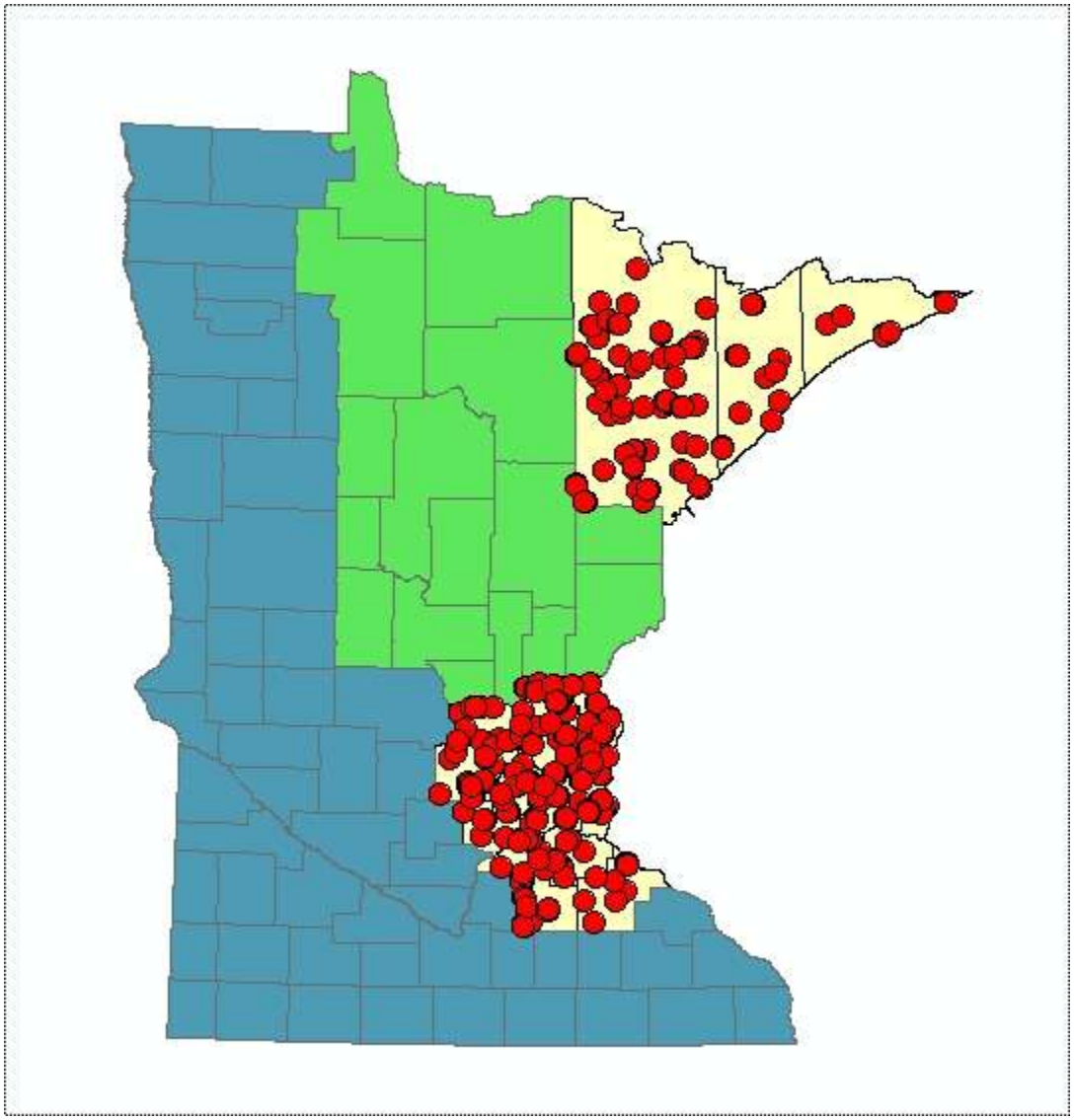


Figure 1: Overview of a sample stratified random point distribution for the NWI validation sites.

Table 1: WSTMP classes in Minnesota and corresponding Cowardin Classes.

WSTMP Class	WSTMP Frequency	Cowardin Class Count	Cowardin Classes	NWI Frequency
Aquatic Bed	2.1%	3	L2AB, PAB, R2AB	0.1%
Cultivated Wetland	1.6%	0	f - modifier	0.0%
Emergent	23.7%	3	L2EM, PEM, R2EM	43.4%
Forested	36.8%	1	PFO	21.8%
Scrub-Shrub	19.1%	1	PSS	24.5%
Unconsolidated Bottom	2.2%	7	L2RS, L2US, PUB, PUS, R2US, R3US, R4SB	7.9%
Deepwater	14.5%	5	L1UB, R2UB, R3UB, R3RB, L2UB	2.3%
Agriculture		1	U	
Natural Upland		1	U	
Rural Development		1	U	
Silviculture		1	U	
Urban		1	U	
~~Other~~	-	~~1~~	~~U~~	-

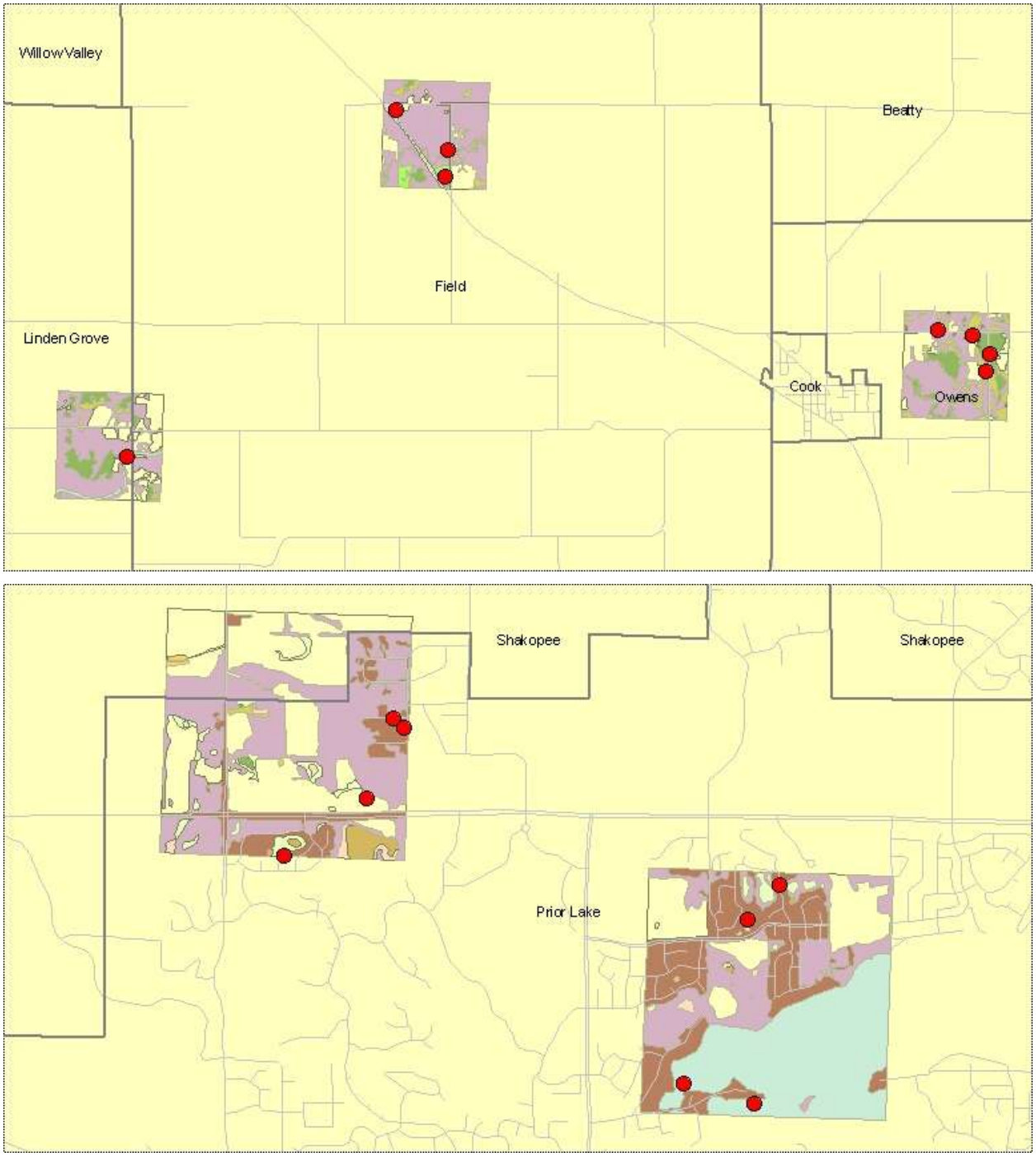


Figure 2: A sample close-up of the stratified random point distribution for the NWI validation sites shown in relation to the 2006 WSTMP data near Cook, MN in St. Louis County (top) and in Prior Lake, MN in Scott County (bottom). Top and bottom figures are shown at different scales.

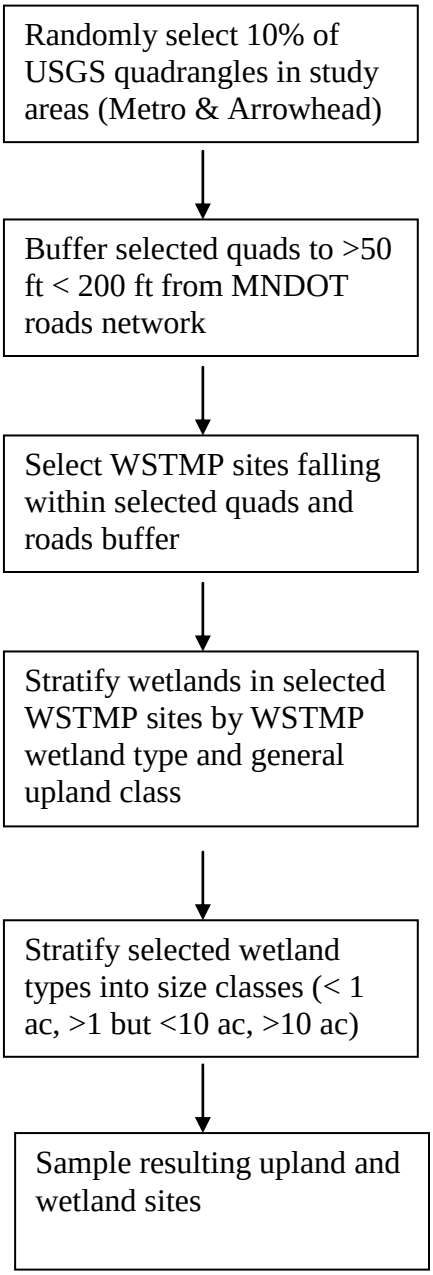


Figure 3: Process diagram for sample site selection

References

Congalton, R.G. and K. Green. 1999. Assessing the accuracy of remotely sensed data: principles and practices. CRC/Lewis Press, Boca Raton, FL. 137 p.

Cowardin L., V. Carter, F. Golet, and E. LaRoe. 1979. Classification of wetlands and Deepwater Habitats of the United States. U.S. Department of the Interior, Fish and Wildlife Service, Washington, DC. 79 p.

Spatial Ecology, LLC, 2010. Introducing the Geospatial Modeling Environment. http://www.spatialecology.com/gme/. Retrieved 4/19/2010.

Comprehensive Project Plan for the National Wetland Inventory Update of Minnesota

July 27, 2011

Minnesota Department of Natural Resources
Division of Ecological Resources
500 Lafayette Road North
St. Paul, MN 55155

Acknowledgements

Funding for this project was provided by the Minnesota Environment and Natural Resources Trust Fund as recommended by the Legislative-Citizen Commission on Minnesota Resources (LCCMR). The Trust Fund is a permanent fund constitutionally established by the citizens of Minnesota to assist in the protection, conservation, preservation, and enhancement of the state's air, water, land, fish, wildlife, and other natural resources.

This document was prepared by the DNR with input and guidance from an interagency technical advisory committee. The agencies represented on the technical advisory committee include:

Member	Organization
Doug Norris	Minnesota DNR
Brian Huberty	U.S. Fish and Wildlife Service
Nancy Read	Metropolitan Mosquito Control District
Mark Gernes	Minnesota Pollution Control Agency
Les Lemm	Board of Water and Soil Resource
Rob Sip	Minnesota Department of Agriculture
Dr. Joe Knight	University of Minnesota – Remote Sensing Lab
Susanne Maeder	Land Management Information Center
Steve Eggers	U.S. Army Corp of Engineers

Questions about this document should be directed to the DNR project manager, Steve Kloiber at 651-259-5164 (steve.kloiber@dnr.state.mn.us).

Table of Contents

Acknowledgements i
Table of Contents ii
1. Document Scope and Relationship to Other Documents 3
2. Background 3
2.1. Wetland Information Needs 3
2.2. History 3
2.3. Issues, Goals, and Objectives 4
3. Project Organization 5
3.1. Overview 5
3.2. DNR Project Manager 5
3.3. Stakeholders 6
3.4. University of Minnesota – Remote Sensing Laboratory 6
3.5. Mapping Contractor 6
3.6. U.S. Fish and Wildlife Service 6
3.7. Technical Advisory Committee 7
3.8. DNR Enterprise Hydrography Workgroup 7
4. Work Breakdown Structure Overview 8
4.1. Requirements Development 9
4.2. Methods Evaluation 9
4.3. Data Acquisition Planning 11
4.4. Quality Assurance Planning 11
4.5. Contract Management 12
4.6. Map Production 14
4.7. Data Management/Delivery 15
5. Documentation, Reporting, and Communications 15
6. Schedule 17
7. Budget 18
8. References 19

1. Document Scope and Relationship to Other Documents

This document serves as a comprehensive project plan for the statewide update of the National Wetlands Inventory (NWI) for Minnesota. Additional details are covered by other documents. These documents are incorporated by reference as part of the overall plan. These include:

- Requirements for the NWI Update of Minnesota,
- Quality Assurance Plan for the NWI Update of Minnesota
- Data Plan for the NWI Update of Minnesota

2. Background

2.1. Wetland Information Needs

Wetland inventories are an essential tool for effective wetland management, protection, and restoration. Such inventories provide baseline information for assessing the effectiveness of wetland policies and management actions. These data are used at all levels of government, as well as by private industry and non-profit organizations for wetland regulation and management, land use and conservation planning, environmental impact assessment, and natural resource inventories. A few local organizations in Minnesota have developed their own wetland inventories, but the NWI is the only spatially comprehensive wetland inventory for the entire state.

2.2. History

In 1974, the US Fish and Wildlife Service directed its Office of Biological Services to design and conduct an inventory of the Nation's wetlands (Wilen and Bates 2004). Their mandate was to develop and disseminate a technically sound, comprehensive database concerning the characteristics and extent of the Nation's wetlands. The NWI has produced 1:24,000 scale maps for about 90% of the conterminous United States, relying primarily on aerial photo interpretation and other ancillary information on soils and topography.

NWI wetland maps were produced for Minnesota using aerial photography collected for the National High Altitude Program (NHAP) between 1979 and 1984 (LMIC 2007). These maps were originally produced as hard copy blue line maps (Figure 2.1), but were converted to digital maps in the early 1990s.

In 2006, an inter-agency partnership developed a comprehensive strategy for monitoring, assessing, and mapping wetlands in Minnesota. The Comprehensive Wetland Assessment Monitoring and Mapping Strategy (CWAMMS) identified three complimentary approaches to support a scientifically sound wetland monitoring and assessment program; (1) design and implement a random sample survey to track wetland status and trends, (2) develop an integrated system for tracking permit related accounting of wetlands, and (3) update the NWI for Minnesota (Gernes and Norris 2006).

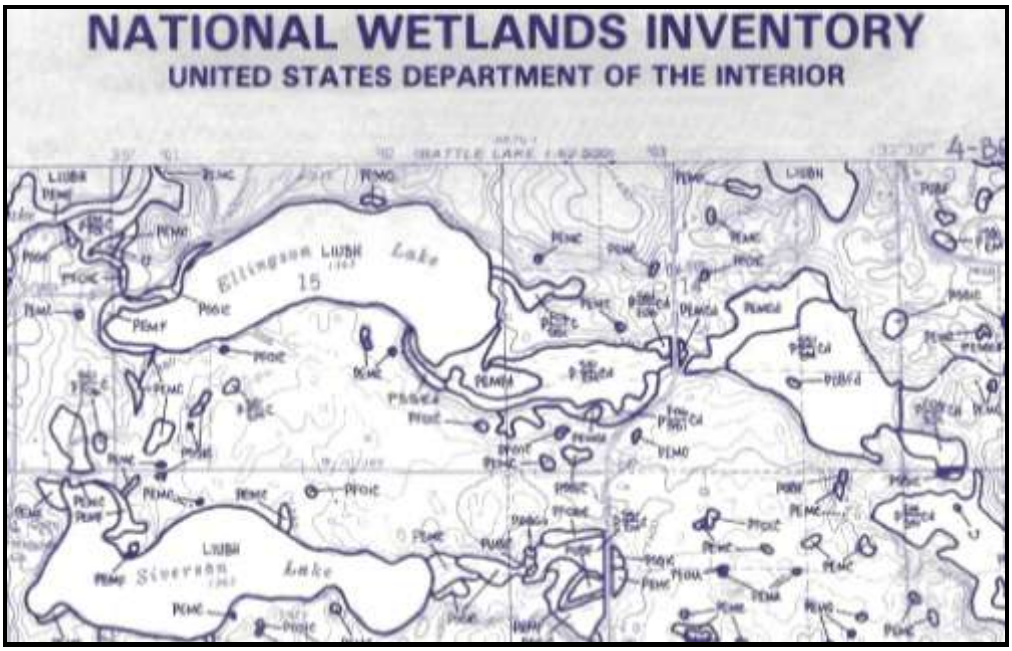


Figure 2.1: Scanned section of the original NWI paper maps.

2.3. Issues, Goals, and Objectives

This project aims to update and enhance the NWI for Minnesota.

There are a couple of issues with the original NWI data for Minnesota that limit its present utility. First and foremost, the data are about 25 to 30 years out of date. Many changes in wetland extent and type have occurred since the original NWI. Changes in the extent of agricultural and urban development have resulted in loss of wetlands. On the other hand changes in wetland policies and programs have resulted in the creation of new wetlands. Without an up-to-date wetland inventory, it is difficult to address our wetland planning and management needs. According to the management adage, you can't manage what you don't measure.

Second, various limitations in the original methodology and source data resulted in an under representation of certain wetland classes. There will always be some constraints on the ability to map wetlands; however, the portions of the state that were mapped with older 1:80,000 scale black and white imagery are a particular problem. Wetland maps in these areas tend to be very conservative, missing many forested and drier-end emergent wetlands (LMIC 2007).

Several specific objectives have been identified in support of the overall project goal of updating and improving the NWI.

- Identify methods and data sources that will improve the accuracy and efficiency of mapping wetlands
- Clearly define the requirements for an updated NWI necessary to meet the needs of end users and to be consistent with national standards for geospatial wetland data

- Acquire a consistent set of base imagery and as consistent as possible set of ancillary data
- Hire and oversee a qualified contractor to conduct the production of the updated NWI
- Establish a quality control program the ensure consistent, high-quality data
- Establish a multi-faceted data delivery program to meet the needs of end users
- Maintain effective communications with key stakeholder groups
- Design a process for keeping the data up-to-date

3. Project Organization

3.1. Overview

The update of the National Wetland Inventory for Minnesota is a collaborative effort involving federal, state, and local agencies and organizations. The Ecological Resources Division of the Minnesota Department of Natural Resources (DNR) is responsible for coordinating this effort. Other key groups include: various end-users of these maps (stakeholders), the University of Minnesota Remote Sensing and Geospatial Analysis Laboratory, a mapping contractor, U.S. Fish and Wildlife Service, a technical advisory committee, and the DNR Enterprise Hydrography Team. The organizational relationship of these groups is shown in Figure 3.1. The composition and roles of these various groups is briefly discussed.

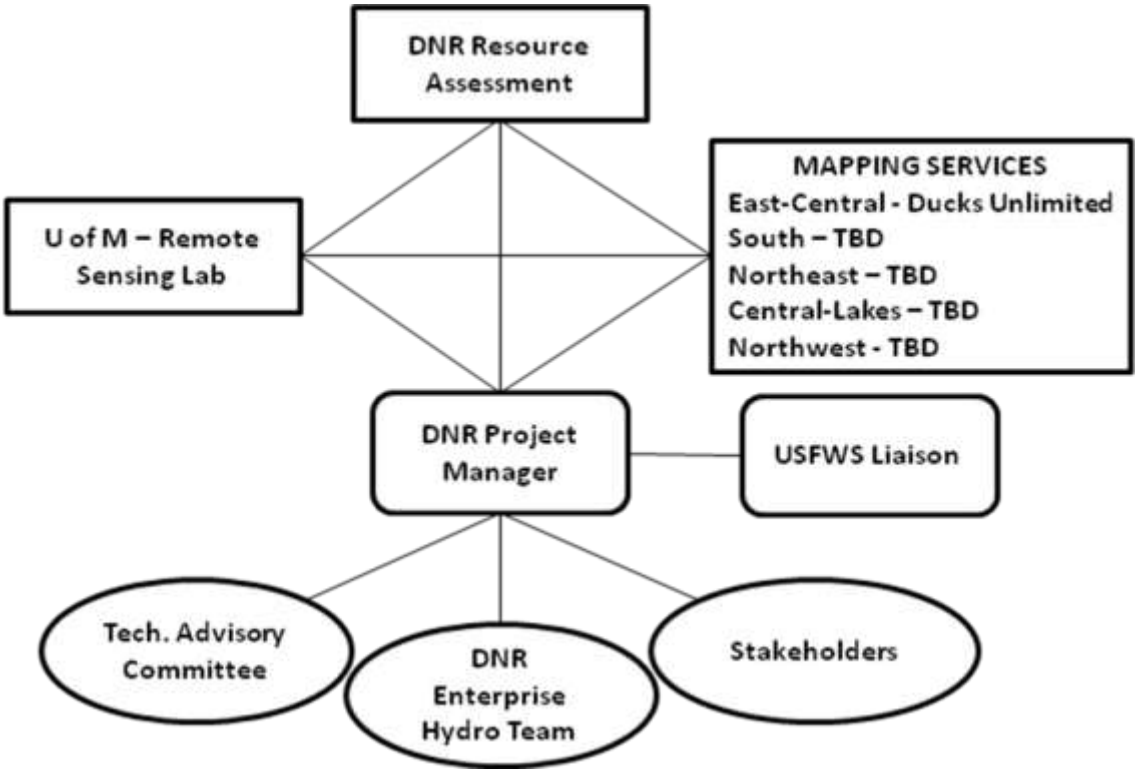


Figure 3.1: Organization structure for the NWI Update project..

DNR Project Manager

The DNR is providing overall project management for the NWI Update. This includes overseeing project documentation, coordinating activities of the technical advisory committee, managing stakeholder communications, preparing and managing vendor contracts, ensuring quality control, and coordinating methods for data delivery.

3.2. Stakeholders

Stakeholders will provide vital advice and information about how they use the NWI and what improvements they would like to have incorporated into the update. However, the stakeholders for the NWI Update for Minnesota are too numerous to have regular effective meetings. Various other techniques will be used to maintain communications with stakeholders include web surveys, e-mail distribution, occasional workshops, and select one-on-one interviews.

3.3. University of Minnesota – Remote Sensing Laboratory

With the continuing evolution of aerial and satellite remote sensing technologies, there are many more options and combinations of systems with the potential to provide more accurate and timely wetland maps than were available when the original NWI was completed. The University of Minnesota - Remote Sensing Laboratory (UM – RSL) will lead the effort to compile and evaluate information on the best available methods for cost-effectively mapping wetlands for Minnesota.

3.4. DNR Resource Assessment Office

The DNR Resource Assessment Office in Grand Rapids, Minnesota will provide a variety of mapping support services for this project including data preprocessing, wetland probability mapping, field data acquisition, and field verification.

3.5. Mapping Contractor

The wetland-mapping contractor will be responsible for day-to-day production efforts for the National Wetland Inventory update. Contractor services will be procured through a standard competitive bid process. The project will be divided into phases with maps being updated for a different region in each phase. Each of the mapping efforts will be bid separately. The wetland-mapping contractor for each region will specify a project manager. The project manager for the wetland-mapping contractor will oversee all resource allocation, budgeting, training, and quality control internal to the contracting organization. The project manager for the wetland-mapping contractor will also act as the primary point of contact for the DNR project manager. The wetland-mapping contractor may also specify other internal roles as needed.

3.6. U.S. Fish and Wildlife Service

One of the objectives of this project is to produce an updated wetland inventory consistent with wetland mapping national standards. As such, the regional NWI coordinator for the U.S. Fish and Wildlife Service will be responsible for ensuring that

national data standards are adequately addressed in the planning phase. The NWI coordinator will also be responsible for acting as a liaison USFWS headquarters staff that will be involved in reviewing the data for inclusion in the National Wetland Inventory database.

3.7. Technical Advisory Committee

The technical advisory committee will provide advice on various technical aspects of the project including review the methods assessment report and making recommendations on methodology, evaluating and commenting on the requirements document, providing input on proposed mapping approaches, and commenting on data deliverables. The technical advisory committee will be comprised of various wetland and GIS professionals from around the state (Table 3.1).

Table 3.1: Technical Advisory Committee

Member	Organization	Contact Info
Doug Norris	Minnesota DNR	doug.norris@dnr.state.mn.us 651-259-5125
Brian Huberty	U.S. Fish and Wildlife Service	brian_huberty@fws.gov 612-713-5332
Nancy Read	Metropolitan Mosquito Control District	nancread@mmcd.org 651-645-9149
Mark Gernes	Minnesota Pollution Control Agency	mark.gernes@state.mn.us 651-757-2387
Les Lemm	Board of Water and Soil Resource	Les.Lemm@state.mn.us 651-296-6057
Rob Sip	Minnesota Department of Agriculture	Twyla.hill@state.mn.us 651-201-6641
Dr. Joe Knight	University of Minnesota – Remote Sensing Lab	jknight@umn.edu 612-625-5354
Susanne Maeder	Land Management Information Center	susanne.maeder@state.mn.us 651-201-2488
Steve Eggers	U.S. Army Corp of Engineers	steve.d.eggers@usace.army.mil 651-757-2387

3.8. DNR Enterprise Hydrography Workgroup

The DNR Enterprise Hydrography Workgroup is responsible for addressing project impacts to existing DNR business processes and data sets as well as assisting with identifying and securing key DNR resources for this project. This team is comprised of key DNR staff dealing with water resource GIS data.

4. Work Breakdown Structure Overview

The NWI Update will be conducted in phases (See schedule in section 6). This comprehensive project plan provides an overview of all tasks for the entire update. The plan entails a planning phase followed by four mapping phases. Mapping regions shown in Figure 4.1. The following phases have been funded.

- Phase 1 – Project coordination, initial project planning, methods assessment, requirements development, and data acquisition for northeastern and east-central Minnesota (funded 7/1/08)
- Phase 2 – Wetland map production for 13-counties in east-central Minnesota and data acquisition for 36 counties in southern Minnesota (funded 7/1/10)
- Phase 3 – Wetland map production for 30 counties in southern Minnesota and data acquisition for 22 counties in Central Minnesota (funding starts 7/1/12)

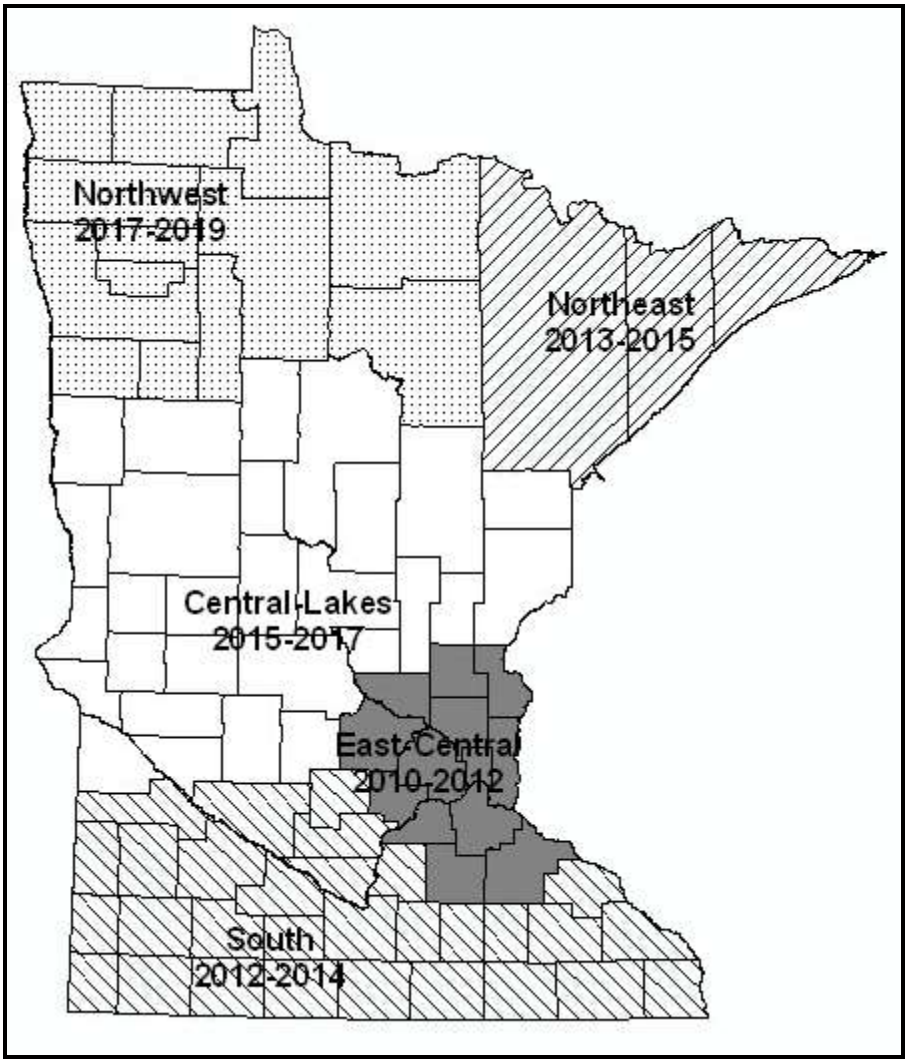


Figure 4.1: Mapping regions for the Minnesota NWI Update Project with fiscal year funding indicated.

4.1. Requirements Development

Clearly defining the requirements is an essential part of all projects. For the NWI update, there are two components of this process: review of federal standards for wetland geographic data and assessing user needs.

4.1.1. Review Wetland Data Standards

One of the objectives of this project is to develop an updated NWI for Minnesota that is consistent with national geospatial data standards in support of having the updated data entered into the U.S. Fish and Wildlife Service wetland database. The primary national geospatial data standard governing wetlands is the wetland mapping standard developed under the auspices of the Federal Geographic Data Committee (FGDC). This standard has been incorporated into the requirements document developed for this project.

4.1.2. User Needs Assessment

A user needs assessment was conducted to help define the requirements. This assessment included a web survey of a broad cross section of end users. In addition, users were solicited through the web survey to participate in follow-up interviews. The information collected through this process was compiled and combined with information on geographic data standards for wetlands into a requirements document.

Table 4.1: User Requirement Deliverables

Deliverable	Date	Responsibility
Draft Requirements	1/31/2009	DNR
Final Requirements	4/30/2009	DNR

4.2. Methods Evaluation

With the continuing evolution of aerial and satellite remote sensing technologies, there are many more options and combinations of systems with the potential to provide more accurate and timely wetland maps than were available when the original NWI was completed. The University of Minnesota - Remote Sensing Laboratory (UM – RSL) is leading the effort to compile and evaluate information on the best available methods for cost-effectively mapping wetlands for Minnesota. This effort is briefly summarized here. More details on the methods evaluation can be found in the methods evaluation reports from the University of Minnesota.

New image data types and approaches show promise for improving upon previous methods. A variety of image data types and mapping approaches are being evaluated for their suitability for wetland mapping in the pilot areas and the state as a whole. This process will result in mapping methods tailored to the different wetland types in Minnesota. Specific data types and mapping methods to be evaluated include:

- Radar image data – Radar data is particularly sensitive to soil moisture. Radar signals are also able to penetrate forest canopy. As such, radar data are well suited to identify wetlands that do not have standing water and also forested wetlands that might otherwise be obscured by forest canopy. The Canadian

government has begun using radar data in combination with color infra-red imagery for mapping wetlands as a part of the Canadian Wetland Inventory.

- LiDAR image data – LiDAR images provide highly detailed elevation data for ground features. The inclusion of LiDAR images in the mapping process can assist in identifying depressions, floodplains and other areas that may contain wetlands. LiDAR data are being collected for Minnesota. The methods assessment effort will help determine the best and most efficient way of incorporating this information in the NWI update.
- NAIP image data –The USDA National Agricultural Image Program (NAIP) collected high resolution digital aerial images for Minnesota in the summer of 2008, 2009, and 2010. The normal procedure in wetland mapping is to use images collected during the few weeks between snow melt and leaf emergence, so as to be able to identify wetlands before they are covered by tree canopies and at seasonally high water levels. However, summer imagery may make a valuable addition tot eh NWI update by improving classification accuracy of certain types of wetlands such as aquatic bed wetlands and improving the identification of farmed wetlands.
- Image segmentation – A relatively recent image processing technique called image segmentation will be evaluated. Traditional image processing techniques are used to discriminate different cover types based on statistical parameters (e.g. the range of color values) of image pixels. Image segmentation involves partitioning an image based upon context and texture. Image segmentation may improve the efficiency of wetland mapping by reducing the amount of time spent on manually digitizing wetland boundaries.
- Wetland probability maps – The current MN NWI delineates wetlands with polygons, so an area is either wetland or it is not. This is problematic for two reasons. First, natural wetlands rarely have such sharp boundaries. Depending on geologic setting and land use, the wetland to non-wetland transition may be very gradual, exhibited by dryer and dryer soil and slowly changing vegetative species the further one moves from the center of a wetland. Second, due to the gradual edge of some wetlands, determining where to draw the polygon boundary may be difficult. A wetland probability map is a continuous gridded surface representing the likelihood that any particular grid cell is a wetland. The probabilities are derived from factors such as slope, elevation, aspect, soil type, and vegetative species present. The main advantage of using a probability map is that wetland boundaries are flexible and can be identified based on the needs of a particular application. Wetland probability maps will be created for the pilot areas and will be compared with wetland boundaries derived from traditional mapping approaches. If the probability maps are accurate and valuable, it may be possible to use this technique to assist with the statewide mapping.

These image sources and mapping techniques will be tested on at least three pilot areas that represent a range of land cover regions in Minnesota. The pilot areas for this effort are:

- City of Chanhassen - Developing suburban area

- Carlton County (Fond du Lac Reservation) – Rural forested area
- Nicollet County (Swan Lake Area) – Rural agricultural area

Updated wetland inventory maps will be created for the pilot areas using the data type(s) and mapping method that provide the highest accuracy for each area. These inventory maps will be provided to stakeholders and the public on an interim basis until the statewide NWI update is complete.

The best performing wetland mapping protocols will be identified. Specific protocols will be recommended for the different areas of the state. The protocols and instructions will be documented and provided to the mapping team and other appropriate parties. Training and technical support will also be provided to the mapping team as needed in support of the recommended wetland mapping protocols.

Table 4.2: Methods Assessment Deliverables

Deliverable	Date	Responsibility
Pilot Area Wetland Map (Urban)	6/30/2010	UM-RSL
Mapping Protocol – Urban	6/30/2012	UM-RSL
Pilot Area Wetland Map (Forested)	9/30/2010	UM-RSL
Mapping Protocol – Forested	6/30/2012	UM-RSL
Pilot Area Wetland Map (Agricultural)	12/31/2012	UM-RSL
Mapping Protocol – Agricultural	6/30/2012	UM-RSL

4.3. Data Acquisition Planning

The primary data used for the update of the NWI in Minnesota will be aerial imagery. In addition, ancillary or collateral data including soils data, LiDAR elevation data, and radar may be incorporated as available to enhance wetland mapping accuracy. Some original data acquisition will be conducted for this project. Other data have already been acquired by other agencies and for other projects. The status of existing data will be summarized in the Data Availability Assessment Report, along with identifying critical data gaps. Additional data to be acquired for this project will be addressed in the Data Acquisition Plan.

Table 4.3: Data Acquisition Plan Deliverables

Deliverable	Date	Responsibility
Data Availability Assessment Report	1/31/2009	DNR
Draft Data Acquisition Plan	5/15/2009	DNR
Final Data Acquisition Plan	6/30/2009	DNR

4.4. Quality Assurance Planning

The DNR will develop a Quality Assurance Project Plan (QAPP) with input from the TAC. The QAPP will define quality control objectives, establish a standard for “ground-

truth" data, define accuracy requirements (position, feature, and attribute), and establish procedures for evaluating accuracy.

Table 4.4: Quality Assurance Plan Deliverables

Deliverable	Date	Responsibility
Draft Quality Assurance Plan	8/31/2009	DNR
Final Quality Assurance Plan	5/31/2010	DNR

4.5. Contract Management

Digital aerial imagery and updated NWI data for Minnesota will be produced for each project phase (Figure 4.1) under a competitive-bid contract to the Minnesota DNR. The process for a standard professional/technical services contract is outlined here. Contracting for aerial photography services will be coordinated with other state agencies such as the Minnesota Geospatial Information Office (MnGeo) to ensure efficient procurement of shared geospatial data.

4.5.1. Request for Proposal

The DNR project manager will prepare a Request for Proposal (RFP) in cooperation with other participating state agencies following the standard procurement procedures for the DNR. This includes developing the scope of work, preparing the Department of Administration Certification form, drafting the formal RFP, developing the selection criteria, and drafting the notice for the State Register.

4.5.2. Bid Evaluation/Selection

The contractors will submit sealed proposals. A selection committee will evaluate the proposals using the Best Value criteria with cost comprising at least 30% of the total score.

4.5.3. Contract Development

The DNR project manager will prepare a draft contract in cooperation with other participating state agencies using the standard contract form for professional/technical services and submit this to the selected contractor for their review. The DNR project manager will negotiate a final contract with support from DNR Office of Management and Budget Services. The required number of copies of the final contract will be routed for signature and the contract will then be executed.

4.5.4. Contract Management

DNR project Manager will provide ongoing contract management services to ensure adequate progress toward contract goals, process vendor invoices, review overall project costs, and evaluate the quality and completeness of deliverables.

Table 4.5: Contract Management Deliverables

Deliverable	Date	Responsibility
Northeast Imagery RFP	1/31/2009	DNR
Northeast Imagery Contract	3/30/2009	DNR
East-Central Imagery RFP	12/31/2009	DNR/MnGeo
East-Central Imagery Contract	2/28/2010	DNR/MnGeo
East-Central Mapping RFP	7/1/2010	DNR
East-Central Mapping Contract	8/31/2010	DNR
South Imagery RFP	12/31/2010	DNR/MnGeo
South Imagery Contract	2/28/2010	DNR/MnGeo
South Mapping RFP	7/1/2012	DNR
South Mapping Contract	8/31/2012	DNR
Central Imagery RFP	12/31/2012	DNR/MnGeo
Central Imagery Contract	2/28/2013	DNR/MnGeo
Northeast Mapping RFP	7/1/2013	DNR
Northeast Mapping Contract	8/31/2013	DNR
Northwest Imagery RFP	12/31/2013	DNR/MnGeo
Northwest Imagery Contract	2/28/2014	DNR/MnGeo
Central Mapping RFP	7/1/2015	DNR
Central Mapping Contract	8/31/2015	DNR
Northwest Mapping RFP	7/1/2017	DNR
Northwest Mapping Contract	8/31/2017	DNR

4.6. Map Production

4.6.1. Contractor Workplan

The successful bidder for the map production contract will be required to develop and submit a workplan for this aspect of the project for review and approval by the DNR and the TAC. This workplan shall incorporate information on the methods and data that will be used to produce updated wetland inventory maps, project staffing requirements, a schedule of project milestones, status report frequency, and budget by project task.

Table 4.6: Map Production Deliverables

Deliverable	Date	Responsibility
East-Central Draft Wetland Data	7/1/2011 – 3/31/2012	Ducks Unlimited
East-Central Final Wetland Data	9/30/2012	Ducks Unlimited
East-Central Final QA/QC Report and Metadata	9/30/2012	Ducks Unlimited
South Draft Wetland Data	7/1/2013 – 3/31/2014	TBD
South Final Wetland Data	9/30/2014	TBD
South Final QA/QC Report and Metadata	9/30/2014	TBD
Northeast Draft Wetland Data	7/1/2014 – 3/31/2015	TBD
Northeast Final Wetland Data	9/30/2015	TBD
Northeast Final QA/QC Report and Metadata	9/30/2015	TBD
Central Draft Wetland Data	7/1/2016 – 3/31/2017	TBD
Central Final Wetland Data	9/30/2017	TBD
Central Final QA/QC Report and Metadata	9/30/2017	TBD
Northwest Draft Wetland Data	7/1/2018 – 3/31/2019	TBD
Northwest Final Wetland Data	9/30/2019	TBD
Northwest Final QA/QC Report and Metadata	9/30/2019	TBD

4.7. Data Management/Delivery

4.7.1. Data Format

Draft and final wetland inventory maps will be delivered in digital format to the DNR in geodatabase format consistent with the latest version of ArcGIS and with an attribute table structure consistent with the federal wetland mapping standard (FGDC 2008).

4.7.2. Storage and Back-Up

The data will be delivered to the DNR on portable hard drives along with a set of data on DVD for back-up. The DNR will store the data on it storage area network (SAN). The vendor will also keep a copy of the data for back-up for a period of at least two years after the completion of the contract.

4.7.3. Delivery Options

The data will be served on the DNR's public access website for geographic information, known as the DNR Data Deli (http://deli.dnr.state.mn.us/). The data will also be submitted by the DNR to the U.S. Fish and Wildlife Service for inclusion in the national wetland geodatabase, which can be accessed through a variety of mechanisms including the USFWS online Wetland Mapper and through Google Earth (http://www.fws.gov/wetlands/data/index.html).

Table 4.7: Data Management Deliverables

Deliverable	Date	Responsibility
East-Central Wetland Data Posted Online	12/31/2012	DNR
South Wetland Data Posted Online	12/31/2014	DNR
Northeast Wetland Data Posted Online	12/31/2015	DNR
Central Wetland Data Posted Online	12/31/2017	DNR
Northwest Wetland Data Posted Online	12/31/2019	DNR

5. Documentation, Reporting, and Communications

5.1.1. Workplan

This document serves as a comprehensive project plan for the statewide update of the NWI for Minnesota. This project plan will be reviewed and updated periodically (at least quarterly) to ensure that it accurately reflects the activities of the NWI update project. Additional details of various project components may be covered by sub-plans.

5.1.2. Related Documents

Additional documentation will be developed for the following key elements:

- Methods Assessment (UM)
- Quality Assurance (DNR)

- Data Acquisition (DNR)
- Map Production (Contractor)

These documents are incorporated into this comprehensive project plan by reference.

5.1.3. Metadata

Metadata (data about the data) will be developed for all geospatial deliverables produced under this project. Anticipated geospatial deliverables include; digital aerial imagery, wetland maps for pilots study areas, and updated NWI maps for the state of Minnesota. Metadata will comply with

5.1.4. Reporting to LCCMR

Semi-annual progress reports will be provided to the LCCMR to track progress toward key project milestones and budget expenditures. These reports will be prepared by the DNR project manager in January and July of each year using the template provided by the LCCMR.

5.1.5. Contractor Reporting

The mapping contractor will provide quarterly progress reports to the DNR project manager to track progress on project milestones and budget expenditures. Reports will be due in March, June, September, and December.

5.1.6. TAC Communications

The technical advisory committee will meet periodically, as needed, to discuss technical aspects of the project including reviewing and commenting on methodology, project requirements, quality control plans, and data deliverables. Meeting agendas will be e-mailed to all TAC members one week prior to each meeting and meeting notes will be e-mailed within one week of each meeting. Project documents will be posted at www.dnr.state.mn.us/eco/wetlands/nwi_proj.html.

5.1.7. Stakeholder Communications

A web-based survey will be used to collect stakeholder input. Follow-up phone interviews will be made for a representative selection of survey respondents.

A database of stakeholder e-mail contacts will be developed and maintained by the DNR project manager. Periodic e-mail announcements will be sent to all interested parties.

Project documents will be posted at www.dnr.state.mn.us/eco/wetlands/nwi_proj.html.

Newsletter articles will be published in various organizations including, but not limited to the DNR, the Wetland Professional Association, the University of Minnesota Water Resource Center, and the Minnesota GIS/LIS Consortium.

Occasional workshops will be held at key project milestones to present results from pilot studies, present draft data, and to solicit stakeholder feedback.

6. Schedule

ID	Task Name	Start	Finish
1	Project Management	Tue 7/1/08	Mon 12/31/18
2	**Phase 1**	**Tue 7/1/08**	**Thu 9/30/10**
3	Project Planning	Tue 7/1/08	Mon 6/28/10
4	Methods Evaluation	Mon 9/1/08	Fri 8/27/10
5	Imagery (Northeast)	Tue 12/16/08	Mon 8/31/09
6	Imagery (East-Central)	Tue 12/1/09	Tue 8/31/10
7	Field Data Acquisition	Mon 5/3/10	Thu 9/30/10
8	**Phase 2**	**Wed 9/1/10**	**Thu 1/3/13**
9	Methods Evaluation	Wed 9/1/10	Tue 8/30/11
10	Imagery (South)	Wed 12/1/10	Tue 8/16/11
11	Field Data Acquisition	Mon 5/2/11	Fri 9/30/11
12	Mapping (East-Central)	Wed 9/1/10	Tue 8/28/12
13	QC	Wed 2/1/12	Tue 10/30/12
14	Web Delivery	Fri 11/2/12	Thu 1/3/13
15	**Phase 3**	**Mon 9/3/12**	**Fri 1/2/15**
16	Imagery (Centra Lakesl)	Mon 12/3/12	Fri 8/16/13
17	Field Data Acquisition	Wed 5/1/13	Mon 9/30/13
18	Mapping (South & Northeast)	Mon 9/3/12	Fri 8/29/14
19	QC	Mon 2/3/14	Fri 10/31/14
20	Web Delivery	Mon 11/3/14	Fri 1/2/15
21	**Phase 4**	**Mon 9/1/14**	**Fri 12/30/16**
22	Imagery (Northwest)	Wed 12/17/14	Tue 9/1/15
23	Field Data Acquisition	Fri 5/1/15	Wed 9/30/15
24	Mapping (Central Lakes)	Mon 9/1/14	Fri 8/26/16
25	QC	Mon 2/1/16	Fri 10/28/16
26	Web Delivery	Mon 10/31/16	Fri 12/30/16
27	**Phase 5**	**Thu 9/1/16**	**Mon 12/31/18**
28	Mapping (Northwest)	Thu 9/1/16	Wed 8/29/18
29	QC	Thu 2/1/18	Mon 10/29/18
30	Web Delivery	Tue 10/30/18	Mon 12/31/18

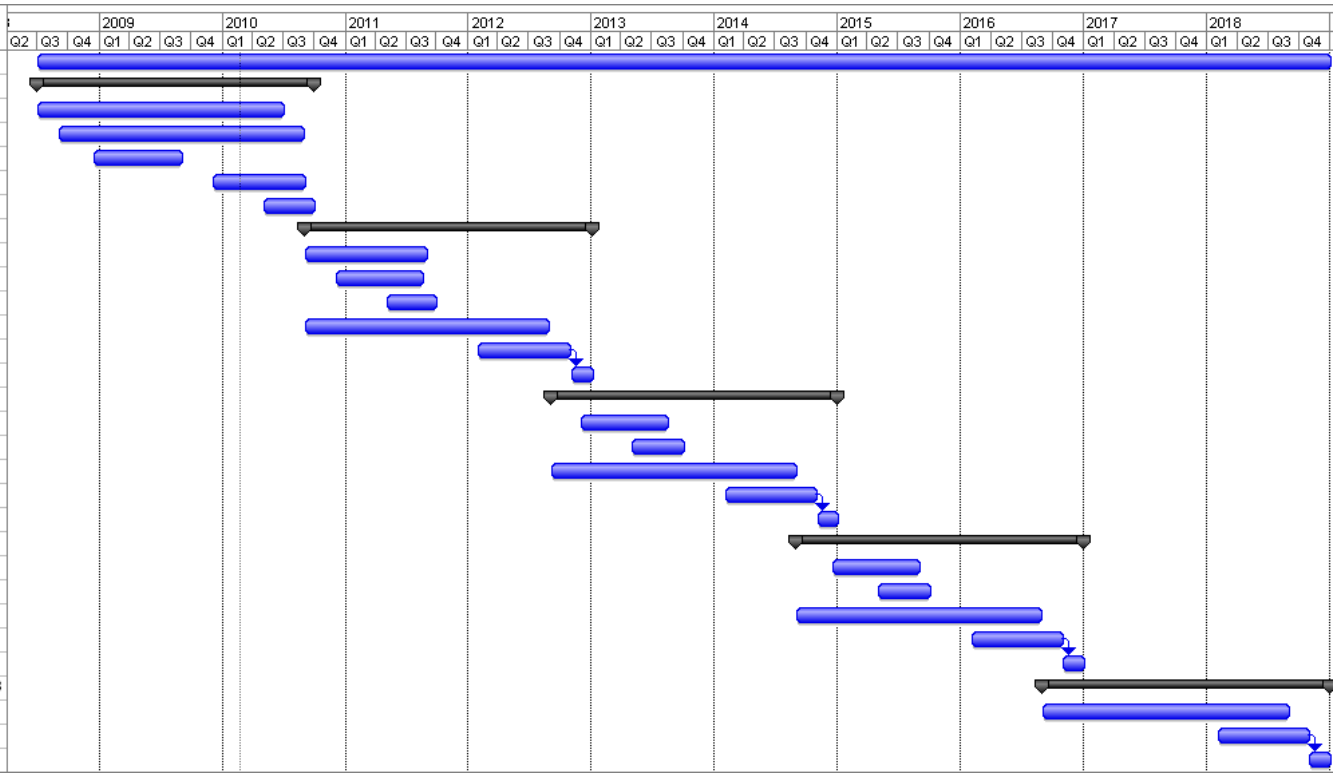


Figure 6.1: Project schedule for the NWI Update for Minnesota.

7. *Budget*

Planning-level budget estimates are provided below. This table does not portray actual expenditures. Detailed data on actual expenditures is available from the DNR financial reporting system and from the regular status reports provided to the LCCMR.

Table 7.1: Planning-level project budget

Fiscal Years	Imagery	Map Production	Methods Evaluation	Field Data	Project Mgmt	Total by Phase
2008 – 2010	$140,000	$0	$200,000	$80,000	$130,000	$550,000
2010 – 2012	$463,000	$324,000	$100,000	$82,000	$139,000	$1,108,000
2012 – 2014	$464,000	$812,000	$0	$84,000	$148,000	$1,508,000
2013 – 2015	$358,000	$967,000	$0	$88,000	$157,000	$1,570,000
2015 – 2017	$0	$1,598,000	$0	$0	$166,000	$1,764,000
2017 – 2019	$0	$1,399,000	$0	$0	$176,000	$1,575,000
				TOTAL =		$8,075,000

8. References

FGDC. 2008. Draft Wetlands Mapping Standard. Federal Geographic Data Committee (FGDC) Wetland Subcommittee and Wetland Mapping Standard Group. Pp. 1-35.

Gernes, M. and D.J. Norris. 2006. A Comprehensive Wetland Assessment, Monitoring, and Mapping Strategy for Minnesota. Minnesota Pollution Control Agency and Minnesota Department of Natural Resources, St. Paul, MN. 54 pp.

Land Management Information Center. 2007. Metadata for the National Wetlands Inventory, Minnesota.

Wilen, B.O. and Bates, M.K. 2004. The U.S. Fish and Wildlife Service's National Wetlands Inventory Project. Plant Ecology. 118:1-2: 153-169.

Requirements for the National Wetland Inventory Update of Minnesota

April 9, 2009

Minnesota Department of Natural Resources
Division of Ecological Resources
500 Lafayette Road North
St. Paul, MN 55155

Table of Contents

1. Problem Statement 1
2. Regulatory and Programmatic Drivers 1
   2.1. Minnesota Wetland Conservation Act 1
   2.2. Minnesota Environmental Policy Act 4
   2.3. Other Drivers 4
   2.4. Estimate of Wetland Inventory Use 5
3. No Action Risk 5
4. User Requirements 5
   4.1. User Survey 5
   4.2. User Interviews 8
5. Review of Federal Geographic Wetland Standard 10
6. Uncertainties and Assumptions 10
7. Desired Outcome 11
8. Benefits 12
9. Constraints 13
10. References 14
11. Appendix A i
   11.1. Wetland Map End User Survey i
   11.2. Full Text Responses to Question 16 viii
   11.3. Map Users Contacted for Follow-Up Interviews x

Acknowledgments

This document was prepared with funding provided by the Minnesota Environment and Natural Resources Trust Fund as recommended by the Legislative-Citizen Commission on Minnesota Resources (LCCMR). The Trust Fund is a permanent fund constitutionally established by the citizens of Minnesota to assist in the *protection, conservation, preservation, and enhancement of the state's air, water, land, fish, wildlife, and other natural resources.*

Input on this document was provided through a web-based survey of users of wetland maps. In addition, thirteen of these map users were contacted for follow-up phone interviews (see appendix). Comments were also provided by the technical advisory committee for the Minnesota National Wetland Inventory Update. If you have questions regarding this document, please direct them to the DNR Wetland Monitoring Coordinator, Steve Kloiber at (651) 259-5164 or steve.kloiber@dnr.state.mn.us.

Acronyms Used

BWSR – Board of Water and Soil Resources

CRP – Conservation Reserve Program

DNR – Department of Natural Resources

FGDC – Federal Geographic Data Commission

HGM – **H**ydro**g**eo**m**orphic

LGU – Local government unit

LLWW – **L**andscape position, **l**andform, **w**ater flow path, and **w**aterbody type

MEPA – Minnesota Environmental Policy Act

NWI – National Wetland Inventory

RIM – Reinvest in Minnesota

RMSE – root mean square error

TMDL – Total Maximum Daily Load

TMU – Target mapping unit

WCA – Wetland Conservation Act

1. Problem Statement

Wetland inventories are an essential tool for effective wetland management, protection, and restoration. Such inventories provide baseline information for assessing the effectiveness of wetland policies and management actions. These data are used at all levels of government, as well as by private industry and non-profit organizations for wetland regulation and management, land use and conservation planning, environmental impact assessment, and natural resource inventories. The National Wetland Inventory (NWI) is the only spatially comprehensive wetland inventory for Minnesota.

Yet, there are a couple of issues with the original NWI data for Minnesota. First and foremost, the data are about 20 to 30 years out of date. Many changes in wetland extent and type have occurred since the original delineation. Changes in the extent of agricultural and urban development have resulted in loss of wetlands leading to inaccuracies in wetland inventory maps (**Figure 1.1**). On the other hand, changes in wetland policies and programs may have resulted in the creation of new wetlands. Without an up-to-date wetland inventory, it is difficult to address our wetland planning and management needs.

Second, various limitations in the original technology, methodology and source data resulted in an under representation of very small wetlands and forested wetlands. There are always constraints on the ability to map wetlands with complete accuracy; however, the portion of the state that was mapped with older 1:80,000 scale black and white imagery is a particular problem (**Figure 1.2**). Wetland maps in this area tend to be very conservative, missing many forested and drier-end emergent wetlands (LMIC 2007).

A comparison of the NWI data and the wetland data for 1802 random plots that were remapped in 2006 shows that for some wetland categories, such as deepwater habitat, there is general agreement between the older and newer data (**Figure 1.3a**) However, for other wetland types, such as forested and emergent, there are considerably more differences between the older and newer data (**Figure 1.3b and 1.3c**). These differences are a result of the combination of land use changes and methodology differences.

2. Regulatory and Programmatic Drivers

Environmental protection laws and conservation programs drive much of the need for wetland inventory maps. Two of the most significant laws are Minnesota Wetland Conservation Act and the Minnesota Environmental Protection Act.

2.1. Minnesota Wetland Conservation Act

To retain the benefits of wetlands and reach the goal of no-net-loss of wetlands, the Wetland Conservation Act (WCA) (MS 103G.222) requires anyone proposing to drain, fill, or excavate a wetland first to try to avoid disturbing the wetland; second, to try to minimize any impact on the wetland; and, finally, to replace any lost wetland acres, functions, and values. WCA is administered by a network of local and state agencies and organizations. State agencies include the Board of Soil and Water Resources and the Department of Natural Resources. Local agencies involved vary throughout the state, but may include cities, townships, soil and water conservation districts, watershed districts, watershed management organizations, and counties.

While WCA requires on-the-ground wetland delineations for boundary or type change applications, very often wetland inventory maps, like the NWI, are used in the initial phase of a project to screen for potential wetland impacts. A developer or consultant may use wetland inventory maps for assessing the feasibility of various development scenarios and for estimating the potential mitigation costs. State and local administrators use wetland inventory maps as a check against on-the-ground wetland delineations to identify areas that may have been missed.

2.2. Minnesota Environmental Policy Act

Minnesota's Environmental Policy Act (MEPA) (MS 116D.02 & MS 116D.04) established a formal process for investigating the environmental impacts of major development projects. The purpose of the review is to provide information about a project's environmental impacts before approvals or necessary permits are issued. The process operates according to rules adopted by the Environmental Quality Board, but is actually carried out by local government, state agencies, and joint powers organizations. Among the various impacts that must be assessed for major projects are the impacts to wetlands and other protected waters. In this case, on-the-ground wetland delineations are not usually required and wetland inventory maps, like NWI, are the only source of available information on wetland location and type. As with WCA, a developer or their consultant may use wetland inventory maps for assessing the feasibility of various development scenarios and estimating the potential mitigation costs. State and local administrators may use wetland inventory maps as a check on the Environmental Assessment Worksheet or Environmental Impact Statement prepared by the project owner or their consultant.

2.3. Other Drivers

Programs that regulate wetland impacts such as WCA and MEPA are only one component driving the need for wetland inventory maps. Conservation programs such as Reinvest in Minnesota (RIM), the Conservation Reserve Program (CRP), the Conservation Reserve Enhancement Program, and other programs seek, in part, to restore and protect wetlands through long-term or permanent easements or acquisition. These programs involve federal, state, and local agencies as well as non-profit organizations. Planning and prioritization for these programs often benefit from wetland inventory maps. Other organizations may also use wetland maps as a tool for guiding land management and wildlife management decisions.

Wetland inventory maps are also used to support a variety of state and local planning efforts. Counties and cities often need wetland inventory maps when developing local land use plans to help guide development away from sensitive areas. State agencies, counties, watershed districts, and watershed management organizations require wetland inventory maps when developing watershed management plans. These organizations need these maps when addressing needs for flood protection, water quality management, and restoration activities. Another related driver for wetlands mapping is the water quality management requirements of the Total Maximum Daily Load (TMDL) requirements of the Clean Water Act.

2.4. Estimate of Wetland Inventory Use

Nationally, there were over 50 million on-line user requests for NWI data for 2008. However, there is little direct data for just Minnesota on the number of people using wetland inventory maps, how frequently these maps are needed, and how much time they saved. Instead we rely here on surrogate data and surveys to assess the need for wetland inventory maps.

According to BWSR (2005), there is an average of about 17,800 landowner contacts each year to the WCA designated local government units regarding wetland issues. Many, if not most, of these contacts will involve a preliminary review of available wetland inventory maps. Add to this another approximately 200 environmental reviews for MEPA that also rely on wetland maps to assess potential environmental impacts (pers. comm. EQB staff). Also add to this an unknown number of uses for non-regulatory wetland conservation efforts and local planning.

The number of people requiring wetland inventory maps for Minnesota is not known, but users likely include the more than 350 local government units (LGUs) – cities, counties, watershed management organizations, soil and water conservation districts, and townships – that implement the WCA locally (BWSR 2005). It likely also includes most wetland professionals in Minnesota. The Minnesota Wetland Professional Association serves close to 200 members. Add to this wetland staff from various federal and state agencies, private consulting companies, academic institutions, and non-profit organizations. While there may be some overlap between these groups, it seems safe to say that there are probably close to 1000 people in Minnesota who would be routine users of an updated National Wetland Inventory.

3. No Action Risk

The biggest problem with the existing NWI is that it is out-of-date and no longer represents an accurate depiction of wetlands. The NWI figures heavily in wetland regulatory activity and environmental impact assessment. The “no action” risk associated with not updating the NWI is significant.

The biggest problem is with wetlands that are not depicted on the wetland inventory. Unmapped wetlands are not detected until later in the development process, when changing the project proposal becomes more costly. Or they are not detected at all, which potentially leads to unmitigated wetland loss. It is also a problem when wetland maps show wetlands that no longer exist. In this instance, effort is wasted and costs increase by assessing wetland impacts for a wetland that no longer exists.

4. User Requirements

User requirements were assessed using two approaches; a web-based survey and phone interviews. The results of the survey and interviews are summarized here. Full details are provided in Appendix A of this document.

4.1. User Survey

A web-based survey was conducted in December 2008. Broadcast e-mails announcing the survey were sent to all wetland professional contacts provided by the technical

advisory committee members for the NWI update. In addition, the survey announcement was sent out to the e-mail distribution list for the Wetland Professional Association and the e-mail distribution list for the Board of Water and Soil Resources.

4.1.1. Characterization of Users

There were 100 respondents to the survey. The bare majority of these respondents (52%) were employed with a state government agency. A substantial number were employed in the private sector (25%) or local government (15%). The rest were employed with the federal government, tribal government, research or educational institutions, and non-profit organizations. Professional roles for the respondents varied widely, with 53% describing themselves as wetland scientists and 46% describing themselves as wetland regulators or permit reviewers. Users were allowed to select more than one role. Other roles were generally cited at rates between 14% and 23%. Many of these respondents described themselves as intensive users of wetland maps with 64% of respondents using wetland maps weekly or daily.

4.1.2. Assessment of Existing NWI Data

A clear majority of respondents (77%) state that the existing NWI data do not meet their needs. However, 51% of respondents have used NWI data to derive some type of map or report product. By far, the most common reason cited for dissatisfaction with NWI is that wetlands are missing and that the data are out-of-date (90%). Another important issue for respondents was that the scale of the existing NWI is considered to coarse (66%) and it misses too many small wetlands.

4.1.3. User Stated Needs

The most commonly desired uses for wetland maps are to support wetland regulation activities (91%), environmental impact analysis (66%), and land use or land development planning (64%). Other closely related uses including flood management and transportation planning were cited around 40% of the time. The next tier of uses, at around 30%, includes wildlife management and recreational uses.

The most common response for how frequently wetland maps should be updated was every 5 years (53%). Combining this with those respondents who cited less frequent updates, it appears that an update frequency of every 5 years would satisfy 94% of users, while an update frequency of every 10 years would only satisfy 41% of users (**Figure 2.1**).

Looking at the issues of scale and resolution, the most frequent response for the smallest size wetland that users believe needed to be mapped was 1/10 of an acre (46%). This was the smallest option presented in the question, so the true mode may not have been bracketed. However, a plurality of respondents (56%) would be satisfied with mapping wetlands down to ¼ of an acre (**Figure 2.2**). Most respondents thought that the base imagery for wetland mapping should be either 1-foot resolution (37%) or 2-foot resolution (36%). Using 2-foot resolution base imagery would meet the requirements of 63% of users.

The preferred format of the deliverable is digital data for use on desktop application (94%) or online maps (39%) and most respondents would like to see a combination of vector and raster data (66%).

An open-ended question was included in the web survey to allow users to provide specific suggestions for improving the NWI that were not captured in the other survey questions. Full responses for this question can be found in the appendix. Several of the responses to this question reinforce the conclusion that improving the update frequency and increasing the mapping resolution are important issues for users. Another common response theme was to improve the NWI by adding additional attribute information. Suggestions for additional attribute information include Ralph Tiner's LLWW system (Tiner 2003), Stewart and Kantrud's classification system (Stewart and Kantrud 1971), Eggers and Reed's classification system (Eggers and Reed 1987), a hydrogeomorphic (HGM) classification system, functional assessments for larger wetlands, a designation for restored or constructed wetlands, and the unique identifier from the DNR's Public Water Inventory (PWI). A few respondents also voiced a desire for having the updated NWI field checked. Others mentioned the need to develop a system for maintaining the data.

4.2. User Interviews

User interviews were conducted by phone with a selection of respondents from the web survey. Those contacted for interviews are listed in the appendix.

4.2.1. Wetland Inventory Uses

User interviews confirm that administration of the Wetland Conservation Act rules and other related regulatory programs is a major driver for the need for wetland inventory maps. The NWI is frequently used as a starting point for the wetland delineations required under WCA or for screening for potential wetland impacts under MEPA. Consultants often rely on NWI as one factor to consider when estimating costs for a delineation project. The WCA rules specifically require including a figure showing the NWI maps for a wetland delineation project. LGU administrators and state agency staff involved with overseeing wetland programs frequently rely on NWI to evaluate reports from wetland delineators. While a few LGUs have developed their own updated wetland inventory maps, for most, the NWI is the only wetland inventory map available.

Another commonly cited use for the NWI was as a key input for locally developed wetland inventories by cities, counties, or watershed districts or watershed management organizations. These local inventories often use NWI as a starting point to develop a more up-to-date inventory and to expand upon the wetland information by incorporating data on wetland functions and values. There was some difference of opinion among government agencies with their own local wetland inventory about whether an updated statewide NWI would be of use to them. Some felt that it would be unnecessary; others said they would still welcome having an updated statewide NWI.

Other uses cited for the NWI included as a tool for identifying wetland monitoring locations, as an input into hydrologic and hydrogeologic models (e.g. water table maps), as an important historical reference for wetland loss, or for identifying potential wetland restoration opportunities. NWI may also be useful for local authorities when reviewing

plans for locating new septic systems (preventing installation of malfunctioning septic systems) or new structures (avoiding chronic wet basement problems).

4.2.2. Problems and Impacts

The problems cited by interviewees were largely the same as those indicated on the web-based survey; however, the emphasis placed on these problems shifted somewhat. In the web survey, the most commonly cited problem was that the maps were out of date. During the interviews, most respondents emphasized the issue of missing wetlands. Through further discussion, it became obvious that these problems are linked. The bottom line for most users is that they need to have an accurate representation of wetland occurrence on the landscape. Inaccuracies in the mapped representation of wetland can come about because of shortcomings in the mapping methods (such as the under mapping of forested wetlands, farmed wetlands, or small wetlands) or they can come about because land use management activities have resulted in gains or losses in wetlands.

Another aspect of this issue that became more apparent through the interviews is that the influence of the different types of inaccuracies varies spatially across the state. For example, forested wetlands were under mapped due to the difficulty of identifying these wetlands from aerial photography, but in particular for an area of northeastern Minnesota that was mapped with smaller scale black and white imagery. Farmed wetlands, went largely unmapped in the initial NWI, leading to an under representation of this class which most prominently affects the southwestern one-third of the state. And wetland gains and losses due to development are more prevalent near the major growth centers of the state, while relatively little wetland change is likely in the state and federal public lands of northern Minnesota.

The end result of these inaccuracies, regardless of the cause, is the same: increased time and costs spent by all parties. One of the most obvious examples of this impact is the situation where a consultant has relied on the NWI to provide a cost proposal to a client. If the NWI drastically under represents wetlands for the area, the consultant will need to spend additional unplanned time in the field delineation effort. Administrators at the state and local level also expend additional time verifying wetland presence. While most professionals seem to be aware of these shortcomings and have tried to account for them in the practice, problems still occur. In the worst-case scenario, wetlands not mapped by the NWI are at greater risk for falling through regulatory cracks and being lost without replacement.

Another problem cited in the follow-up interviews was positional errors for the wetland boundaries. Most of those interviewed did not think that positional errors were a major issue, but a few people described instances where there appears to be a geographic shift in the NWI data when compared to some of the available modern digital aerial ortho-photography.

4.2.3. Desired Improvements

The most commonly requested improvement was to increase the accuracy so that all wetlands that exist on the landscape (or as many as possible) are represented on the updated NWI maps. Other requested improvements were to include other wetland classification systems (such as Eggers and Reed 1987), ensure that wetland boundaries

align with the aerial photos, incorporate addition attributes (such as HGM or LLWW), and to include a unique wetland basin identifier (similar to the PWI number).

5. Review of Federal Geographic Wetland Standard

The Federal Geographic Data Committee (FGDC) has distributed a final draft wetland mapping standard in September 2008 (FGDC 2008). This standard, as applied to Minnesota, is briefly summarized here.

The FGDC wetland mapping standard specifies a requirement that source imagery and base imagery for wetland mapping should have a resolution of 1 meter or better (equivalent to a 1:12,000 scale map). It defines source imagery as the imagery used for interpreting wetlands and base imagery as a spatially consistent set of orthorectified imagery used for wetland overlays. Source imagery should be color-infrared, according to this standard. It also recommends, but does not require that source imagery should be stereoscopic, and/or acquired during leaf-off conditions. Base imagery should have a horizontal accuracy that ensures a root mean square error (RMSE) of 5 meters or less.

Wetlands classification should follow the standard given in Wetlands and Deepwater Habitats of the United States (http://www.fws.gov/stand/standards/cl_wetl.html) (see also Cowardin et al. 1979). The minimum standard for the completeness of the wetland classification is: ecological system, subsystem (except Palustrine systems), class, subclass (for forested, scrub-shrub, and emergent classes), water regime, and special modifiers (where applicable). The minimum standard for deepwater habitat classification is: system, subsystem, class, and water regime.

The target mapping unit (TMU) is the smallest wetland consistently mapped and should be 0.5 acres or smaller. The feature level classification accuracy should correctly identify at least 98% of the wetlands at or above the TMU that appear on the imagery, referred to as the producer's accuracy. The attribute accuracy should be 85% or higher. The horizontal accuracy of the wetland delineation shall be consistent with the horizontal accuracy of the base imagery (RMSE ≤ 5 meters).

> Ninety-eight percent of all wetlands visible on an image, at the size of the TMU or larger shall be mapped regardless of the origin – FGDC Draft Wetlands Mapping Standard – September 2008

To meet the requirements of the FGDC standard, the data must be verified and quality checked by the U.S. Fish and Wildlife Service (USFWS). These checks include topological checks to ensure the internal consistency of the data structure (e.g. polygons are closed, no duplicate features, no overlaps, etc.), checks to ensure the data is properly edge-matched to ensure consistent data across tile boundaries, and checks on attributes to ensure that all assigned attributes are consistent with the standard and are valid.

For further details, refer to the full FGDC wetland mapping standard (FGDC 2008).

6. Uncertainties and Assumptions

One area of uncertainty regarding this project is how well the user needs are understood. Reading the aggregated results of the user needs survey; it would appear that users have

high expectations. Users want very-high resolution base imagery, they want very small wetlands mapped, and they want the inventory updated at least every five years. Combine this with the goal of a producer's accuracy of 98% from the federal wetland mapping standard and the bar is set very high indeed. Meeting all these requirements would have a potentially significant impact on the project cost. However, there is some uncertainty whether these statements represent the true business need for a wetland inventory, represent a conflation of multiple business needs, or represent a desire to have the best available data regardless of the actual need and cost.

The assumption is that these statements reflect the conflation of at least two separate data needs for wetland mapping information. The first need is for a regulatory screening tool to identify potential wetland impacts during the planning phase of a project. This tool should be up-to-date and spatially comprehensive. In addition, to serving as a regulatory screening tool, an updated wetland inventory also serves several other purposes. The second need is for highly accurate wetland boundary information and detailed assessment of wetland functions and values to be used for regulatory permit requirements. This second level of information does not need to be spatially comprehensive, but only created on a case-by-case basis for specific sites proposed for development. This level of detail is not usually needed in areas of the state that are not under consideration for development.

Another area of uncertainty is the fundamental uncertainty about the boundary delineation of wetlands. The distinction between wetland and upland is based upon a detailed assessment of soils, plants, and hydrology. This assessment relies on the preponderance of evidence from multiple factors and professional judgment. In addition, these factors are not static in time. Often there is a degree of interpretation required to assess what the wetland boundary would be under typical, long-term climate conditions when observations can only be made over a very short time window with a limited set of climate conditions.

In addressing boundary uncertainty, the assumption is that locating precise wetland boundaries for all wetlands across the entire state is neither technically feasible nor is it entirely necessary. In fact, the language of the WCA states that wetland boundary delineation performed for the WCA be done using "field" data. And while a sample of wetlands from a statewide wetland inventory can be field verified, it would be cost-prohibitive and unnecessary to field verify all wetland boundaries.

7. Desired Outcome

Based on the information gathered through this assessment, the desired outcome would be to have an NWI that is as current as possible with a reasonably high accuracy for indicating where wetlands of all sizes and types occur. Most respondents to the survey indicated that the wetland inventory should be updated every five years. In follow-up discussions, the reason cited for this update frequency was the belief that land use and hydrology changes over long periods would render the map inaccurate. However, these changes do not necessarily occur in a spatially uniform manner. Some areas of the state experience more rapidly changing conditions than others. The underlying need is that the wetland inventory maps need to be an accurate depiction of the current state of wetlands. However, there does not appear to be a strong consensus on the priority for highly precise wetland boundaries for a statewide wetland inventory.

It would be desirable to have the updated wetland inventory for Minnesota meet the federal requirements for mapping wetland so the data could be included in the National Wetland Inventory Database. Specific minimum requirements include:

- 98% of wetlands larger than ½-acre that are visible on source imagery should be mapped
- Wetlands as small as 1/10th of an acre should be mapped, whenever possible
- Wetland classification accuracy should also be verified against a sample of field-checked sites and the results of this accuracy assessment should be published as part of the metadata
- A system should be developed to keep the data up-to-date
- Wetlands should be classified according to the Cowardin (1979) classification system
- The data should be provided digitally in vector format to the public in both downloadable datasets and online maps
- Wetland boundaries should be properly aligned with a concurrent, high-resolution imagery dataset and the imagery should be made publicly available along with the wetland inventory maps

Additionally, incorporating the following value-added options should be considered if they do not add significantly to the cost of the project.

- A wetland probability model in raster (grid) format
- Additional attributes describing the hydrogeomorphic setting such as landscape position, landform, water flow path, and waterbody type
- Provide a classification crosswalk to alternative wetland classification systems including Eggers and Reed (1987)
- A unique identification system for wetland basins, building upon the public waters inventory system

8. Benefits

One of the key benefits of having up-to-date wetland inventory maps is the time saved by regulatory review or planning programs. Up-to-date wetland inventory maps provide a readily available tool for screening for potential wetland impacts and for efficiently directing any field review efforts that are required. Using a conservative estimate of an average of 1 hour saved for each regulatory review (WCA or MEPA), the total time saved per year would be about 18,000 hours. Using a professional hourly rate of $50/hr, this translates into $900,000 saved each year just for regulatory reviews.

Another key benefit includes the avoidance of wetland impacts. Wetland inventory maps are used to help avoid wetland losses through a variety of regulations and programs. For example, BWSR (2005) indicates that 30% of initial WCA inquiries are resolved without a wetland impact and that on average about 3,400 acres of wetland impacts are avoided each year. The cost of replacing wetlands varies widely, but even under the most

conservative estimate the cost saved by avoiding wetland impacts is well over a $3 million per year. Not all of these impact avoidances can be directly attributed to having up-to-date wetland inventory maps, but clearly these maps play an important role in implementing regulatory programs.

9. Constraints

There are several constraints on implementing an update of the NWI to meet the desired outcome.

Funding – The update of the NWI is likely to require considerable funding resources. The initial cost estimate for a statewide update is $7,000,000. To date, the funding directly available for this project is $550,000 through a grant from the Environmental and Natural Resources Trust Fund. Some additional funds have been obtained from project partners for imagery acquisition. Without adequate and consistent funding, this project will be difficult, if not impossible, to implement.

Technical Feasibility – There is often an inherent technical trade-off between some of the key desired outcomes for this project. For example, small wetlands tend to be more difficult to accurately map. Lowering the threshold for the minimum mapping unit will likely increase mapping costs and decrease overall accuracy. Advances in mapping technology may mitigate this trade-off, but they are not likely to eliminate it.

Resource Availability – Another potential constraint to updating the NWI is the availability of the labor resources needed, if the project is implemented using a traditional photo-interpretation approach. The original NWI was created using manual wetland delineation by photo-interpreters. Even many of the more recent projects still use photo-interpreters to map wetlands. Data on labor requirements suggest that 25 to 30 full-time equivalent employees would be needed to complete an update in six years. Since the work often relies on part-time college students, this translates into hiring, training, and overseeing the efforts of a large contingent of photo-interpreters. Other mapping efforts have taken advantage of automated mapping technology to greatly reduce the labor requirement; however, most of the published reports from these efforts suggest that fully automating the classification process may entail a significant reduction in accuracy (Islam et al. 2008).

10. References

BWSR. 2005. 2001-2003 Minnesota Wetland Report. Minnesota Board of Water and Soil Resources, St. Paul, MN. 100 pages. http://www.bwsr.state.mn.us/wetlands/publications/wetlandreport.pdf

Cowardin L., V. Carter, F. Golet, and E. LaRoe. 1979. Classification of wetlands and Deepwater Habitats of the United States. U.S. Department of the Interior, Fish and Wildlife Service, Washington, DC, USA.

EQB. 2009. Personal communication with Gregg Downing of the Minnesota Environmental Quality Board. St. Paul, MN.

Eggers S. D., and D. M. Reed. 1987. Wetland plants and plant communities of Minnesota and Wisconsin. US Army Corps of Engineers, St. Paul District, St. Paul, MN, USA.

FGDC. 2008. FGDC Draft Wetland Mapping Standard. Federal Geographic Data Commission. http://www.fgdc.gov/standards/projects/FGDC-standards-projects/wetlands-mapping/

Islam, M.A., P.S. Thenkabail, R.W. Kulawardhana, R. Alankara, S. Gunasinghe, E. Edussriya, and A. Gunawardana. Semi-automated methods for mapping wetlands using Landsat ETM+ and SRTM data. International Journal of Remote Sensing. 29:24:7077-7106.

Land Management Information Center. 2007. Metadata for the National Wetlands Inventory, Minnesota.

Stewart, R. E., and H. A. Kantrud. 1971. Classification of natural ponds and lakes in the glaciated prairie region. U.S. Fish. Wildlife Service, Resource Publication 92. 57 pp.

Tiner, R.W. 2003. Correlating Enhanced National Wetlands Inventory Data With Wetland Functions for Watershed Assessments: A Rationale for Northeastern U.S. Wetlands. U.S. Fish and Wildlife Service, National Wetlands Inventory Program, Northeast Region, Hadley, MA.

11. Appendix A

11.1. Wetland Map End User Survey

Q1. What is your primary organizational affiliation? (Check one)

Answer Options	Response Percent	Response Count
Private sector business / consultant	24.7%	22
Land owner / farmer / real estate developer	0.0%	0
Local government	15.7%	14
State government	51.7%	46
Research	3.4%	3
Education	3.4%	3
Non-profit	1.1%	1
Private individual (other than land owner)	0.0%	0
Comments		13
	answered question	89
	skipped question	12

Q2. What is your personal/professional role with respect to wetlands? (Check all that apply)

Answer Options	Response Percent	Response Count
Regulator / permit reviewer	46.9%	46
Regulated / permittee	20.4%	20
Land manager	14.3%	14
Conservationist	19.4%	19
Planner / policy analyst	18.4%	18
Wetland scientist	52.0%	51
Geographer / mapping specialist	18.4%	18
Recreational (fisherman, hunter, outdoorsman)	22.4%	22
Comments		8
	answered question	98
	skipped question	3

Q3. How frequently do you deal with wetland issues? (Check one)

Answer Options	Response Percent	Response Count
Nearly every day	54.5%	54
Every week	26.3%	26
A couple of times a month	15.2%	15
Once a month	4.0%	4
Once a year or less	0.0%	0
	answered question	99
	skipped question	2

Q4. How often do you use wetland maps? (Check one)

Answer Options	Response Percent	Response Count
Nearly every day	28.7%	29
Once or twice a week	35.6%	36
A couple of times a month	23.8%	24
Once a month	9.9%	10
Once a year or less	2.0%	2
	answered question	101
	skipped question	0

Q5. Which of the following uses of wetland maps apply to you? (Check all that apply)

Answer Options	Response Percent	Response Count
Wetland regulation	90.7%	88
Flood management	39.2%	38
Wildlife management	28.9%	28
Land use / land development planning	63.9%	62
Environmental impact analysis	66.0%	64
Farmland management	21.6%	21
Transportation planning	40.2%	39
Forest harvest planning	7.2%	7
Education	24.7%	24
Recreation (fishing, hunting, birding)	29.9%	29
Comments		10
	answered question	97
	skipped question	4

Q6. Does the National Wetland Inventory data meet your needs? (Check one)

Answer Options	Response Percent	Response Count
Yes	23.0%	23
No	76.0%	76
Don't know, I've never used it	1.0%	1
	answered question	100
	skipped question	1

Q7. Do you have other data and/or reports that are derived from the National Wetlands Inventory? (Check one)

Answer Options	Response Percent	Response Count
Yes	50.0%	50
No	32.0%	32
Don't know.	18.0%	18
	answered question	100
	skipped question	1

Q8. If National Wetland Inventory does not meet your needs, why not? (Check all that apply)

Answer Options	Response Percent	Response Count
Wetlands are missing from the map (out-of-date or never mapped)	89.5%	77
The scale is too coarse or it doesn't capture small enough wetlands	66.3%	57
I need the data to be simplified	5.8%	5
I need more information about wetland variability over time (e.g. water level fluctuations)	32.6%	28
The descriptive data do not provide enough information	30.2%	26
Comments		21
	answered question	86
	skipped question	15

Q9. If you use wetland maps from a source other than NWI, what is its origin? (Check all that apply)

Answer Options	Response Percent	Response Count
Not applicable, I only use NWI	31.1%	23
Created or enhanced by consultant	41.9%	31
Created or enhanced by city	36.5%	27
Created or enhanced by watershed organization	41.9%	31
Created or enhanced by county	48.6%	36
Comments		29
	answered question	74
	skipped question	27

Q10. Which figure best represents the reoslution needs for wetland mapping?

For reference the wetland shown in this figure is about ¼ of an acre.

Answer Options	Response Percent	Response Count
a. 1-foot	37.0%	37
b. 2-foot	37.0%	37
c. 4-foot	18.0%	18
d. 8-foot	6.0%	6
e. 16-foot	2.0%	2
	answered question	100
	skipped question	1

Q11. What is the smallest wetland that you need to have mapped? (Check one)

Answer Options	Response Percent	Response Count
10-acre	1.0%	1
5-acre	1.0%	1
1-acre	8.2%	8
½-acre	8.2%	8
¼-acre	35.1%	34
1/10-acre	46.4%	45
	answered question	97
	skipped question	4

Q12. What format do you prefer to use for wetland maps? (Check all that apply)

Answer Options	Response Percent	Response Count
Digital GIS data on desktop	94.0%	94
Online maps	40.0%	40
Paper maps	19.0%	19
Comments		5
	answered question	100
	skipped question	1

Q13. Which of the following figures best represents the way you would like to have wetland maps presented?

(Check one)

Answer Options	Response Percent	Response Count
Vector	31.6%	31
Raster	2.0%	2
Both	66.3%	65
	answered question	98
	skipped question	3

Q14. How frequently should wetland maps be updated? (Check one)

Answer Options	Response Percent	Response Count
Seasonally	0.0%	0
Yearly	6.1%	6
Every 5 years	53.5%	53
Every 10 years	25.3%	25
Every 20 years	7.1%	7
Don't know	8.1%	8
	answered question	99
	skipped question	2

Q15. If you obtain wetland map data from an online source, what is your primary source? (Check one)

Answer Options	Response Percent	Response Count
DNR Deli available at http://deli.dnr.state.mn.us/	64.6%	51
DNR Landview available at http://www.dnr.state.mn.us/maps/landview.html	8.9%	7
The National Map viewer available at http://nmviewogc.cr.usgs.gov/viewer.htm	1.3%	1
The US Fish and Wildlife Wetland Mapper available at http://wetlandsfws.er.usgs.gov/wtlnds/launch.html	25.3%	20
Comments		10
	answered question	79
	skipped question	22

Q16. Do you have suggestions to improve the wetland data so that it better meets your need?

Answer Options	Response Count
	36
answered question	36
skipped question	65

11.2. Full Text Responses to Question 16

16. Do you have suggestions to improve the wetland data so that it better meets your need?

1 An interactive process should be developed between BWSR, DNR and the COE that makes use of the reviewed and approved wetland delineations submitted to LGU's and the COE. These are prepared by (for the most part) by certified wetland professionals and reviewed and approved by other certified professionals. The deleiantions are surveyed so the boundaries are accurate. Most delineatoirs and engineers use digital technology so the results could easily be used to update NWI maps on a "realtime" basis. I have met with BWSR, FWS and COE and all agree that this would be a useful idea. Implementation could be achieved fairly easily from what I've been told. It mainly requires a system of input quality control and steps to educate delineators on involvemnt and participation.

2 Better resolution, better digitization accuracy standards

3 Biggest need for NWI is to update it using more recent information. Inclusion of smaller basins would be nice, but not critical. Removal of basins no longer present is more important. Consider adding an attribute that notes if the basin is also a Public Water. Consider adding Eggers and Reed classification? Drop the upland classification on the shapefiles.

4 Cass County has poor underlying mapping, ie USGS quads that should also be updated. This may be the case in parts of Crow WIng County too and others?

5 Consistent use of Cowardin's classification system throughout the state (e.g., modifiers, subclass designations); addition of more wetland attributes such as Tiner's landscape position, landform, waterflow path, and waterbody type (LLWW); incorporate Governor's GIS Council "Basin" Standard for lakes and depressional wetlands (e.g., Basin ID field could be used to dissolve Cowardin classes into distinct waterbodies where appropriate)

6 Cowardin System is the standard required for use by federal agencies and recomended for use by others. A commitment by federal and,or state governements is needed to fund imagery acquisition and data creation. This would ensure consistently accurate data. As stated above, the Cowardin System has inherent flexibility to incorporate data address a variety of resource information needs.

7 Functional assessments of large (>10 acres) intact Protected Waters basins would be nice to have.

8 Get the F&W to show comparable data!

9 Give us more high res aerials for base theme coverage

10 I delineate very small wetland areas but would not expect a large project to capture everything. It should be emphasized that this does not replace a delineation, sometimes landowners get confused.

11 I have been working on wetlands for about one year, at this juncture, these responses and experience is limited.

12 I think periodic updateing of the maps is critical, however I realize it is costly. I think colaborating with all agencies to ensure all databases of wetland information are included (e.g., NRCS has GIS layers of WRP easements and mitigated wetlands, that would provide "type" information).

13 If NWI is updated, it would be helpful to designate restored basins vs. natural basins. We need a statewide shapefile showing wetlands restored through DNR, NRCS, SWCD's etc.

14 If possible mapping conventions to show all drainage facilities. Minimize or eliminate omission errors for small wetlands (especially PEMA/Type I wetlands) Obtain information from various agencies, entities and include mapping conventions to show which wetlands maybe protected by various programs i.e. WMAs, WPAs, Wetland Easements, TNC, MN DNR Protected Waters, etc. One of the most important factors in producing good wetland maps is to acquire aerial photography in mid to late April during an above average runoff year.

15 Include LLWW coding by Ralph Tiner

16 Include Stewart and Kanturd classification in addition to Cowardin classification. The Stewart and Kantrud classification system is uniquely designed for Prairie Pothole Wetlands.

17 It needs to be up to date!! 5 years is feasible and is the max lag time because of all the development and hydrological changes that occur on the landscape over time.

18 It would be nice to have a system that allows users to provide updated information to the wetland GIS data. For example, I know of a type 3 wetland that doesn't show up in NWI.

19 Maintenance is the biggest issue. Maps should be be updated via permitting reults

20 Make sure that the file formats are also compatible with free GIS software like MapWindowGIS (http://www.mapwindow.com/)

21 Map during early spring hydrology. Improve mapping of agricultural wetlands.

22 Maps by county coords.

23 Need to have wetlands display more accurately in space, not off by more than 20 ft or 50 ft. Hopefully, someone will use the periodic updates to track wetland 'health' over time; how they change as development/ disturbance increases. And how buffers make a difference.

24 One statewide layer as opposed to quad layers

25 Overall pretty good, just needs to be updated. Perhaps better mapping in agricultural settings.

26 Provide latest versions all in one location

27 Scale and resolution are really the factors. The city just collects much more data than what is on the FWS map.

28 Simple labels that aren't codes

29 Smaller scale of digitizing: <1:2000 Finer detail and higher resolution.

30 Some way to correlate with hydric soils potential, to see if there are auxiliary issues to consider for environmental analysis.

31 The main things are a digital or online format, more up to date, and a little more detailed.

32 The most important will be updating the data so that it is accurate/current. Increasing the scale is also important. Labels that correspond to the new WCA community type descriptions would be helpful.

33 There needs to be significantly more ground truthing in MN to improve reliability so that maps can be more reliable and not just guides. Map updates should be done at a predictable time intervals.

34 Upland areas need not be included in the data set. Use multiple wetland classification systems (i.e. HGM, Eggers and Reed, etc.).

35 Wetland mapping methods should no longer rely purely on remote sensing as the only method of interpretation and data gathering. Field checking is essential, even if much of the land can not be accessed. If the agencies plan on updating existing data with only remotely sensed data, then I strongly believe this will be a waste of time and taxpayer money.

36 Will it be feasible to field check boundaries???? Will updated boundaries just be based on soils and aerials?

11.3. Map Users Contacted for Follow-Up Interviews

Name	Affiliation
John Anderson	St. Mary's University / Geospatial Services
Ben Meyer	Bonestroo
Jed Chesnut	WSB Engineering
Rob Peterson	West Central Environmental Consultants
Nick Rowse	US Fish & Wildlife Service
David Thill	Hennepin County
Jyneen Thatcher	Washington Conservation District
Leslie Stovring	City of Eden Prairie
Allen Schmitz	Minnesota Department of Transportation
Joan Weyandt	Board of Water and Soil Resources
John Genet	Minnesota Pollution Control Agency
Randy Bradt	Minnesota DNR / Division of Waters
Rick Gitar	Fond du Lac Reservation

Wetland Mapping Methods for the Arrowhead Region of Minnesota

Joseph F. Knight, Ph.D.
Jennifer Corcoran, M.S.
Lian Rampi
Bryan Tolcser
Margaret Voth

Remote Sensing and Geospatial Analysis Laboratory
Department of Forest Resources
University of Minnesota

9/30/2010

Contents

1. Introduction 3
1.1. Objectives 3
1.2. Background 3
2. Methods/Results 4
2.1. Wetland Mapping using Decision Trees 4
2.1.1. Decision Trees Introduction 4
2.1.2. Decision Trees Methods 4
2.1.3. Decision Trees Accuracy Assessment 10
2.1.4. Decision Trees Results 11
2.1.5. Decision Trees Discussion 26
2.1.6. Decision Trees Conclusions 30
2.1.7. Decision Trees Future Directions 31
2.2. Wetland Mapping using Radar Image data 31
2.2.1. Radar Mapping Introduction 31
2.2.2. Radar Mapping Methods 32
2.2.3. Radar Mapping Results 33
2.2.4. Radar Mapping Conclusions 38
2.3. The Importance of Leaf-off Imagery 38
3. Recommendations and Protocol for Wetland Mapping in the Arrowhead 38
3.1. General Recommendations 38
3.2. Mapping Protocol 39
3.2.1 Data Types and Software 39
3.2.2 Preprocessing 40
3.2.3 Data display and Interpretation 40
3.2.4 Data Post-processing and Delivery 40
3.2.5 Quality Assurance / Quality Control 41
4. Conclusions 41
5. References 42

Funding for this project was provided by the Minnesota Environment and Natural Resources Trust Fund as recommended by the Legislative-Citizen Commission on Minnesota Resources (LCCMR). The Trust Fund is a permanent fund constitutionally established by the citizens of Minnesota to assist in the protection, conservation, preservation, and enhancement of the state's air, water, land, fish, wildlife, and other natural resources.

1. Introduction

1.1. Objectives

This document is a report to the Minnesota Department of Natural Resources (MNDNR) that provides a review of research conducted on wetland mapping methods for the Arrowhead, or boreal forest, region of Minnesota (the counties of Carlton, Cook, Itasca, Koochiching, Lake, and St. Louis). This report is intended as a companion to the report, "Wetland Mapping Methods for the Twin Cities Metropolitan Area," which was submitted to MNDNR in June of 2009. Given herein are recommendations for wetland mapping methods appropriate for the ongoing National Wetlands Inventory update in Minnesota. This document is provided to MNDNR by the University of Minnesota's Remote Sensing and Geospatial Analysis Lab (RSGAL) in partial fulfillment of a contractual agreement between the two parties. The structure of this report is as follows: 1) detailed summaries of the research undertaken by RSGAL under this agreement, 2) Recommendations and a suggested protocol for wetland mapping in the Arrowhead.

1.2. Background

For background information on wetland mapping we respectfully refer the reader to the report "Wetland Mapping Methods for the Twin Cities Metropolitan Area," which was submitted to MNDNR in June of 2009. This report should be viewed as an addendum to the previous work.

Wetlands are jointly defined by the U.S. Army Corps of Engineers (USACE) and the U.S. Environmental Protection Agency (EPA) as: "those areas that are inundated or saturated by surface or ground water at a frequency and duration to support, and under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions" (Federal Register, 1982; Federal Register, 1980). Wetlands are a valuable natural resource as they play a crucial role in the ecology of a landscape. Wetlands function as a buffer to open water bodies and provide important ecosystem functions by maintaining water quality by filtering nutrients and pollutants, storing floodwater and mitigating its effects on water bodies, and also providing habitat to a variety of wildlife that have adapted to life in saturated environments. Wetlands also play a role in the global carbon cycle, acting as both carbon sources and sinks.

Wetland loss has occurred at an alarming rate. In a 200 year period between colonization and the 1980's, the lower 48 states lost an estimated 53% wetland acreage due to a variety of human activities such as agriculture, urbanization and development, and pollution (Dahl, 1990; Johnston, 1989). Over 50% of Minnesota's 3.6 million hectares(ha) of wetlands have been lost. The concentration of wetland loss is greatest, over 80%, in southern Minnesota and the Red River Valley where wetlands were drained for agriculture. Urbanization causes small wetland area losses, but significantly alters a wetland's physical, biological, and chemical properties (Johnston, 1989). The loss of wetlands continues, but trends appear to be that wetland loss is slowing (Dahl and Johnson, 1991). Accurate mapping of the spatial distribution of wetlands is an important tool for understanding the effects of wetland loss, and may contribute to policy decisions influencing land use (Baker, et al. 2006).

2. Methods/Results

2.1. Wetland Mapping using Decision Trees

2.1.1. Decision Trees Introduction

Mapping wetlands can be achieved through a variety of methodologies ranging from field investigation to remote wetland assessment. Remote sensing has been used as a wetland mapping tool since the 1960's (Cowardin and Myers, 1974) but early assessments were not accurate enough for many practical applications. However, with recent advances in remote sensing technologies, it may be possible to map wetlands in a large geographic area with sufficient accuracy in an efficient and cost-effective manner. The following study is a survey of the usefulness of various geospatial data types in wetland mapping using decision tree classifiers (e.g. RandomForests™, CART™, etc.).

2.1.2. Decision Trees Methods

2.1.2.1. Pilot Study Areas

Two areas, one located in the St. Paul – Minneapolis metropolitan area and one located in the northern forested region of Minnesota, were selected as pilot areas for the study. Pilot areas were selected to be areas in which high quality geospatial datasets were available. In addition, local government agencies in both areas had recently performed wetland inventories. The GIS datasets and wetlands inventories were excellent tools to study automated wetland classification. The location of the two pilot study areas is shown in Figure 1, below.

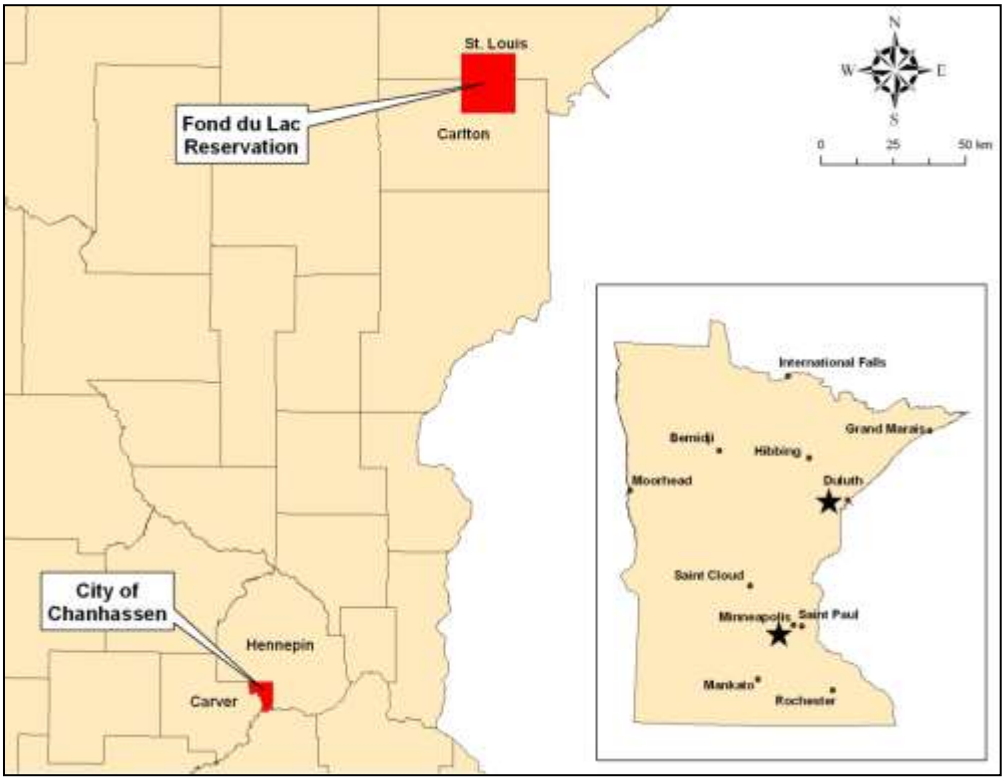


FIGURE 1 – LOCATION OF PILOT STUDY AREAS

City of Chanhassen, Minnesota

The metro study area is located within the limits of the City of Chanhassen, Carver County, Minnesota, a southwestern suburb of Minneapolis with an area of approximately 22.9 mi^2. Land use within the city is primarily medium density residential housing with some areas of industrial and dedicated open space. Wetlands, lakes, ponds, and rivers account for approximately 26% of the city's surface area (City of Chanhassen, 2006). The City of Chanhassen completed an update to its Surface Water Management Plan (SWMP) in 2006. Wetlands and water features throughout the city were identified and observed in the field, and mapping of features throughout the city was completed using a combination of GPS delineation and image interpretation. Further methodology is described in the City of City of Chanhassen SWMP (2006).

In addition to the wetland mapping conducted as a part of the Chanhassen SWMP, high resolution LiDAR elevation data was available for Carver County. The LiDAR data was acquired as a digital elevation model (DEM) with 3m horizontal spatial resolution.

Fond du Lac Reservation, Minnesota

The Fond du Lac Reservation, located northwest of the City of Cloquet, Minnesota, was selected as the pilot area for the northern forested area. The Fond du Lac Reservation has an area of approximately 150 mi^2. Land cover is primarily dominated by both deciduous and evergreen forests and low density residential housing. Wetlands and water bodies account for approximately 38% of the Reservation's surface area. The Fond du Lac Reservation completed a reservation wide wetland inventory in 2008. The wetland inventory was completed primarily by manual photo interpretation, and was used along with other ancillary data sets as a guide in development of training areas for wetland classification.

In addition to the reservation wide wetland inventory, radar imagery and spring leaf off imagery were also acquired for the area. The Radar data acquired for the Fond du Lac Reservation were collected on June 15, 2009 from RADARSAT-2, co-operated by the Canadian Space Agency (CSA) and MacDonald Dettwiler and Associates Ltd. (MDA). The data acquired were Fine Quad-Polarization, C-band (5.6 cm wavelength) imagery with WGS 84 geographic projection and 4.73m pixel spacing. Four polarizations are available from RADARSAT-2 data, horizontal-horizontal (HH), horizontal-vertical (HV), vertical-vertical (VV), and vertical-horizontal (VH). Each pixel in each polarization is represented by a real and imaginary 16-bit unsigned integer, and as a result, Radar images do not look like a typical optical image. The real values describe the mean magnitude, or backscattering, of the reflected target whereas the imaginary values describe the complex behavior of the scattering mechanisms of the target (Raney, 1998). Reflectivity values of Radar imagery typically have a wide range in value that can span several factors of ten; thus, Radar imagery is converted to a logarithmic form using decibel values (Frulla, 1998). After converting to decibel values, the imagery used in this study was georectified using 30 ground control points with a root mean square error (RMSE) of 1.5m and resampled to 3m pixels using the nearest neighbor resampling technique. Leaf off aerial imagery was acquired for the several counties in northeastern Minnesota during the spring of 2009. The imagery contained four spectral bands (color and infrared) and had a horizontal spatial resolution of 0.5m.

2.1.2.2. Field Data Collection

Field validation data was necessary to assess the accuracy of the wetland classification to be performed in the Fond du Lac pilot area. A field study was conducted July 13-17, 2009 by researchers from the University of Minnesota, including one MN Certified Wetland Delineator. A stratified random sampling

scheme was used within wetland types to generate a sample of 250 wetland points. An additional 150 points were randomly generated within uplands. All points were generated within areas of public or reservation owned land throughout the study area. The points were loaded into Trimble GeoXT and GeoXH handheld GPS units, which are sub-meter accurate under optimal conditions. A minimum of 50 positions were collected for each GPS point collected during the field study. Data were post processed and corrected using Pathfinder Office. Due to time restraints, and in order to maximize the wetland data points collected per wetland class, some points were collected on the fly. A total of 195 points were collected during the week of field work. The initial data collection was focused on shrub and forested wetlands. The small number of validation points, as well as oversampling of shrub and forested wetland classes, may adversely affect overall accuracy assessments when considering all wetland types within Fond du Lac Reservation. Additional field validation data will be collected during the summer of 2010 in order to provide a more robust validation sample to be used in accuracy assessment.

2.1.2.3. Automated Wetland Classification

Wetlands were classified to the Cowardin class level (Table 1) and a simplified plant community classification developed by the Minnesota DNR. This modified wetland type classification was developed specifically for the remote sensing-based update of the NWI.

Table 1 – Cowardin Wetland Classes

Cowardin Code[1]	Description
PEM	Palustrine Emergent
PSS	Palustrine Scrub Shrub
PFO	Palustrine Forested
L	Lacustrine
PUB	Palustrine Unconsolidated Bottom

[1] Cowardin codes are taken from Cowardin et al. (1974).

Table 2 and Table 3 show the wetland composition in Chanhassen and Fond du Lac by Cowardin classes and DNR modified wetland types, respectively. Wetland data for the City of Chanhassen were collected during the 2006 SWMP update and data for Fond du Lac are derived from the 2008 wetland inventory.

TABLE 2 – Summary of WETLAND Types by Cowardin Class

	Chanhassen			Fond du Lac		
Class	Count	Acres	% of Total	Count	Acres	% of Total
PEM	305	2304	58.4%	826	4311	11.8%
PFO	40	19	0.5%	1797	15776	43.1%
PSS	3	1	0.02%	2334	13584	37.1%
W[1]	189	1621	41.1%	309	2949	8.1%
Total Features	**537**	**3944**	**100.0%**	**5266**	**36619**	**100.0%**
Study Area		**14515**	**27.2%**		**96119**	**38.1%**

[1] Water class includes Lacustrine and PUB wetlands as well as non-vegetated stormwater detention basins.

TABLE 3 – Summary of Wetland Types by DNR Simplified Plant Communities

	Chanhassen			Fond du Lac		
Class	Count	Acres	% of Total	Count	Acres	% of Total
Coniferous Wetland	0	0	0.0%	883	9743	26.6%
Deep Marsh	52	228	5.8%	148	1045	2.9%
Hardwood Wetland	47	25	0.6%	914	6033	16.5%
Seasonally Flooded	10	5	0.1%	0	0	0.0%
Shallow Marsh	132	1410	35.8%	270	2013	5.5%
Shrub Wetland	3	1	0.02%	2334	13584	37.1%
Water[1]	191	1635	41.5%	309	2949	8.1%
Wet Meadow	102	641	16.2%	408	1253	3.4%
Total Features	**537**	**3944**	**100.0%**	**5266**	**36619**	**100.0%**
Study Area		**14515**	**27.2%**		**96119**	**38.1%**

[1] Water class includes Lacustrine and PUB wetlands as well as non-vegetated stormwater detention basins.

2.1.2.4. Decision Tree Classification

Automated wetland classification was done using decision tree classification, a type of expert classification. The decision tree classifier was developed using See5 software package developed by Rulequest, Inc. (http://rulequest.com) and the NLCD Mapping Tool, developed by MDA Ltd. Three steps are involved in decision tree classification: data sampling, data mining and decision tree creation, and classification. A detailed, stepwise, guide to the processes used throughout wetland classification can be found in Appendix E.

2.1.2.5. Data Sampling

The first step involves assembling training data points and data sets to be sampled. Training data for the Chanhassen classification were derived from the city's 2006 SWMP data. Wetland polygons were edited in GIS to correct for subsequent wetland loss and creation as a part of the Highway 212 construction project. Five thousand random points were generated throughout the City in both known wetland and known upland areas for a total of 10,000 sample points.

Training data for Fond du Lac were created using a combination of techniques because, unlike Chanhassen, the Reservation's wetland assessment did not include field data verification. Training polygons were developed in geographically similar locations to the field collected data points in areas that shared like spectral characteristics. In an effort to obtain a large enough number of sample data

points in each training polygon, and at the same time capture spectral variety within wetland types, a segmentation was created using 2008 NAIP and the 2009 spring leaf off imagery in Definiens' eCognition (http://www.ecognition.com). Five random sample points were generated within each eCognition segment for a total of 5,412 sample points.

The NLCD Sampling Tool v2.0, a utility included in the NLCD Mapping Tool, was used to create an input data file for use in See5. The NLCD Sampling Tool extracts values for each input raster file at each sampling point of known wetland type. This generates a tabular data file which contains a row for each sampling point with comma separated values for each input raster file. Table 4 shows the data that were available for use in classification in both the Chanhassen and Fond du Lac study areas.

TABLE 4 – Data Available for Wetland Classification

Data Layer	Fond du Lac	Chanhassen
Aerial Imagery		
2008 NAIP Leaf On Imagery (R,G,B,IR)	X	X
2009 Spring Leaf Off Imagery (R,G,B,IR)	X	
Radar Imagery (Quad Pol)	X	
Aerial Imagery – Derived		
2008 NAIP NDVI	X	X
2009 Leaf Off NDVI	X	
NDVI Difference	X	
Topography		
10m NED DEM	X	
2-ft Hi-Res LiDAR Based DEM		X
Topography Derivations		
CTI (3m LiDAR derived)		X
CTI (10m NED derived)	X	
CTI (24m LiDAR degrade derived)		X
Slope (3m LiDAR derived)		X
Slope (10m NED derived)	X	
Curvature (3m LiDAR derived)		X
Curvature (10m NED derived)	X	
Other Data		
SSURGO (Drainage Class)	X	X

2.1.2.6. Data Mining

The second step involves data mining algorithms developed by Rulequest, Inc. as a part of their See5 software package. See5 mines for patterns within the data tables created using the NLCD Sampling Tool. The boost, fuzzy thresholds, and global pruning options were enabled for classifier construction. The result of the data mining process is a decision tree that is used to produce a classification. Decision trees were constructed to perform wetland/upland classification, wetland classification to the Cowardin class level, and wetland classification using the DNR simplified plant communities. The output file also includes an accuracy assessment done using all of the input sampling points as a measure of error inherent in the resultant decision tree. The cross-validation option was also enabled to provide an estimated accuracy assessment of sampling data withheld from several extra iterations of decision tree generation. These options are described further in Appendix E.

2.1.2.7. Classification

The final step is to produce a classification. The outcome classes are the same as those from the training data and the area classified is the geometric intersection of all input raster datasets. The classification was performed using the See5 Classifier Tool, a part of the NLCD Mapping Tool. The additional option to produce a classification confidence image was also selected. A wetland/upland classification was performed on the entire study area. Wetland type classifications were performed only on those areas classified as wetlands with at least 70% confidence in the initial wetland/upland classification. Even though the 70% wetland mask was applied, uplands remained a potential output class in the wetland type classifications. A small percentage of pixels initially classified as wetlands were subsequently classified as uplands and were considered as such in the final classifications and accuracy assessments.

Several wetland classifications were performed in an effort to determine the effects of various datasets on the classification accuracy. Classifications for both Chanhassen and Fond du Lac were performed using the best available data, shown in Table 4, the best available data without topography, and only the NAIP imagery. Additional classifications in Chanhassen were performed to compare differences between high resolution (2-ft) and low resolution (10m) topography data as well as differences in the Compound Topographic Index (CTI) and the surface curvature topographic derivations. Additional classifications in Fond du Lac were performed to determine effect of Radar data and leaf-off imagery on the classification accuracy. Table 5 shows which data were used for each classification.

TABLE 5 – Data Used for Wetland Classification

Data Layer	Classification Scenario													
	Chanhassen								Fond du Lac					
	All Data	HR – CTI	HR – Curve	NED Data	NED – CTI	NED – Curve	No Topo	NAIP Only	All Data	No Radar	No Leaf Off	No Topo	Aerials Only	NAIP Only
Aerial Imagery														
2008 NAIP Leaf On Imagery (R,G,B,IR)	X	X	X	X	X	X	X	X	X	X	X	X	X	X
2009 Spring Leaf Off Imagery (R,G,B,IR)									X	X		X	X	
Radar Imagery (Quad Pol)									X		X	X		
Aerial Imagery – Derived														

2008 NAIP NDVI	X	X	X	X	X	X	X	X	X	X	X	X	X	X
2009 Leaf Off NDVI									X	X		X	X	
NDVI Difference									X	X		X	X	
Topography														
10m NED DEM				X	X	X			X	X	X			
2-ft Hi-Res LiDAR Based DEM	X	X	X											
Topography Derivations														
CTI (3m LiDAR derived)	X	X												
CTI (10m NED derived)				X	X				X	X	X			
CTI (24m LiDAR degrade derived)	X	X												
Slope (3m LiDAR derived)	X	X	X											
Slope (10m NED derived)				X	X	X			X	X	X			
Curvature (3m LiDAR derived)	X		X											
Curvature (10m NED derived)				X		X			X	X	X			
Other Data														
SSURGO (Drainage Class)	X	X	X	X	X		X		X	X	X	X		

2.1.2.8. Other Classifications

Traditional unsupervised and supervised classifications were performed in Imagine 2010, developed by Erdas, Inc. (http://www.erdas.com) for both pilot study areas in addition to the decision tree classification. Unsupervised classification was performed using the ISODATA algorithm and 20 classes. Classes were reclassified based on summary statistics of areas of known wetland types and visual inspection of the classification. Supervised classification was performed using the same training locations as were used for decision tree classification.

2.1.3. Decision Trees Accuracy Assessment

The accuracy of each classification performed was assessed using field validated points. Randomly generated training data included some wetland classes comprising a very small portion of the total wetland area within the study area. While wetland classifications were performed for all wetland types present in the training sample, accuracy assessments were performed for wetland types with more than 10 field validation points. However, because the dominant wetland classes could be misclassified as the less dominant wetland classes, all wetland types were reported in error matrices. Error matrices were calculated using RS Accuracy (Joe Knight, http://knightlab.org) and formatted as described in Congalton and Green (1999).

2.1.3.1. Chanhassen Accuracy Assessment Methodology

In Chanhassen, a random sample of 10,000 points was generated throughout the city. Wetland classes were extracted from the SWMP for each point. Single wetland polygons in the SWMP with two or more

wetland types noted were considered to be the more dominant wetland type. The sampling scheme was not stratified so the total reference set consisted of 7343 upland points and 2657 wetland points. The greater number of upland points would bias the accuracy assessment, so upland reference data were removed when calculating accuracy for wetland types.

Wet features in Chanhassen mostly consisted of water and emergent wetlands, as shown in Table 1 and Table 2 Wetland type classification by Cowardin class included water (L, PUB, PAB), emergent (PEM), scrub shrub (PSS), and forested (PFO) wetlands. Scrub shrub comprised a very small area of the wetland cover in the city and contained only five field validation points, and was therefore removed from the accuracy assessment. Wetland type classification by DNR simplified plant communities included water, wet meadow, shallow marsh, deep marsh, shrub wetland, seasonally flooded, hardwood wetland classes. Seasonally flooded and shrub wetlands each had less than 10 field validation points and were removed from the accuracy assessment.

2.1.3.2. Fond du Lac Accuracy Assessment Methodology

The 195 field collected data points were used as validation data in the accuracy assessment for the Fond du Lac study area. These reference data are independent of the training polygons used in decision tree development. The initial goal of the study was to concentrate on classifying forested wetland types and therefore most field collected points consisted of scrub shrub and forested wetlands. Additional field work in 2010 will supplement the existing field validation data in order to provide for a more robust sample across all wetland types.

Wet features in Fond du Lac consisted mostly of forested and scrub shrub type wetlands. Wetland type classification by Cowardin class included water (L, PUB, PAB), emergent (PEM), scrub shrub (PSS), and forested (PFO) wetlands. Most of the field validation points were scrub shrub and forested wetlands, so emergent wetlands were not included in the accuracy assessment. Wetland type classification by DNR simplified plant communities included water, wet meadow, shallow marsh, deep marsh, shrub wetland, hardwood wetland, and coniferous wetland. The wet meadow, shallow marsh, and deep marsh classes each had less than 10 field validation points and were removed from the accuracy assessment.

2.1.4. Decision Trees Results

Numerous iterations of the NLCD Sampling Tool and See5 were performed using a variety of combinations of datasets in an effort to determine the effect of each of these datasets on the accuracy of the resulting wetland classification. The results for wetland/upland, Cowardin class, and simplified plant community classifications are presented below.

2.1.4.1. City of Chanhassen Results

The following sections present the results of wetland classifications for the City of Chanhassen. For comparison purposes, the 2008 NAIP aerial photograph is provided at a city scale in Figure A.1 and at a local scale in Figure A.2 to show the land cover in the area. Chanhassen SWMP wetlands are shown by Cowardin class at city and local scales in Figure A.3 and Figure A.4, respectively, and by DNR simplified plant community type at city and local scales in Figure A.5 and Figure A.6, respectively. Additional figures showing each classification described at both large and small scales can also be found in Appendix A. Full error matrices for each classification can be found in Appendix C.

Best Performing Classification Scenario

The best performing classification for the City of Chanhassen used as many data sets as were available for the area, including NAIP Imagery, a high resolution LiDAR-based DEM, the Soil Survey Geodatabase

(SSURGO) drainage class, and a several imagery and topography derivations as shown in Table 5. The wetland/upland accuracy for the best performing classification, *Hi-Res Topo (All Data)*, was 93.1%, as shown in Table 6. Cowardin class accuracy was 85.7% (Table 7), and DNR simplified plant community type accuracy was 76.5% (Table 8).
Figure **2** and
Figure **3** show the best classification for simplified plant community type at a city and local scale, respectively, with the SWMP wetlands shown for comparison purposes. Figure A.7 and Figure A.8 show the *Hi-Res Topo (All Data)* classification for Cowardin class at city and local scales, respectively.

TABLE 6 – HI-RES TOPO (ALL DATA) – W/U ERROR MATRIX

		Reference Data		
		Upland	Wetland	Map Total
Map Data	Upland	6945	296	7241
	Wetland	398	2361	2759
	Ref. Total	7343	2657	10000

Producer's Accuracy		User's Accuracy	
Reference	Percent	Map	Percent
Upland	94.6	Upland	95.9
Wetland	88.9	Wetland	85.6

OVERALL ACCURACY = 9306 / 10000 = **93.1%**

TABLE 7 – HI-RES TOPO (ALL DATA) – COWARDIN CLASS ERROR MATRIX

		Reference Data					
		UPL	PEM	W	PFO	PSS	Map Total
Map Data	UPL	0	230	34	11	0	276
	PEM	0	1262	53	8	0	1323
	W	0	41	1013	0	0	1054
	PFO	0	1	0	2	0	3
	PSS	0	0	0	0	0	0

Ref. Total	0	1534	1101	21	0	2656
	Total N does not include reference uplands or wetland classes with less than 10 reference data points. See Section 2.4 for details.					

Producer's Accuracy		User's Accuracy	
Reference	Percent	Map	Percent
UPL	0	UPL	0
PEM	95	PEM	82
W	96	W	92
PFO	67	PFO	10
PSS	0	PSS	0

OVERALL ACCURACY = 2275 / 2656 = **85.7%**

OVERALL ACCURACY (upland errors removed) = 2275 / 2380 = **95.6%**

TABLE 8 – HI-RES TOPO (ALL DATA) – SIMPLIFIED TYPES ERROR MATRIX

		Reference Data								
		Upland	Shallow Marsh	Water	Wet Meadow	Deep Marsh	Hardwood Wetland	Seasonally Flooded	Shrub Wetland	Map Total
Map Data	Upland	0	126	42	104	37	12	0	0	321
	Shallow Marsh	0	743	23	64	30	2	0	0	862
	Water	0	22	1005	11	39	0	0	0	1077
	Wet Meadow	0	37	14	251	14	3	0	0	319
	Deep Marsh	0	9	17	7	31	2	0	0	68
	Hardwood Wetland	0	2	0	2	0	2	0	0	6
	Seasonally Flooded	0	0	0	1	0	0	0	0	1

Shrub Wetland	0	0	0	0	1	0	0	0	1
Ref. Total	0	939	1101	442	152	21	0	0	2655

Total N does not include reference uplands or wetland classes with less than 10 reference data points. See Section 2.4 for details.

Producer's Accuracy

Reference	Percent
Upland	0
Shallow Marsh	79
Water	91
Wet Meadow	57
Deep Marsh	20
Hardwood Wetland	10
Seasonally Flooded	0
Shrub Wetland	0

User's Accuracy

Map	Percent
Upland	0
Shallow Marsh	86
Water	93
Wet Meadow	79
Deep Marsh	46
Hardwood Wetland	33
Seasonally Flooded	0
Shrub Wetland	0

OVERALL ACCURACY = 2032 / 2655 = **76.5%**

OVERALL ACCURACY (upland errors removed) = 2032 / 2334 = **87.1%**

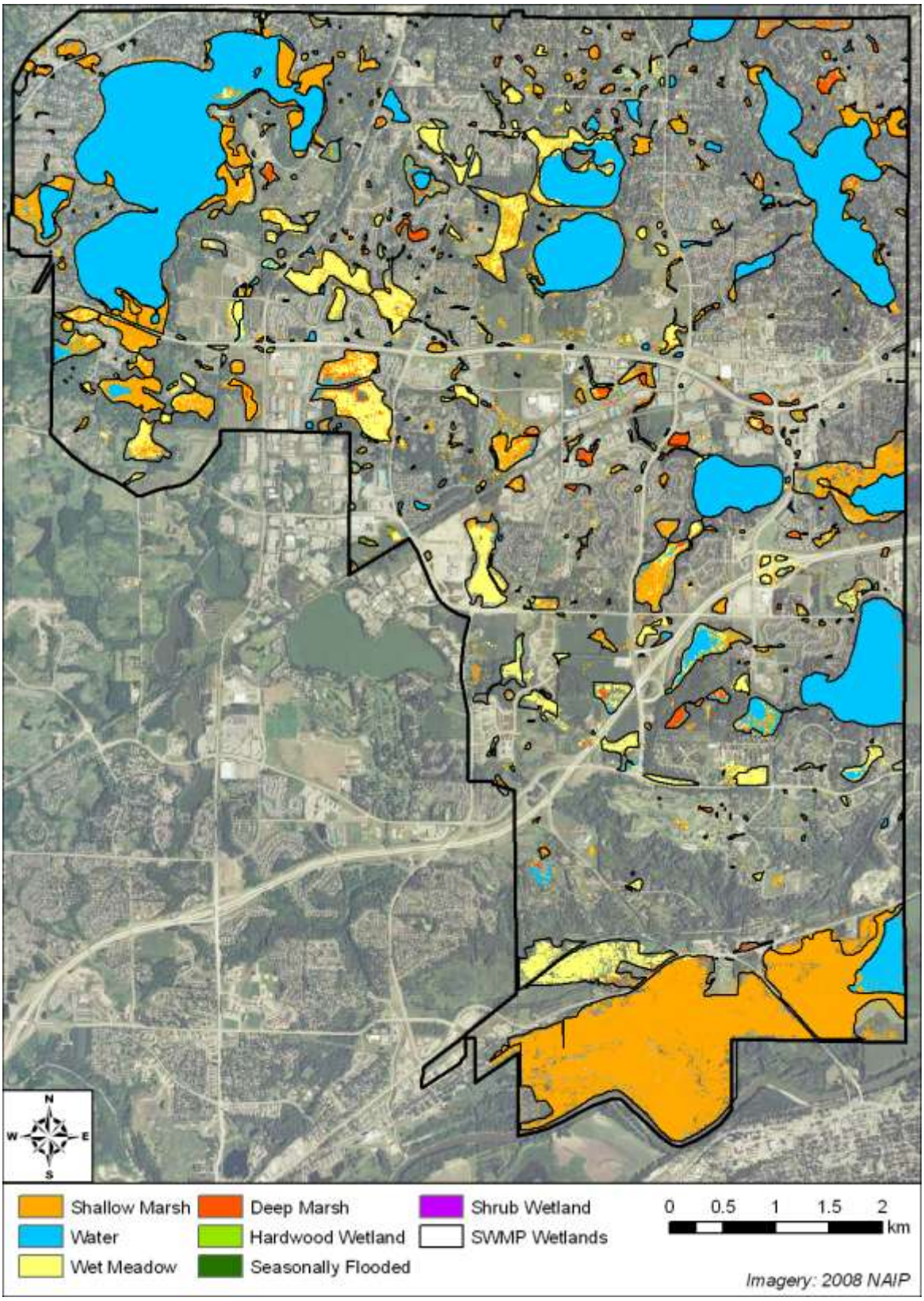


Figure 2 – Hi-Res Topo (All Data) – Simplified type – city view (with SWMP wetlands)

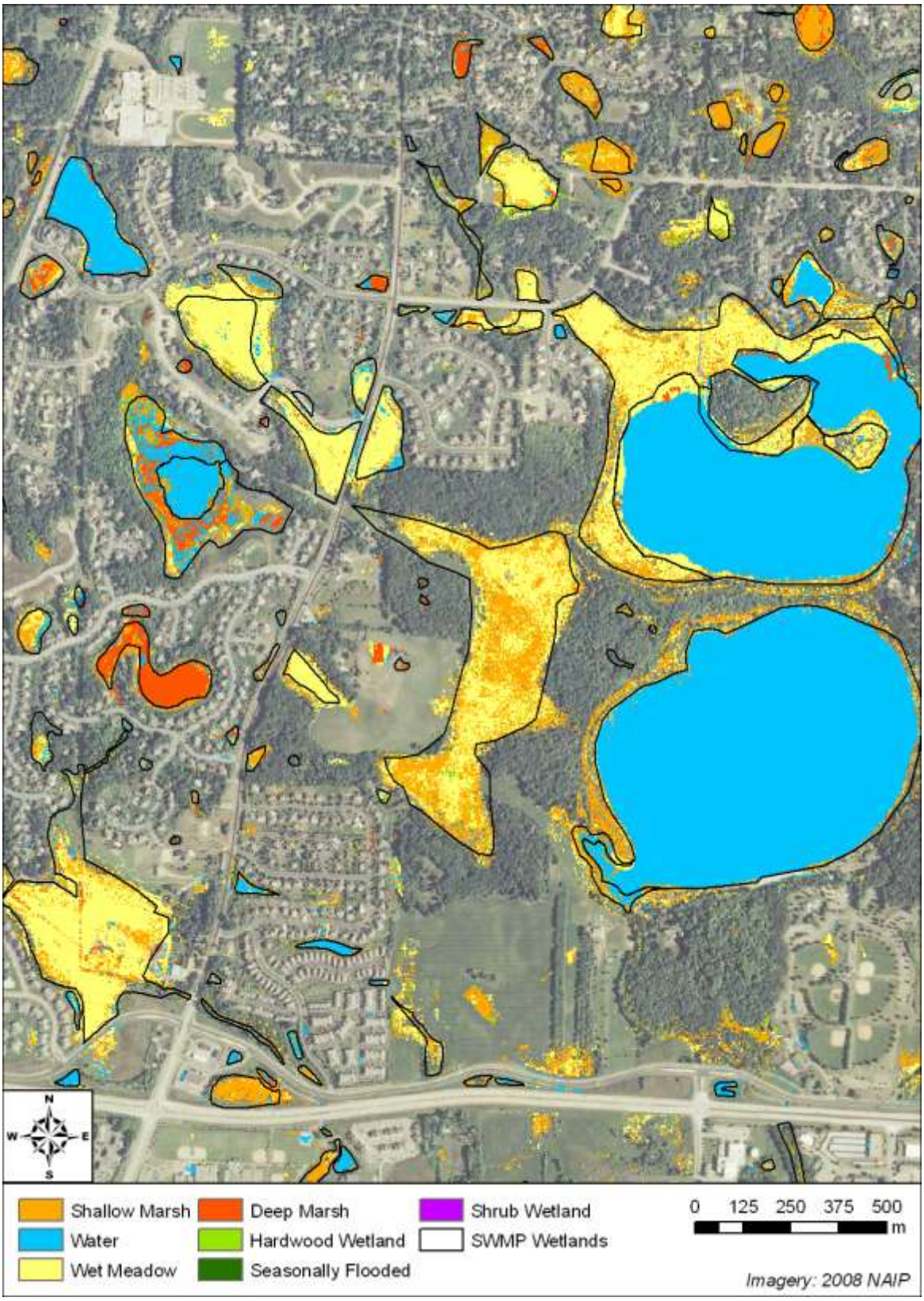


Figure 3 – Hi-Res Topo (All Data) – Simplified type – local view (with SWMP wetlands)

NED and No Topography Scenario

The best performing classification scenario, *Hi-Res Topo (All Data)*, was performed using a 3m resolution LiDAR based DEM. Additional classifications were performed using the U.S. Geological Survey's (USGS) National Elevation Dataset (NED) with a spatial resolution of approximately 10m. Classifications were also performed without topography or topographic derivates as input datasets.

Effects of Resolution

The wetland/upland accuracy for the classification *NED Topo (All Data)* was 91.6%, as shown in Table C.1. Cowardin class accuracy was 84.4% (Table C.2), and DNR simplified plant community type accuracy was 76.2% (Table C.3). Figure A.9 and Figure A.10 show the *NED Topo (All Data)* classification for Cowardin class at city and local scales, respectively. Figure A.11 and Figure A.12 show the classification for DNR simplified plant community type at city and local scales, respectively.

The wetland/upland accuracy for the classification *No Topo* was 88.7%, as shown in Table C.4. Cowardin class accuracy was 79.8% (Table C.5), and DNR simplified plant community type accuracy was 60.6% (Table C.6). Figure A.13 and Figure A.14 show the *No Topo* classification for Cowardin class at city and local scales, respectively. Figure A.15 and Figure A.16 show the classification for DNR simplified plant community type at city and local scales, respectively.

Effects of Topographic Derivations

The best performing classification scenario, *Hi-Res Topo (All Data)*, was performed using several topographic derivations including the compound topographic index (CTI), slope, and surface curvature. Slope was included in all topographic classifications, but additional classifications were performed without curvature and without the CTI as input datasets. Such classifications were performed for both high resolution and NED data.

Compound Topographic Index

The wetland/upland accuracy for the classification *Hi-Res Topo (CTI)* was 92.4%, as shown in Table C.7. Cowardin class accuracy was 84.1% (Table C.8), and DNR simplified plant community type accuracy was 75.1% (Table C.9). Figure A.17 and Figure A.18 show the *Hi-Res Topo (CTI)* classification for Cowardin class at city and local scales, respectively. Figure A.19 and Figure A.20 show the classification for DNR simplified plant community type at city and local scales, respectively.

The wetland/upland accuracy for the classification *NED Topo (CTI)* was 91.4% (Table C.10). Cowardin class accuracy was 84.8% (Table C.11), and DNR simplified plant community type accuracy was 76.6% (Table C.12). Figure A.21 and Figure A.22 show the *NED Topo (CTI)* classification for Cowardin class at city and local scales, respectively. Figure A.23 and Figure A.24 show the classification for DNR simplified plant community type at city and local scales, respectively.

Curvature

The wetland/upland accuracy for the classification *Hi-Res Topo (Curvature)* was 92.5%, as shown in Table C.13. Cowardin class accuracy was 84.2% (Table C.14), and DNR simplified plant community type accuracy was 75.7% (Table C.15). Figure A.25 and Figure A.26 show the *Hi-Res Topo (Curvature)* classification for Cowardin class at city and local scales, respectively. Figure A.27 and Figure A.28 show the classification for DNR simplified plant community type at city and local scales, respectively.

The wetland/upland accuracy for the classification *NED Topo (Curvature)* was 91.3% (Table C.16). Cowardin class accuracy was 84.0% (Table C.17), and DNR simplified plant community type accuracy was

76.2% (Table C.18). Figure A.29 and Figure A.30 show the *NED Topo (Curvature)* classification for Cowardin class at city and local scales, respectively. Figure A.31 and Figure A.32 show the classification for DNR simplified plant community type at city and local scales, respectively.

Other Classification Scenarios

Several other classifications were performed in addition to those described above for comparison purposes. A classification using only the NAIP imagery was performed, as well as traditional unsupervised and supervised classifications.

Imagery Only

The wetland/upland accuracy for the classification *NAIP Only* was 78.3%, as shown in Table C.19. Cowardin class accuracy was 54.7% (Table C.20), and DNR simplified plant community type accuracy was 60.6% (Table C.21). Figure A.33 and Figure A.34 show the *NAIP Only* classification for Cowardin class at city and local scales, respectively. Figure A.35 and Figure A.36 show the classification for DNR simplified plant community type at city and local scales, respectively.

Unsupervised Classification

The wetland/upland accuracy for the unsupervised classification was 52.5%, as shown in Table C.22. Cowardin class accuracy was 61.4% (Table C.23). Figure A.37 and Figure A.38 show the unsupervised classification for Cowardin class at city and local scales, respectively. No unsupervised classification was performed for the DNR simplified plant community types.

Supervised Classification

The wetland/upland accuracy for the supervised classification was 53.3%, as shown in Table C.24. Cowardin class accuracy was 57.8% (Table C.25). Figure A.39 and Figure A.40 show the supervised classification for Cowardin class at city and local scales, respectively. No supervised classification was performed for the DNR simplified plant community types.

See5 Cross-Validation Accuracy

See5 produces a measure of accuracy during its optional cross validation step. Table 9 and Table 10 show a comparison between the accuracy assessment using reference points and the See5 cross validation accuracy.

TABLE 9 – CHANHASSEN COMPARISON – SEE5 CROSS VALIDATION VS. ACCURACY ASSESSMENT

	Hi-Res Topo		NED Topo		No Topo		NAIP Only	
	X-Val	Assess	X-Val	Assess	X-Val	Assess	See5	Assess
Wetland/Upland	89.9	93.1	86.2	91.6	81.8	88.7	68.5	78.3
Cowardin Class	85.0	85.7	81.8	84.4	77.4	79.8	64.2	54.7
Simplified Type	81.3	76.5	76.6	76.2	67.2	60.6	59.7	43.4

TABLE 10 – CHANHASSEN COMPARISON – SEE5 CROSS VALIDATION VS. ACCURACY ASSESSMENT (CONT'D)

	Hi-Res Topo Curvature Only		NED Topo Curvature Only		Hi-Res Topo CTI Only		NED Topo CTI Only	
	X-Val	Assess	X-Val	Assess	X-Val	Assess	X-Val	Assess
Wetland/Upland	85.7	92.5	85.1	91.4	89.6	92.4	86.0	91.4
Cowardin Class	81.1	84.2	80.7	84.0	84.6	84.1	81.7	84.8
Simplified Type	77.1	75.7	76.0	76.6	79.4	75.1	77.0	76.6

2.1.4.2. Fond du Lac Reservation Results

The following sections present the results of wetland classifications for the Fond du Lac Reservation. For comparison purposes, the 2008 NAIP aerial photograph is provided at a city scale in Figure B.1 and at a local scale in Figure B.2 to show the land cover in the area. Additional figures showing each classification described at both large and small scales can be found in Appendix B. Full error matrices for each classification can be found in Appendix D.

Best Performing Classification Scenario

The best performing classification for the Fond du Lac Reservation used the highest quality datasets available for the area, including NAIP imagery, leaf-off imagery, Radar imagery, NED, SSURGO drainage class, and several imagery and topography derivations as shown in Table 5. The wetland/upland accuracy for the best classification, *All Data*, was 79.0% (Table 11). Cowardin class accuracy was 58.2% (Table 12), and DNR simplified plant community type accuracy was 55.7% (Table 13). Figure 4 and Figure 5 show the best classification for the simplified plant community type at reservation and local scales, respectively. Figure B.3 and Figure B.4 show the *All Data* classification for Cowardin class at reservation and local scales, respectively.

TABLE 11 – FOND DU LAC ALL DATA CLASSIFICATION – W/U ERROR MATRIX

		Reference Data		
		Upland	Wetland	Map Total
Map Data	Upland	27	37	64
	Wetland	4	127	131
	Ref. Total	31	164	195

Producer's Accuracy		User's Accuracy	
Reference	Percent	Map	Percent
Upland	87	Upland	42
Wetland	77	Wetland	97

OVERALL ACCURACY = 154 / 195 = **79.0%**

TABLE 12 – FOND DU LAC ALL DATA CLASSIFICATION – COWARDIN CLASS ERROR MATRIX

		Reference Data					
		PSS	UPL	PFO	PEM	W	Map Total
Map Data	PSS	31	0	14	0	0	45
	UPL	14	0	20	0	1	35
	PFO	8	0	47	0	0	55
	PEM	8	0	1	0	0	9
	W	0	0	0	0	14	14
	Ref. Total	61	0	82	0	15	158

Total N does not include reference uplands or wetland classes with less than 10 reference data points. See Section 2.4 for details.

Producer's Accuracy		User's Accuracy	
Reference	Percent	Map	Percent
PSS	69	PSS	51
UPL	0	UPL	0
PFO	85	PFO	57
PEM	18	PEM	0
W	100	W	93

OVERALL ACCURACY = 92 / 158 = **58.2%**

OVERALL ACCURACY (upland errors removed) = 92 / 123 = **74.8%**

TABLE 13 – FOND DU LAC ALL DATA CLASSIFICATION – SIMPLIFIED TYPE ERROR MATRIX

Map Data	Reference Data: Shrub Wetland	Upland	Coniferous Wetland	Shallow Marsh	Water	Hardwood Wetland	Deep Marsh	Wet Meadow	Map Total
Shrub Wetland	34	0	11	0	0	6	0	0	51
Upland	13	0	7	0	1	12	0	0	33
Coniferous Wetland	3	0	25	0	0	2	0	0	30
Shallow Marsh	8	0	1	0	0	1	0	0	10
Water	0	0	0	0	14	0	0	0	14
Hardwood Wetland	2	0	2	0	0	15	0	0	19
Deep Marsh	0	0	0	0	0	0	0	0	0
Wet Meadow	1	0	0	0	0	0	0	0	1
Ref. Total	61	0	46	0	15	36	0	0	158

Total N does not include reference uplands or wetland classes with less than 10 reference data points. See Section 2.4 for details.

Producer's Accuracy

Reference	Percent
Shrub Wetland	56
Upland	0
Coniferous Wetland	54
Shallow Marsh	0
Water	93
Hardwood Wetland	42
Deep Marsh	0
Wet Meadow	0

User's Accuracy

Map	Percent
Shrub Wetland	67
Upland	0
Coniferous Wetland	83
Shallow Marsh	0
Water	100
Hardwood Wetland	79
Deep Marsh	0
Wet Meadow	0

OVERALL ACCURACY = 88 / 158 = **55.7%**

OVERALL ACCURACY (upland errors removed) = 88 / 125 = **70.4%**

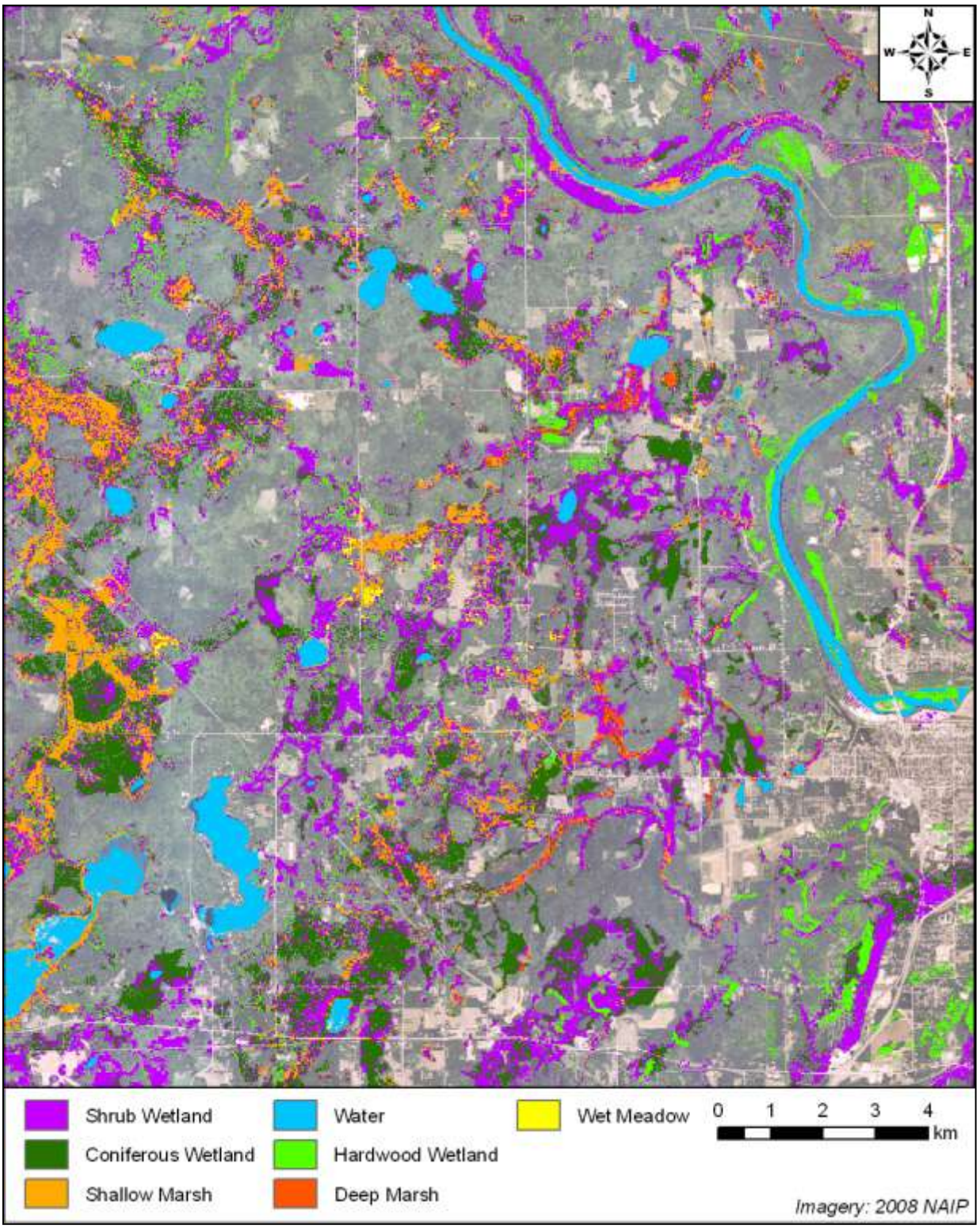


FIGURE 4 – FOND DU LAC ALL DATA CLASSIFICATION – SIMPLIFIED TYPE – RESERVATION VIEW

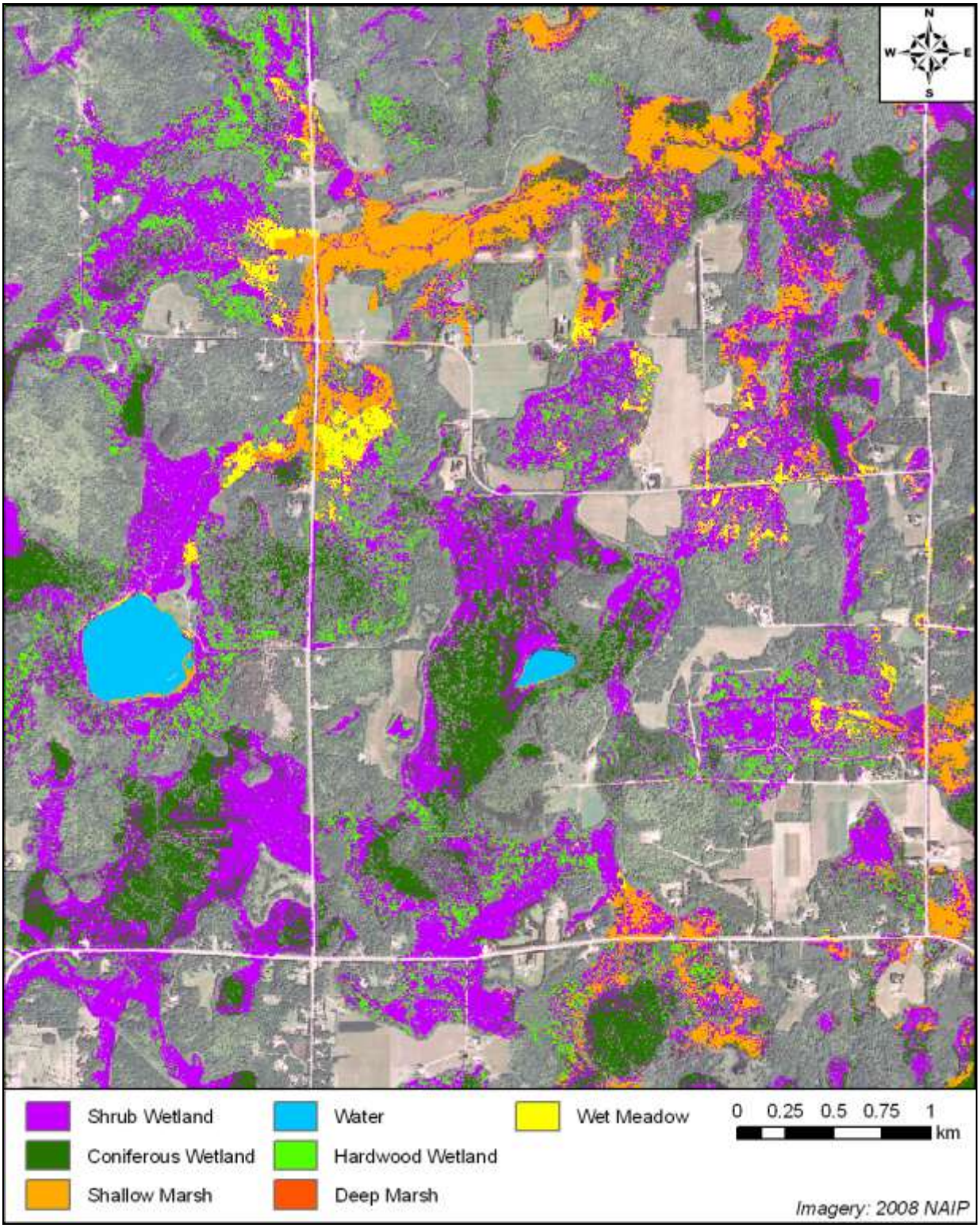


FIGURE 5 – FOND DU LAC ALL DATA CLASSIFICATION – SIMPLIFIED TYPE – LOCAL VIEW

Effects of Types of Imagery

The best performing classification scenario, *Fond du Lac All Data,* was performed using several types of aerial and satellite imagery including the 2008 NAIP imagery, 2009 leaf-off imagery, and Radar imagery. Additional classifications were performed without each of these data sets in an effort to determine their effect on classification accuracy.

Radar Imagery

The wetland/upland accuracy for the classification *No radar* was 77.9%, as shown in Table D.1. Cowardin class accuracy was 53.8% (Table D.2), and DNR simplified plant community type accuracy was 53.2% (Table D.3). Figure B.5 and Figure B.6 show the *No radar* classification for Cowardin class at reservation and local scales, respectively. Figure B.7 and Figure B.8 show the classification for DNR simplified plant community type at reservation and local scales, respectively.

Spring Imagery

The wetland/upland accuracy for the classification *No Leaf-off* was 77.4%, as shown in Table D.4. Cowardin dass accuracy was 59.5% (Table D.5), and DNR simplified plant community type accuracy was 57.6% (Table D.6). Figure B.9 and Figure B.10 show *the No Leaf-off* classification for Cowardin class at reservation and local scales, respectively. Figure B.11 and Figure B.12 show the classification for DNR simplified plant community type at reservation and local scales, respectively.

Other Classification Scenarios

Several other classifications were performed in addition to those described above for comparison purposes. Classifications using the all data without topography, only NAIP and leaf-off imagery, only NAIP imagery, and traditional unsupervised and supervised classifications were performed.

No Topography

The wetland/upland accuracy for the classification *No Topo* was 71.3%, as shown in Table D.7. Cowardin dass accuracy was 44.3% (Table D.8), and DNR simplified plant community type accuracy was 43.0% (Table D.9). Figure B.13 and Figure B.14 show the *No Topo* classification for Cowardin class at reservation and local scales, respectively. Figure B.15 and Figure B.16 show the classification for DNR simplified plant community type at city and local scales, respectively.

Imagery Only

The wetland/upland accuracy for the classification *NAIP & Leaf-Off* was 50.3%, as shown in Table D.10. Cowardin class accuracy was 29.1% (Table D.11), and DNR simplified plant community type accuracy was 31.6% (Table D.12). Figure B.17 and Figure B.18 show the *NAIP & Leaf-Off* classification for Cowardin class at reservation and local scales, respectively. Figure B.19 and Figure B.20 show the classification for DNR simplified plant community type at reservation and local scales, respectively.

The wetland/upland accuracy for the classification *NAIP Only* was 41.5%, as shown in Table D.13. Cowardin class accuracy was 25.9% (Table D.14), and DNR simplified plant community type accuracy was 23.4% (Table D.15). Figure B.21 and Figure B.22 show the *NAIP Only* classification for Cowardin class at reservation and local scales, respectively. Figure B.23 and Figure B.24 show the classification for DNR simplified plant community type at reservation and local scales, respectively.

Unsupervised Classification

The wetland/upland accuracy for the unsupervised classification was 74.4%, as shown in Table D.16. Cowardin class accuracy was 32.9% (Table D.17). Figure B.25 and Figure B.26 show the unsupervised classification for Cowardin class at reservation and local scales, respectively. No unsupervised classification was performed for the DNR simplified plant community types.

Supervised Classification

The wetland/upland accuracy for the supervised classification was 80.5%, as shown in Table D.18. Cowardin class accuracy was 54.4% (Table D.19). Figure B.27 and Figure B.28 show the supervised classification for Cowardin class at reservation and local scales, respectively. No supervised classification was performed for the DNR simplified plant community types.

See5 Cross-Validation Accuracy

Table 14 and Table 15 show a comparison between the accuracy assessment using reference points and the See5 cross validation accuracy for the classifications performed in Fond du Lac Reservation.

TABLE 14 – FOND DU LAC COMPARISON – SEE5 CROSS VALIDATION VS. ACCURACY ASSESSMENT

	All Data		No Leaf Off		No Radar		No Topo	
	X-Val	Assess	X-Val	Assess	X-Val	Assess	X-Val	Assess
Wetland/Upland	96.1	79.0	95.8	77.4	95.6	77.9	92.3	71.3
Cowardin Class	93.0	58.2	93.2	59.5	93.2	53.8	86.9	44.3
Simplified Type	93.1	55.7	92.3	58.1	92.9	53.2	85.7	43.0

TABLE 15 – FOND DU LAC COMPARISON – SEE5 CROSS VALIDATION VS. ACCURACY ASSESSMENT (CONT'D)

	NAIP & LeafOff		NAIP Only	
	X-Val	Assess	X-Val	Assess
Wetland/Upland	84.0	50.3	76.4	41.5
Cowardin Class	79.6	29.1	72.9	25.9
Simplified Type	78.0	31.6	71.2	23.4

2.1.5. Decision Trees Discussion

2.1.5.1. See5 Cross-Validation

See5 cross-validation is a measure of accuracy done using training points as a part of the decision tree construction process. With the validation option enabled, See5 performs a user determined number of iterations of decision tree construction (i.e. folds) with a subset of the total training points and uses the remainder of the points for an accuracy assessment. In this study, a 10-fold cross validation was used. In this scheme, 10% of the training points were randomly set aside and the decision tree was constructed using the other 90% of points. Repeat iterations were performed with a different subset of points set aside such that after 10 iterations each point has been used in accuracy assessment once. Accuracy is reported for each fold and totaled for an estimate of overall classification accuracy.

The See5 cross-validation method is not a true assessment of accuracy because it uses training data employed in tree construction. However, it has been used as a preliminary surrogate for accuracy assessment when a formal independent accuracy assessment is yet to occur (Homer, 2007). In the Chanhassen study, cross-validation appeared to be a low estimate of accuracy for the wetland/upland classification and a high estimate for the simplified types when compared to the formal accuracy assessment. Table 9 and Table 10 compare the cross-validation accuracy with the formal accuracy assessment for each classification performed in Chanhassen. In the Fond du Lac study, cross validation appeared to be a high estimate for each classification. The reason for this is probably two-fold. First, the reference points used in the formal accuracy assessment are not a complete representation of the wetlands present, and accuracy within wetland types may be lower because of this. Second, training polygons were created in areas that were obvious representatives of target wetland classes. The training data used for cross-validation were spectrally similar and probably did not account for the diverse spectral difference inherent within wetland types. As a result, variation between natural wetlands may not have been adequately captured in the cross-validation accuracy. Table 14 and Table 15 show the comparison of cross-validation accuracy and formal accuracy assessment for classifications performed in Fond du Lac.

While not a statistically sound assessment of accuracy, the cross-validation process takes seconds to complete and does appear to show general trends. There may not be a strong, consistent relationship between the cross validation accuracy and the formal accuracy assessment, but the trend of increased or decreased accuracy across classifications as determined by See5 through cross validation may be valuable information if interpreted appropriately.

2.1.5.2. Comparison to Traditional Classifications

The decision tree method consistently proved to be superior to traditional unsupervised and supervised classification of wetlands for both wetland/upland and Cowardin class classifications. Wetland/upland classification accuracy for the unsupervised, supervised, decision tree with only NAIP imagery, and decision tree with all data classifications are shown in Table 16, below.

TABLE 16 – COMPARISON OF DECISION TREE AND TRADITIONAL CLASSIFICATION ACCURACY RESULTS

	Chanhassen				**Fond du Lac**			
	Sup	Unsup	DT w/ NAIP	DT w/ All Data	Sup	Unsup	DT w/ NAIP	DT w/ All Data

Wetland/Upland	53.3	52.5	78.3	93.1	74.4	80.5	76.4	79.0
Cowardin Class	57.8	61.4	54.7	85.7	54.9	34.8	72.9	57.3

The unsupervised and supervised classification accuracies were lower than reported in the literature. Ozesmi and Bauer (2002) report studies with accuracies of approximately 70%-80%, but these studies were accomplished using more sophisticated classification techniques such as cluster busting and hybrid approaches. Traditional classifications were not the primary focus of this study and were meant for comparison purposes only. Accuracy results for decision tree classifications performed with only the NAIP imagery are also presented in Table 16, also for comparison purposes. It is evident that the decision tree method outperforms traditional classifiers, but the results of various decision tree scenarios show that the type and quality of data used to construct the tree have an effect on the quality of the decision tree classification.

2.1.5.3. City of Chanhassen

The City of Chanhassen offered the best opportunity for testing because of the city-wide wetland inventory. An unlimited amount of data was available for training and validation purposes within the area which allowed for a strong and diverse training data set and a robust accuracy assessment. However, Chanhassen contains little wetland variety. Most of the wet features in Chanhassen are water bodies and emergent wetlands. While few scrub shrub and forested wetlands did exist, the opportunity to train a decision tree to discriminate these wetland types was limited.

Effects of Topography

Resolution

A LiDAR based DEM with a spatial resolution of 3m was used for topography and topographic derivations in the best classification scenario. However, LiDAR data is expensive to acquire and is not readily available for most areas. The U.S. Geological Survey (USGS) produces and continuously updates the NED, a seamless DEM for the United States that is public domain. The additional cost of using LiDAR data should be justified by directly correlating to higher classification accuracy. Table 17 compares the accuracy of classifications using high resolution LiDAR-based topography, NED topography, and no topography.

TABLE 17 – ACCURACY RESULTS FOR VARYING TOPOGRAPHIC RESOLUTION

	Hi-Res Topo	Z	NED Topo	Z	No Topo	Z
Wetland/Upland	93.1	**3.8**	91.6	**6.8**	88.7	**10.5**
Cowardin Class	85.7	1.1	84.4	**4.2**	79.8	**5.4**
Simplified Type	76.5	0.1	76.2	**13.9**	60.6	**13.9**
Z-statistic values in bold show a significant difference (Z>2) between classifications to the left and right. Z value at the far right is for differences between Hi-Res Topo and No Topo.						

As shown in Table 17, classification accuracy for wetland/upland decreases significantly between classifications using high resolution, NED topography, and no topography as input data. No significant difference between high resolution and NED topography existed for the Cowardin class and simplified type classifications, but decreases in accuracy were significant between the *NED Topo* classifications and the *No Topo* classifications. High resolution topography appears to be more useful in discriminating wetlands and uplands than it does in differentiating wetland types, however, a classification with no topography significantly decreases wetland type classification and should be avoided. As expected, a decrease in accuracy is evident as more classes are characterized. The decrease in accuracy seems to be consistent for each set of topography classifications.

Significant differences are present between classification accuracies using NED and high resolution topography data, however, the benefits of the increased classification accuracy come at a substantial financial cost. The goals of future classification should be carefully considered to determine if the cost for acquiring high resolution data is worth the increase in classification accuracy. The freely available NED topography data allows for 91.6% accuracy in upland/wetland discrimination, a result that should not be ignored and one that could prove beneficial given the correct circumstances.

Topography Derivations

The CTI and surface curvature were both used as input datasets for the best classification. The calculation of the CTI is both labor and time intensive and, for high resolution topography data, requires considerable computer resources. The surface curvature derivation is a one step calculation that can be done relatively easily with standard software packages. The accuracy of classifications performed with each of these topographic derivations was compared in order to determine their impact on wetland classification (Table 18).

TABLE 18 – ACCURACY RESULTS FOR VARYING TOPOGRAPHIC DERIVATIONS

High Resolution LiDAR Topography						
	CTI & Curvature	Z	CTI Only	Z	Curvature Only	Z
Wetland/Upland	93.1	1.9	92.4	0.4	92.5	1.5
Cowardin Class	85.7	1.5	84.1	0.1	84.2	1.4
Simplified Type	76.5	1.2	75.1	0.5	75.7	0.6
NED Topography						
Wetland/Upland	91.6	0.3	91.4	0.5	91.4	0.8
Cowardin Class	84.4	0.4	84.8	0.8	84.0	0.4
Simplified Type	76.2	0.4	76.6	0.3	76.2	0.04

Z-statistic values in bold show a significant difference (Z>2) between classifications to the left and right. Z value at the far right is for differences between CTI & Curvature and Curvature Only.

There was a slight decrease in accuracy between the classifications using high resolution CTI and surface curvature in conjunction and using each derivation individually, but this change was not significant (Z<2). This slight decrease was present only with derivations calculated from high resolution topography and

not with the NED data. No significant differences existed between wetland/upland, Cowardin class, or simplified types for any set of topographic derivation classifications.

Due to the lack of significant changes between the methods of topographic derivation, it appears that the curvature is an acceptable alternative to the labor intensive CTI. This could represent a large time and cost saving opportunity in future classification methods development.

2.1.5.4. Fond du Lac Reservation

The Fond du Lac Reservation offered an opportunity to investigate the effects of various types of imagery on classification accuracy. Unfortunately, only a partial set of field verified reference points was collected. Optimally, these points would be well distributed, representative of all wetland types present, and numerous enough to be used for both decision tree construction and a formal accuracy assessment. The original intended use of the reference data involved only scrub shrub and forested wetlands so a high percentage of the points collected represented these types.

Most of the wet features in the Fond du Lac Reservation are shrub and forested wetlands, but enough wetland diversity exists to train a decision tree classier for less dominant types given appropriate data. An additional field study in Fond du Lac will occur in summer 2010 to supplement the existing data and provide a complete reference data set. These data will be used in future studies to provide more spectrally diverse training data and a more robust accuracy assessment.

Effects of Imagery

Radar Imagery

Radar imagery was used in conjunction with other data sets in the best classification scenario. Radar data can be sensitive to soil moisture (Whitcomb et al., 2007; Henderson and Lewis, 2008) and may be a useful addition to wetland classifiers. However, radar data is expensive to acquire and is not readily available for use without appropriate licensing or ownership. The additional cost of using radar data should be justified by directly correlating to higher classification accuracy. Table 19 compares the accuracy of classifications with and without using radar data.

TABLE 19 – ACCURACY RESULTS FOR EFFECTS OF RADAR IMAGERY

	All Data	Z	No Radar
Wetland/Upland	79.0	0.2	77.9
Cowardin Class	58.2	0.6	53.8
Simplified Type	55.7	0.3	53.2
Z-statistic values in bold show a significant difference (Z>2) between classifications to the left and right.			

According to the accuracy assessment performed for this study, adding radar data to a wetland/upland, Cowardin class, or simplified wetland type classier does not have a significant effect on the accuracy of the resulting classification. Previous studies (Arzandeh and Wang, 2003; Costa, 2004) prove the benefit of radar data in wetland classification. These results are believed to be biased and not valid because of

poor quality of the reference data set. The classification and accuracy assessment will be revisited when a robust reference data set is collected.

Spring Imagery

Leaf-off imagery was used in conjunction with other data sets in the best classification scenario. Leaf-off imagery, when used in addition to summer leaf-on data, provides multi-temporal data that show vegetative characteristics throughout the growing season. Aerial imagery is not typically flown in the spring prior to leaf out, so additional aerial photography must be completed to acquire such data. Table 20, below, compares the accuracy of classifications with and without spring leaf-off imagery.

TABLE 20 – ACCURACY RESULTS FOR EFFECTS OF LEAF-OFF IMAGERY

	All Data	Z	No Leaf-off
Wetland/Upland	79.0	0.6	77.4
Cowardin Class	58.2	0.2	59.5
Simplified Type	55.7	0.4	57.6
Z-statistic values in bold show a significant difference (Z>2) between classifications to the left and right.			

According to the accuracy assessment performed for this study, adding leaf-off imagery to a wetland/upland, Cowardin class, or simplified wetland type classier does not have a significant effect on the accuracy of the resulting classification. Many studies (Ozesmi and Bauer, 2002; Lunetta and Balogh, 1999) document the increased accuracy, especially in forested areas, of adding multi-temporal imagery to a wetland classification. Because of poor quality of the reference data set, these results are believed to be biased and not valid. The classification and accuracy assessment will be revisited when a robust reference data set is collected.

2.1.6. Decision Trees Conclusions

The results presented in this research prove that decision tree classifiers outperform traditional classification methods when discriminating wetlands from uplands and when classifying wetland types. The See5 software package used in conjunction with the NLCD Mapping Tool performed above expectations in the streamlined ease and efficiency of use. The cross-validation tool in See5 was a valuable, albeit not statistically sound, surrogate for a formal accuracy assessment and may be used to quickly compare results in a qualitative manner. Achieving high accuracy when performing automated classification of wetland types, while using limited data, is a positive outcome. With the addition of other relevant data into the decision tree classifier, the potential for increases in wetland classification accuracy beyond those presented herein certainly exists.

Several conclusions can also be made regarding the usefulness of topography data in decision tree development. Topography data is an essential element in decision tree construction, but high resolution topography data may not guarantee higher classification accuracy. In this study, the use of high resolution topography yielded a significant increase in classification accuracy compared to the NED topography only for the wetland/upland determination. Topographic derivatives are also a necessary input data source, but the use of the CTI as an input dataset did not outperform the simply calculated curvature model. The goals of future research projects should be carefully considered when choosing

input types and quality of input data. High resolution topography data and complex topographic derivative calculations may not be necessary in order to achieve adequate wetland classification accuracy.

While there were several informative outcomes from this study in the Chanhassen study area, the results of classifications from the Fond du Lac study area conflict with several literature sources which indicates a flawed methodology. The primary flaw in the Fond du Lac portion of the study involves inadequate reference data, and is discussed further below.

2.1.7. Decision Trees Future Directions

The results of this study highlighted several items that should be revisited in the future. First and foremost, adequate reference data must be collected for the Fond du Lac study area. Unfortunately, the reference data set for the Fond du Lac area available at the time of this study did not include a large enough sample size. In addition, the reference samples that were available were not distributed evenly across wetland types. A field data collection will occur during the summer of 2010 in an effort to obtain a more robust reference data set for the Fond du Lac Reservation. With a larger reference data set it is hoped that more samples of each wetland class will allow for greater differentiation of classes during classification, higher spectral variability within classes will be represented in the decision tree model, and a large enough sample size will remain available for an unbiased accuracy assessment.

Additional work can also be done with radar data. Only radar reflectivity values were used in decision tree construction for this study. Unfortunately, due to the inadequate Fond du Lac reference data, radar reflectivity data were unable to be assessed for its effects on wetland classification accuracy in this study. A variety of other radar products in addition to reflectivity values may also be derived, particularly those utilizing the imaginary backscatter mechanism data unique to radar. Further exploration of these complex radar derivatives may prove beneficial to future wetland classification efforts.

2.2. Wetland Mapping using Radar Image data

2.2.1. Radar Mapping Introduction

Most of the focus of remote sensing of wetlands has been put on sensors operating in the optical and infrared range of the electromagnetic spectrum, the limitations of which have been noted (Ozesmi and Bauer, 2002). Unlike optical sensors, radar sensors are unique in that they operate in the microwave portion of the electromagnetic spectrum and are insensitive to atmospheric conditions (e.g. cloud cover) and low light conditions and can therefore offer more consistent multi-temporal images. radar backscatter is sensitive to soil and vegetation moisture properties and can, to some degree, penetrate the forest canopy and provide sub-canopy vegetation and soil saturation information (Whitcomb et al., 2007; Henderson and Lewis, 2008). Because radar is sensitive to moisture, techniques using inferometric analysis of radar data can identify changes in water levels down to the centimeter (Wdowinski, 2007).

Radar antennas can transmit radar waves of varying wavelengths. Common radar bands are C-band, L-band, and P-band, in order of increasing wavelength. Longer wavelengths tend to penetrate much farther into the forest canopy, thus providing a backscatter signal that conveys information about sub-canopy vegetation and moisture conditions (Whitcomb et al., 2007). Woody wetlands have high backscatter and appear white, and are often confused with urban areas, while herbaceous wetlands have less backscatter and appear darker (Wdowinski, 2007). Wang (1995) used C-band, L-band, and P-band radar and found that high leaf area indices had an effect on C-band radar only, not L-band or P-band. Thus, L-band radar is significantly better at detecting flooded forests with intact canopy cover

than C-band (Kasischke, 1997; Rosenqvist et al., 2004; Hess et al., 2003). Conversely, C-band radar is better at identifying herbaceous wetlands (Henderson and Lewis, 2008).

Radar waves can be sent and received at similar or dissimilar polarizations. Similar polarizations (HH, VV) are reported as useful in discriminating forested wetland/non-wetland by providing better image contrast than cross-polarization (HV), whereas cross-polarization was preferable when distinguishing between forested swamps and herbaceous marshes (Hess et al., 1990; Hess et al., 1995).

Multiple studies report that a combination of C-band and L-band radar, as well as mixed polarizations, significantly increased accuracy of wetland/non-wetland discrimination and wetland vegetation classification (Hess et al., 1990; Hess et al., 1995; Dobson, 1995; Whitcomb et al., 2007; Henderson and Lewis, 2008). Henderson and Lewis (2008) wrote that cross-polarized imagery can be as valuable as single-polarized, multitemporal imagery. Studies also found that vegetation information is enhanced by using multitemporal and cross-polarized imagery and reported land cover accuracies above 90% when using SAR imagery (Kasischke, 1997; Dobson, 1995). Lozano-Garcia and Hoffer (1993) reported increased accuracy in land cover classification when they combined SIR-B data with Landsat TM data.

Whitcomb et al. (2007) used JERS to collect two seasons of L-band SAR imagery to produce a wetland map throughout the state of Alaska. Ancillary data sets including DEM (66m spatial resolution), map of open water, and latitude were included in the classification model. The Random Forests decision tree algorithm (Breiman, 2001) was used as a classifier. Nine wetland classes were aggregated which roughly correlated to the Circular 39 (FWS citation here) wetland classifications. They reported accuracies ranging from 69.5% to 95%, depending on wetland class, with an overall accuracy of 89.5%. The NWI map for Alaska was used as test data set in the accuracy assessment. The authors suggest L-band in combination with C-band SAR will better distinguish between emergent wetland types (Whitcomb et al. 2007).

Henderson and Lewis (2008) provide the most recent review of usage of radar data to detect and classify wetlands. They reported that distinguishing wetlands and non-wetlands is consistently done with higher accuracy than discriminating wetland vegetative species. However, they noted that when mapping wetland species, most of the confusion is between wetland types and not between wetland and non-wetland vegetation. (Henderson and Lewis, 2008).

2.2.2. Radar Mapping Methods

This preliminary study examines the usefulness of radar-derived products for wetland mapping using decision trees. The radar data used consists of two RADARSAT-2 fine mode (10 m spatial resolution), quad polarized (HH, HV, VV, VH) images acquired on June 15 and September 19, 2009. The data were processed to represent constant beta intensity in decibels. Three polarimetric decompositions were then applied to both images. These decompositions were “van Zyl” (vZ), “Freeman-Durden” (F-D), and “Cloude-Pottier” (C-P). The vZ decomposition estimates three parameters of a radar image: odd bounce, even bounce, and diffuse scattering. vZ works on the theory that scattering objects on the ground create a number of bounces or reflections that then create recognizable phase differences between the HH and VV channels. The F-D decomposition estimates three paramaters: surface/single bounce, double bounce, and volume scattering. F-D is based on a physical model that separates the scattering mechanisms of the target and computes a percentage of each type of scatterer in each pixel. The C-P decomposition computes entropy, alpha angle, and anisotropy from the eigenvalues and eigenvectors of the image’s correlation matrix. Entropy is the randomness of scattering (low values indicate a single scattering mechanism and high values indicate a random mixture). Alpha angle is indicative of the average or dominant scattering mechanism (low angles indicate surface scattering, mid-angles indicate dipole scattering, and high values indicate multiple scattering). Anisotropy indicates

multiple scatterers. The three decompositions were combined with additional data in a decision tree classification algorithm (described below).

Additional geospatial data used included color infra-red (CIR) aerial images of leaf-on (summer 2008) and leaf-off (spring 2009) conditions and a USGS National Elevation Data (NED) 10 m Digital Elevation Model (DEM), from which elevation and slope were derived and used as inputs to the classifier.

A decision tree classifier is a rule-based algorithm that uses training data. The algorithm is designed to reduce intra- and inter-class variability through binary splitting of training values. The result of this splitting is a branching dichotomous key in which the various decision points are based on the variables that are found to be most significant in explaining the variation in the training data. The trained decision tree is then applied to a data set to classify it into the applicable categories. The decision tree classifier used in this project was the Random Forest algorithm (described alternately as Random Forest***s***). Random Forest (RF) generates an ensemble of decision trees that use different combinations of the training data. Each tree is given a "vote" as to which best discriminates the desired classes. The RF algorithm then chooses the tree with the most votes – i.e. the best performance in using the training data to classify the same training data. RF uses "out of bag" (OOB) sampling of roughly 1/3 of the input data to compute an unbiased estimate of the error in the classification trees and to estimate the importance of the input variables. The outputs of the algorithm are the best performing decision tree, the Gini Index of the importance of each input variable, the cross validation accuracy of the classifier derived from OOB sampling, a classification map of all pixels in the input layer, and a confidence map showing the relative classification confidence for each image pixel. The input data were 158 Fond du Lac field verified wetland type points described above. The classes of interest were Open Water, Emergent Wetland, Forested Wetland, Scrub Wetland, and Upland. The study area was the Fond du Lac portion of Carlton County described above.

2.2.3. Radar Mapping Results

The three decomposition layers are shown in Figures 7, 8, and 9. The vZ decomposition, with its dependence on bounce type and diffuse scattering, appears to perform reasonably well in discriminating open water from forested areas. It also is highly sensitive to water level, as shown in the difference in the value of the decomposition between the June and September dates. The F-D decomposition (Figure 8) is similar to the vZ decomposition in that it is highly dependent on bounce type; however F-D emphasizes the number of bounces rather than whether that number is odd or even. It also uses the volume scattering parameter rather than diffuse scattering, which increases its water and vegetation type discrimination potential. In this study F-D was able to discriminate forest versus scrub vegetation and areas where vegetation bordered water due to the strong double bounce effect at water-vegetation boundaries. The C-P decomposition (Figure 9) is the most difficult of the three to interpret visually. There layers of the decomposition represent the various combinations of entropy, scattering, and anisotropy, as summarized in Table 21. In general, the C-P decomposition was not effective in discriminating vegetation type or water-land boundaries. Most of the variability in C-P values was found within open water areas, making it less than suitable for wetland type mapping.

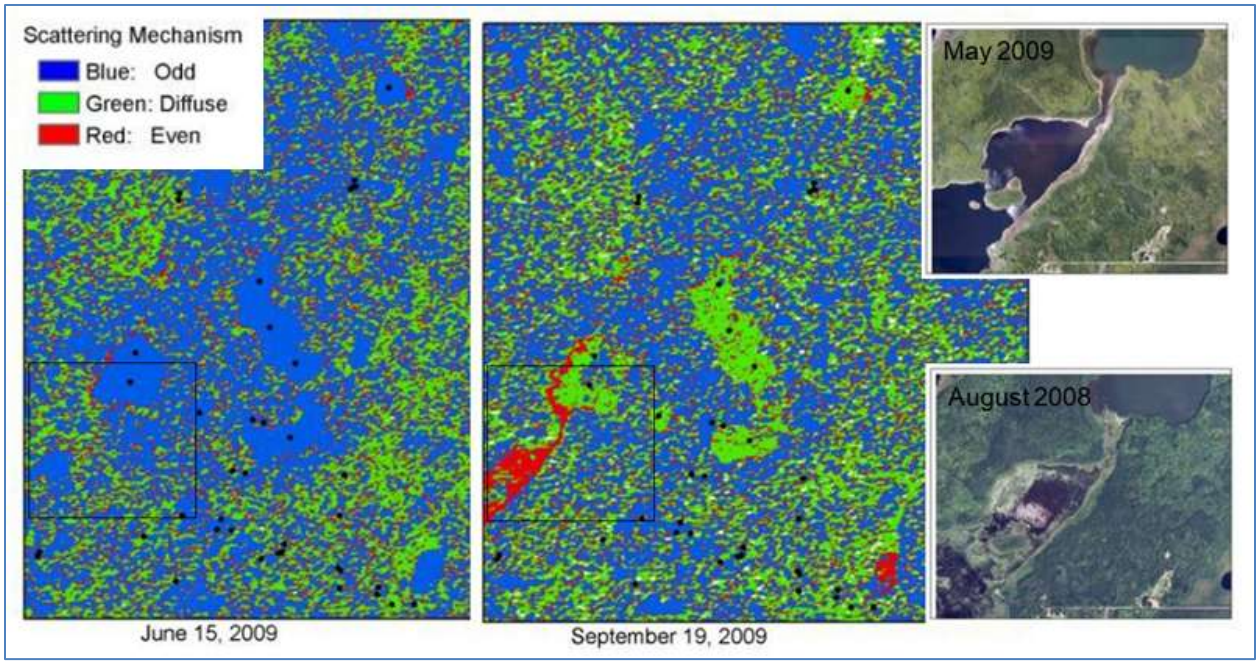


Figure 7. The van Zyl (vZ) decomposition layer with seasonally contemporaneous aerial images for comparison.

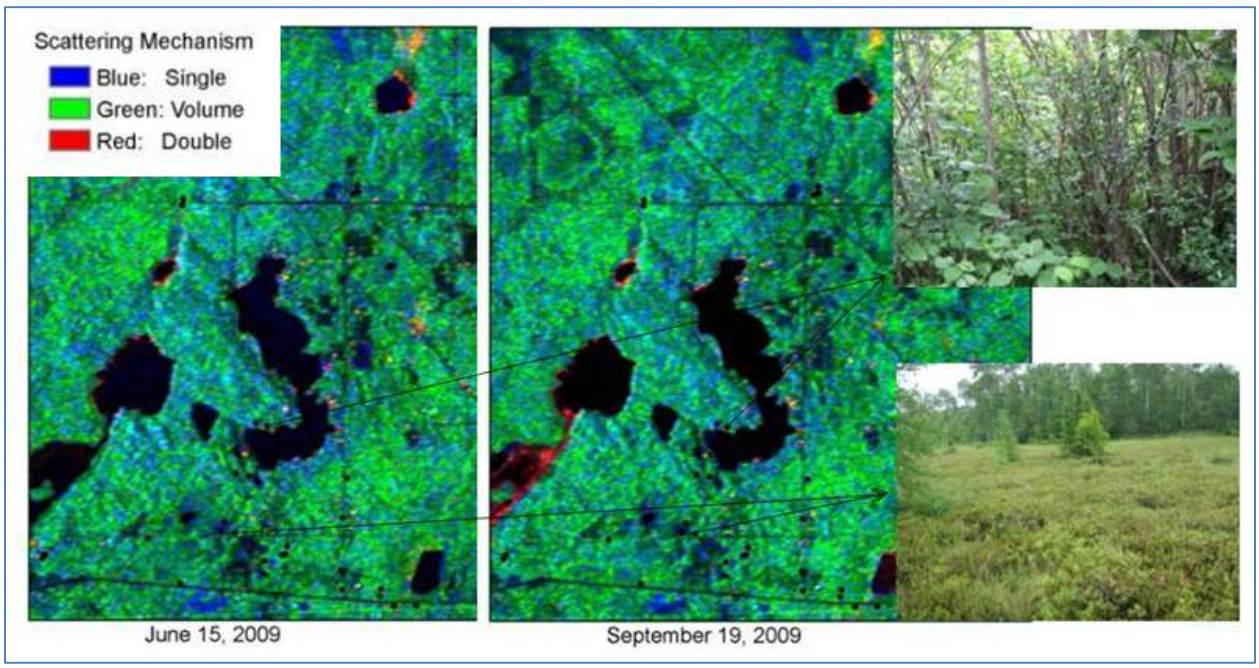


Figure 8. The Freeman-Durden (F-D) decomposition layer with field photos for comparison.

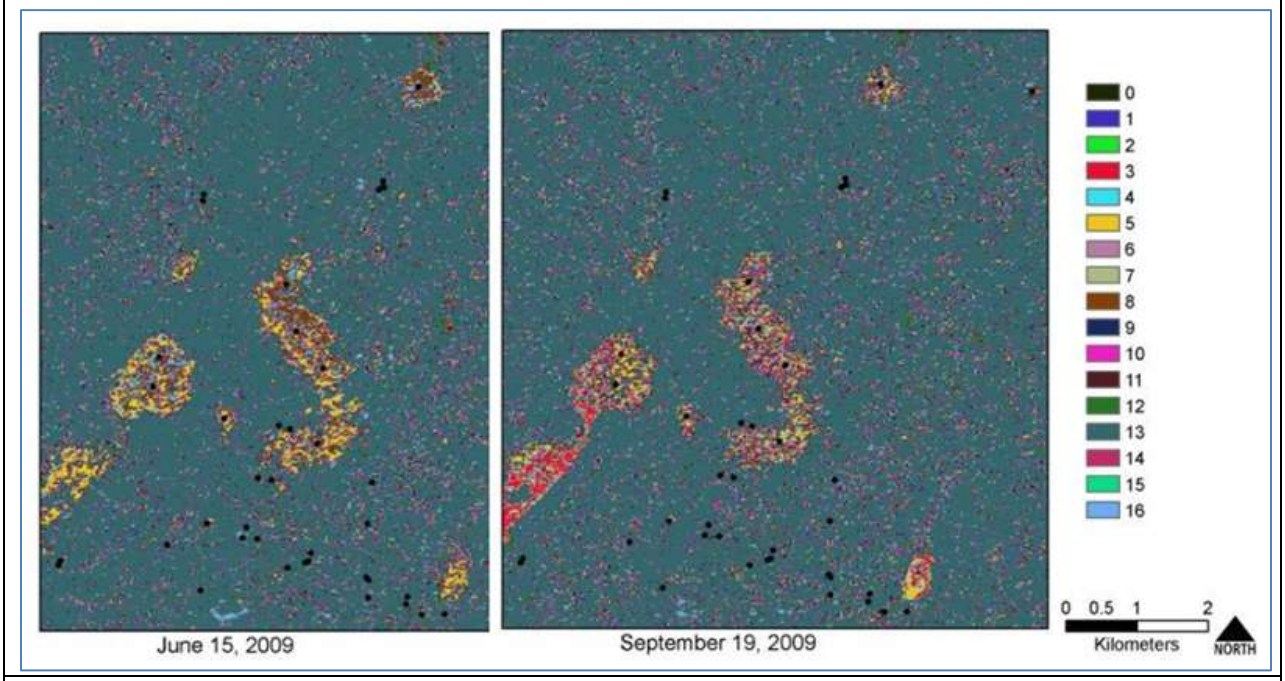


Figure 10. The Cloude-Pottier (C-P) decomposition layer. The class numbers represent the various combinations of entropy, scattering, and anisotropy, as summarized in Table 21.

Table 21. List of C-P decomposition layers
Classes 0–7 have low anisotrophy, 8–15 have high anisotropy
0 & 8: High entropy double bounce scattering
1 & 9: High entropy multiple scattering
2 & 10: Medium entropy multiple scattering
3 & 11: Medium entropy dipole scattering
4 & 12: Medium entropy surface scattering
5 & 13: Low entropy multiple scattering
6 & 14: Low entropy dipole scattering
7 & 15: Low entropy surface scattering
Class 16 is high entropy surface scattering, which is considered not a feasible region in entropy/alpha space

Figures 11, 12, and 13 give the results of the RF decision tree classification. Figure 11 shows the Gini Index values for the input data sets. Higher values of the Gini Index mean that the data set was more useful in discriminating the classes of interest. Interestingly, the most useful variables were the raw image bands themselves – particularly the infra-red leaf-on and leaf-off aerial image bands and the raw quad polarization radar bands. Closely following in Gini values were the terrain-derived variables of slope and elevation. The radar decomposition values were not highly useful in the decision tree. We attribute this result partially to the timing of the radar data collects (we did not capture a transition from wet to dry) and partially to the composition of the field data (most of the points were in forested

wetlands). Figure 12 shows the current, outdated NWI along with a recent aerial photo. In this case, the NWI layer appears to reasonably accurately identify the wetlands in the frame. Figure 13 shows the same NWI layer along with the output of the RF classifer. The broad wetland patterns match well with the NWI. The RF does persistently underestimate the amount of upland in the frame. We attribute this again to the training data. Since few of the 158 training points fell in upland areas – and very few in what would be termed urban areas – the classifier likely could not adequately discriminate those areas. The overall computed RF cross-validation accuracy resulting from the OOB sampling was 74.5%, which we suggest is reasonable for a limited training set. Several hundred new points collected during the 2010 field season are expected to remedy these training data related problems.

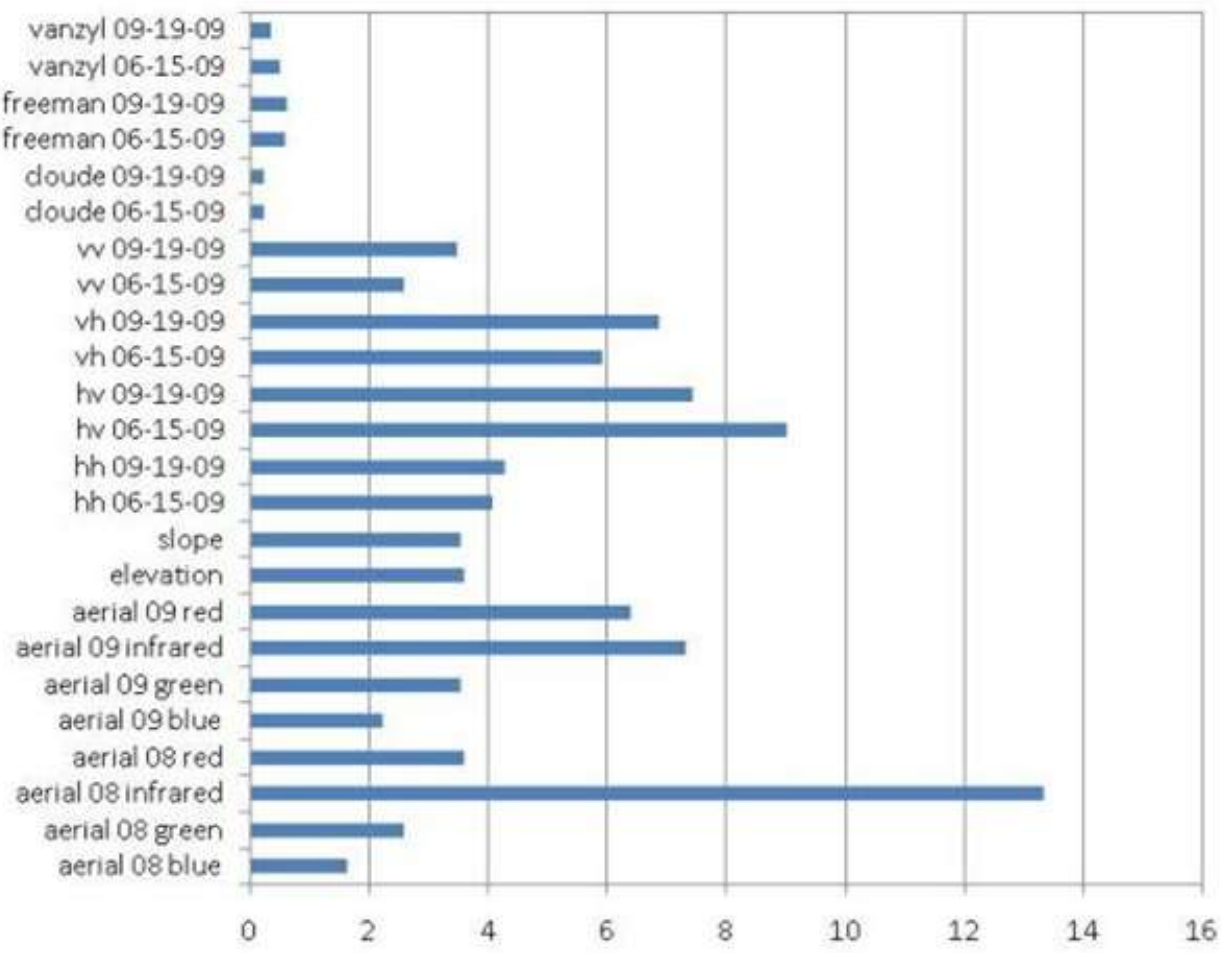


Figure 11. The Gini index for each variable in the decision tree classifier. Higher values indicate that the variable had a greater value in correct determination of wetland areas.

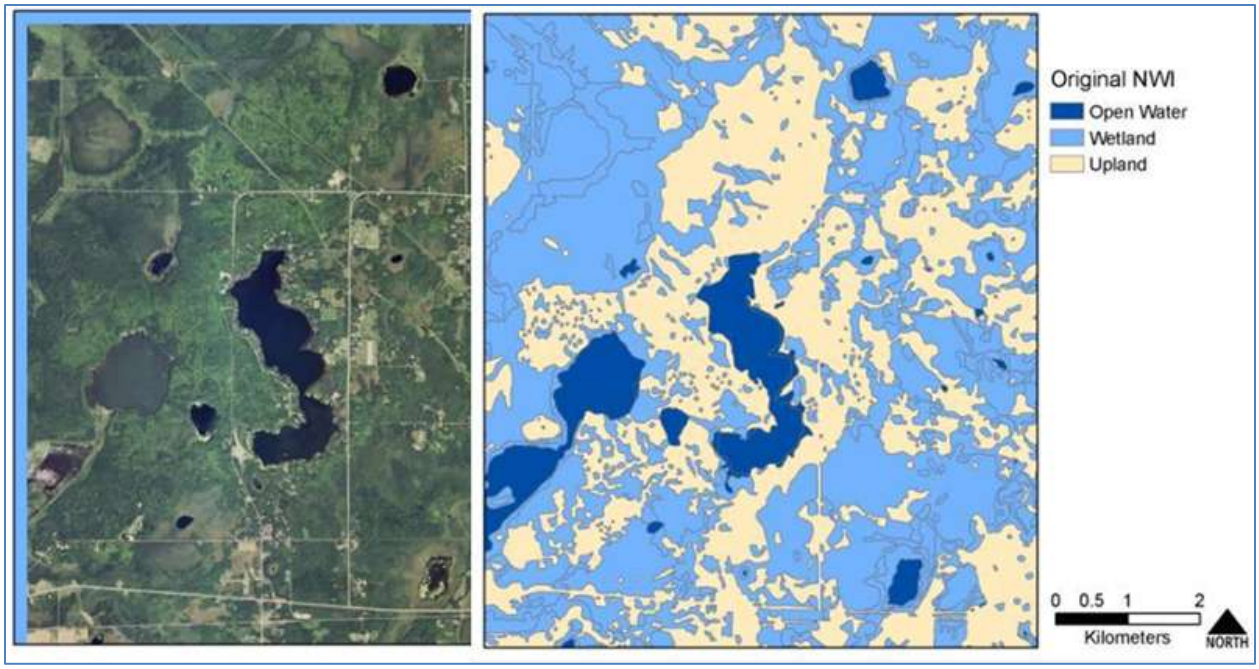


Figure 12. The current NWI layer as compared with a recent aerial image.

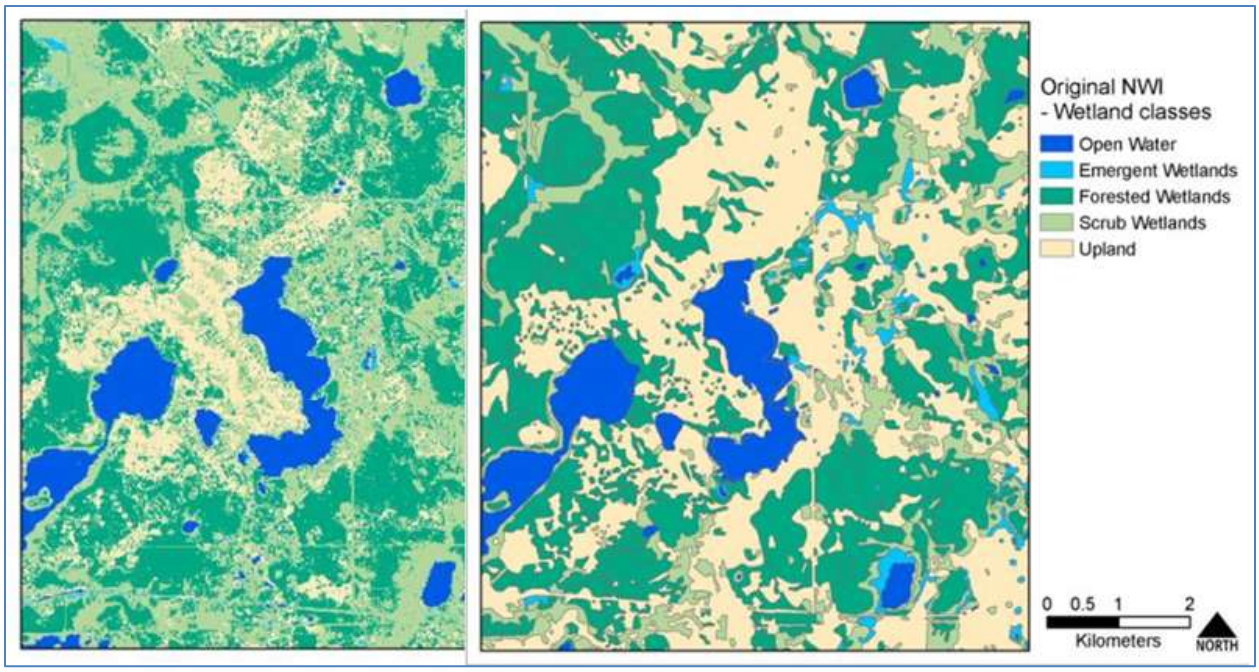


Figure 13. The current NWI (right) as compared with the output of the decision tree classifier.

2.2.4. Radar Mapping Conclusions

In this study decompositions derived from radar data did not significantly impact classification results. However, while products derived from radar were not deemed useful, the raw quad polarized radar bands were significant variables. The June 2009 HV polarization was the second most useful input variable as measured by the Gini Index. We are continuing to work with radar data. We expect that improved field data will make the limited conclusions we've drawn from this study more comprehensive and robust.

2.3. The Importance of Leaf-off Imagery

The results of this study indicate that leaf-off images are very important for accurate wetland mapping. In both See5 and RF decision tree studies, the spring leaf-off image bands were significant contributors to the overall accuracy of the results. In the See5 study the accuracy of the output maps decreased when leaf-off images were removed from consideration. In the RF study, the leaf-off infra-red band was the third most significant variable. Therefore, for the creation of the ancillary data layers we recommend that the wetland mapping workers use to assist in their efforts (e.g. the "likely wetland" layers), leaf-off images are vital.

In addition, the temporal difference in ground conditions between the spring leaf-off and summer leaf-on images is significant. In forested areas, the tree canopy matures quickly in the spring and will obscure wetland features. In regions dominated by agriculture wet soil conditions will not be captured by summer imagery because of both the common drying of soil from spring through summer and the growth of crop canopies, which obscure remaining wet features. Therefore we strongly recommend that leaf-off images be collected statewide for use in the MN NWI update.

3. Recommendations and Protocol for Wetland Mapping in the Arrowhead

3.1. General Recommendations

The results presented above suggest that an ideal geospatial dataset for wetland mapping, whether for automated analysis or interpretation by analysts, would include recent high resolution color infra-red images in both leaf-on and leaf-off conditions, high resolution LIDAR data providing both a bare earth DEM and vegetation height information, RADAR image data for several dates in spring and summer, and comprehensive soil type data for the study area. The limited geospatial data available for the Arrowhead is not sufficient to create such an idea dataset. Thus, a wetland mapping approach for the Arrowhead must identify the most useful of the available data types and analysis approaches. The following are general recommendations for conducting an NWI update in the Arrowhead:

- *Base image data for interpretation*: 2009 leaf-off 1 meter color infra-red imagery.
- *Ancillary image data*: 2008/2009 NAIP. NAIP imagery was collected in Minnesota in 2009 but it does not have a color infra-red band. An important characteristic of infra-red images is that water and saturated areas appear significantly darker than non-wet areas because of the absorption of infra-red wavelengths by water. Thus, while the 2009 NAIP images are newer and will provide a more recent wetland map, the spectral information present in the 2008 images is likely to be more advantageous in both manual interpretation and image segmentation. The new NAIP could be viewed side-by-side with the 2008 and leaf-off images, providing improved spectral and temporal information.

- *Elevation data*: LIDAR DEMs where available (soon to be statewide), National Elevation Data in LIDAR coverage gaps. Elevation data are critical for identifying depressional areas that may not be readily visible on optical imagery.
- *Soils data*: NRCS SSURGO layers. The SSURGO database, while limited in availability in the Arrowhead (notably absent in St. Louis County), and at relatively coarse spatial resolution, provides useful information about the general soil characteristics of an area. Parameters drawn from the database, such as hydric and poorly-drained designations and soil acidity data, can be used to distinguish some commonly confused wetland types – particularly in the Eggers and Reed classification system.
- *Image preprocessing*: The base image data should be segmented using an object oriented algorithm prior to interpretation. While very time consuming initially, creating image segments will substantially reduce manual interpretation time and subjectivity in drawing wetland polygon boundaries.
- *Classification system*: The Cowardin classification system should be the main wetland typing method used; however, the Eggers and Reed type for each wetland should be identified during the interpretation process. Increasing nationwide adoption of the Eggers and Reed indicates that failing to collect such data would be a substantial oversight – particularly given the difficulty of developing a robust crosswalk between Cowardin and Eggers and Reed.

3.2. Mapping Protocol

The following is a set of detailed guidelines and protocol steps for mapping wetlands in the Arrowhead. The project steps are presented in order: data acquisition, pre-interpretation data processing, data display and interpretation, post processing, delivery, and quality control.

3.2.1 Data Types and Software

The following data types should be acquired for use in this project:

- 2009 Spring leaf-off images for the study area
- 2008 National Agriculture Imaging Program (NAIP) images for the study area
- 2009 National Agriculture Imaging Program (NAIP) images for the study area
- USDA NRCS Soil Survey Geographic (SSURGO) soils data
- High resolution LiDAR DEMs where available
- National Elevation Data at 10 meter spatial resolution
- MN DNR hydrology dataset (rivers, lakes, etc.)
- USGS quarter quadrangle tile index from MN DNR
- Minnesota ecoregions layer from MN DNR

Software:

- ESRI ArcGIS
- Definiens Server 7 (or later)
- Python GDAL library
- TauDEM hydrology extension for ArcGIS
- The R statistical package with decision tree module (Random Forest)

3.2.2 Preprocessing

- Prepare the 2009 leaf-off images (all four bands) for image segmentation by subsetting them into quarter quadrangle tiles using the tile index. This can be automated using Python and the GDAL library.
- Use the batch feature in Definiens to automate segmentation of the NAIP tiles using the following parameters:
    - Color/shape: 0.5 each
    - Scale 50-70 (lower for smaller wetlands)
- Generalize segment boundaries by a reasonable amount to reduce the number of vertices. This will make subsequent editing of segment boundaries much easier and will not significantly affect the segments shapes.
- Export segments from Definiens as ArcGIS Shapefiles. Ensure they are exported with projection/coordinate information.
- Create a Normalized Difference Vegetation Index layer from the NAIP infra-red and red bands
- Threshold the NDVI layer to include only pixels with values greater than 0.2
- Use the LiDAR or NED elevation layers to create a Compound Topographic Index layer using the d-infinity water flow algorithm in TauDEM
- Compute a "likely wetland" map by using the data types described above as inputs to the Random Forest decision tree algorithm in combination with valid training data (either collected by the mapping contractor or provided by DNR or others). The output of the RF algorithm will be a layer showing the wetland presence/absence as well as type attributes for the study area, along with a confidence map depicting the statistical certainty of the classification result for each pixel.

3.2.3 Data display and Interpretation

- We recommend against viewing the old NWI polygons at any point in this procedure so as not to bias the results. The old NWI could perhaps be used after the initial interpretation as a comparison.
- A dual monitor setup is recommended if possible.
- Display in ArcGIS or other appropriate software the leaf-off tile of interest, the wetland likelihood map, a topography layer (LiDAR, NED), and the image segments.
- Display leaf-off images and segments for each adjacent image tile so that local context can be used to inform the interpretation process at the edges of the tile of interest.
- For each segment:
    - Determine whether it is wetland or upland using the interpreter's best professional judgment.
    - If the segment is wetland, record the Cowardin and Eggers & Reed (E&R) types in the ArcGIS table associated with the segment layer. We recommend this be done using a constrained attribute domain to minimize data entry errors.
    - Edit the boundaries of the segment using the ArcGIS feature editing tools so that the boundaries correspond to the natural wetland edges.

3.2.4 Data Post-processing and Delivery

- Dissolve (merge) adjacent segments that have the same wetland type. This operation should not be done if the E&R types are different.
- Delete upland segments from the segment layer.

- Deliver final segment layer as NWI wetland map. The map should be delivered at a scale desired by MN DNR, either at the quarter quad, full quad, or county, and in a GIS format such asgeodatabase.
- The product should be fully compliant with all USFWS requirements so that it is ready for upload to the main NWI.

3.2.5 Quality Assurance / Quality Control

- The mapping contractor should perform comprehensive in-house validation of the data products both during and subsequent to interpretation work. These should include positional and thematic accuracy assessments.
- If a free text data entry approach is used (e.g. the interpreters type in rather than select Cowardin codes for wetland segments), attribute validity checks should be used to ensure consistency.

4. Conclusions

The research presented in this document is an in-depth analysis of selected wetland mapping techniques for the Arrowhead. While some work remains to be completed, such as the wetland typing using radar images approach, the results are sufficient to draw conclusions and to make recommendations for the optimal approach to accomplishing the objectives of the Minnesota NWI update. The protocol provided above is expected to be suitable for meeting or exceeding the FGDC wetland mapping standard and thus allowing for the inclusion of Minnesota's updated wetland maps in the USFWS National Wetland Inventory.

5. References

Arzandeh, S., & Wang, J. (2003). Monitoring the change of *phragmites* distribution using satellite data. *Canadian Journal of Remote Sensing, 29*(1), 24-35.

Baghdadi, N., Bernier, M., Gauthier, R., & Neeson, I. (2001). Evaluation of C-band SAR data for wetlands mapping. International Journal of Remote Sensing, 22(1), 71-88.

Baker, C., Lawrence, R., Montagne, C., & Patten, D. (2006). Mapping wetlands and riparian areas using Landsat ITM+ imagery and decision-tree-based models. *Wetlands, 26*(2), 465-474.

Becker, B. L., Lusch, D. P., & Qi, J. (2005). Identifying optimal spectral bands from in situ measurements of great lakes coastal wetlands using second-derivative analysis. *Remote Sensing of Environment, 97*(2), 238-248.

Becker, B. L., Lusch, D. P., & Qi, J. (2007). A classification-based assessment of the optimal spectral and spatial resolutions for great lakes coastal wetland imagery. *Remote Sensing of Environment, 108*(1), 111-120.

Blyth E. M., Finch J., Robinson M., Rosier P.: Can soil moisture be mapped onto the terrain? Hydrology and Earth System Sciences 8 (2004) 923-93

Bolstad, P. V., & Lillesand, T. M. (1992). Improved classification of forest vegetation in northern Wisconsin through a rule-based combination of soils, terrain, and Landsat Thematic Mapper data. *Forest Science, 38*(1), 5-20.

Bolstad, Paul (2006); “GIS Fundamentals”, second edition, www.paulbolstad.net/gisbook.html

Bourgeau-Chavez, L. L., Kasischke, E. S., Brunzell, S. M., Mudd, J. P., Smith, K. B., & Frick, A. L. (2001). Analysis of space-borne SAR data for wetland mapping in Virginia riparian ecosystems. *International Journal of Remote Sensing, 22*(18), 3665.

Bruzzone, L. and Carlin, L. 2006. A multilevel context-based system for classification of very high spatial resolution images. IEEE Transactions on Geoscience and Remote Sensing, 44(9): 2587-2600.

Campbell, J.B. 2007. Introduction to Remote Sensing. 4th edition. The Guilford Press: New York, NY

Costa, M. P. F., & Telmer, K. H. (2006). Utilizing SAR imagery and aquatic vegetation to map fresh and brackish lakes in the Brazilian pantanal wetland. *Remote Sensing of Environment, 105*(3), 204-213.

Costa-Cabral, M. and Burges, S. J. (1994). Digital Elevation Model Networks (DEMON): A Model of Flow Over Hillslopes for Computation of Contributing and Dispersal Areas. Water Resources Research, 30(6): 1681-1692

Cowardin, L. M., & Myers, V. I. (1974). Remote sensing for identification and classification of wetland vegetation. *The Journal of Wildlife Management, 38*(2), 308-314.

Cowardin, L. M., Carter, V., Golet, F. C., & LaRoe, E. T. (1974). Classification of wetlands and deepwater habitats of the United States.

Craig Dobson, M., Ulaby, F. T., & Pierce, L. E. (1995). Land-cover classification and estimation of terrain attributes using synthetic aperture radar. *Remote Sensing of Environment, 51*(1), 199-214.

Creed, I. F., Sanford, S. E., Beall, F. D., Molot, L. A., & Dillon, P. J. (2003). Cryptic wetlands: Integrating hidden wetlands in regression models of the export of dissolved organic carbon from forested landscapes. *Hydrological Processes, 17*(18), 3629-3648.

Dahl, T. E. (1990). *Wetlands losses in the united states 1780's to 1980's*. Washington, D.C.: U.S. Department of the Interior, Fish and Wildlife Service.

Dahl, T. E., & Johnson, C. E. (1991). *Status and trends of wetlands in the conterminous United States, mid-1970's to mid-1980's*. Washington, D.C.: U.S. Department of the Interior, Fish and Wildlife Service.

Definiens AG. 2006. Definiens Professional 5 Reference Book. Trappentreustr, 1D-80339 München, Germany.

Douglas, D. H. 1986. Experiments to locate ridges and channels to create a new type of digital elevation model. Cartographic 23: 29-61

Eggers, S.D., Reed, D.M., 1997. Wetland plants and communities of Minnesota and Wisconsin. U.S. Army Corps of Engineers, St. Paul District, 263pp.

Environmental Laboratory. (1987). *Corps of engineers wetlands delineation manual* No. Technical Report Y-87-1). Vicksburg, Miss.: U.S. Army Engineer Waterways Experiment Station.

ERDAS IMAGINE Expert Classifier, 2005. Leica Geosystems GIS and Mapping, LLC, http://gis.leica-geosystems.com.

Federal Geodetic Data Committee (FGDC) Wetlands Subcommittee. 2008. FGDC draft wetlands mapping standard. Environmental Protection Agency, Office of Water.

Federal Register. (1980). 40 CFR part 230: Section 404(b)(1) guidelines for specification of disposal sites for dredged or fill material.*45*(249), 85352-85353.

Federal Register. (1982). Title 33: Navigation and navigable waters; chapter II, regulatory programs of the corps of engineers. *47*(138), 31810.

Fournier, Grenier, Lavoie, & Helie, 2007. Towards a strategy to implement the Canadian Wetland Inventory using satellite remote sensing.

Frappart, F., Seyler, F., Martinez, J., León, J. G., & Cazenave, A. (2005). Floodplain water storage in the negro river basin estimated from microwave remote sensing of inundation area and water levels. Remote Sensing of Environment, 99(4), 387-399. doi:DOI: 10.1016/j.rse.2005.08.016

Grenier, M., Demers, A. M., Labrecque, S., Benoit, M., Fournier, R. A., & Drolet, B. (2007). An object-based method to map wetland using RADARSAT-1 and Landsat ETM images: Test case on two sites in Quebec, Canada. Canadian Journal of Remote Sensing, 33(Suppl. 1), S28-S45.

Grenier, M., Demers, A., Labrecque, S., Benoit, M., Fournier, R.A., and Drolet, B. 2007. An object-based method to map wetland using Radarsat-1 and Landsat ETM imagers: test case on two sites in Quebec, Canada. Canadian Journal of Remote Sensing. 33 (Suppl. 1), S28-S45.

Guntner A., Seibert J., Uhlenbrook S.: Modeling spatial patterns of saturated areas: An evaluation of different terrain indices. Water Resources Research 40 (2004) W05114

Harken, J., & Sugumaran, R. (2005). Classification of iowa wetlands using an airborne hyperspectral image: A comparison of the spectral angle mapper classifier and an object-oriented approach. Canadian Journal of Remote Sensing, 31(2), 167-174.

Harvey, K. R., & Hill, G. J. E. (2001). Vegetation mapping of a tropical freshwater swamp in the Northern Territory, Australia: A comparison of aerial photography, landsat TM and SPOT satellite imagery. *International Journal of Remote Sensing, 22*(15), 2911.

Healy, T. (2005). *Muddy coasts*

Henderson, F. M., & Lewis, A. J. (2008). Radar detection of wetland ecosystems: A review. *Int.J.Remote Sens., 29*(20), 5809-5835.

Hess, L. L., Melack, J. M., & Simonett, D. S. (1990). Radar detection of flooding beneath the forest canopy: A review. *International Journal of Remote Sensing, 11*(7), 1313.

Hess, L. L., Melack, J. M., Filoso, S., & Yong Wang. (1995). Delineation of inundated area and vegetation along the Amazon floodplain with the SIR-C synthetic aperture radar. *Geoscience and Remote Sensing, IEEE Transactions on, 33*(4), 896-904.

Hess, L. L., Melack, J. M., Novo, E. M. L. M., Barbosa, C. C. F., & Gastil, M. (2003). Dual-season mapping of wetland inundation and vegetation for the central amazon basin. *Remote Sensing of Environment, 87*(4), 404-428.

Hirano, A., Madden, M., & Welch, R. (2003). Hyperspectral image data for mapping wetland vegetation. *Wetlands, 23*(2), 436-448.

Hodgson, M. E., Jensen, J. R., Mackey, H. E., & Coulter, M. C. (1987). Remote sensing of wetland habitat: A wood stork example. *Photogrammetric Engineering and Remote Sensing, 53*, 1075-1080.

Huan, Y. and Zhang, S. 2008. Application of high resolution satellite imagery for wetlands cover classification using object-oriented method. The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences. 37(B7): 521-526.

Hunt, R., Hamilton, R., and Everitt, J. 2007. Mapping weed infestations using remote sensing, in *A Weed Manager's Guide to Remote Sensing and GIS – Mapping and Monitoring*, USDA Forest Service.

Islam, ,Md.A., Thenkabail, ,P.S., Kulawardhana, ,R.W., Alankara, ,R., Gunasinghe, ,S., Edussriya, ,C., et al. (2008). Semi-automated methods for mapping wetlands using Landsat ETM+ and SRTM data. *Int. J. Remote Sens., 29*(24), 7077-7106.

Jensen, John R., 2005, *Introductory Digital Image Processing*, 3rd Ed., Upper Saddle River, NJ: Prentice Hall, 526 pages.

Johnston, C. A. (1989). *Human impacts to Minnesota wetlands* No. PB-91-183160/XAB; EPA--600/J-89/519). Duluth, Minnesota: U.S. Environmental Protection Agency.

Kasischke, E. S., Melack, J. M., & Craig Dobson, M. (1997). The use of imaging radars for ecological applications - a review. *Remote Sensing of Environment, 59*(2), 141-156.

Kasischke, E. S., Smith, K. B., Bourgeau-Chavez, L. L., Romanowicz, E. A., Brunzell, S., & Richardson, C. J. (2003). Effects of seasonal hydrologic patterns in south Florida wetlands on radar backscatter measured from ERS-2 SAR imagery. Remote Sensing of Environment, 88(4), 423-441. doi:DOI: 10.1016/j.rse.2003.08.016

Kloiber, S. Personal communication, 1/4/2010.

Lang, M.W. and G.W. McCarty, 2009. Lidar intensity for improved detection of inundation below the forested canopy. *Wetlands* 29(4).

Li, J., & Chen, W. (2005). A rulebased method for mapping canada's wetlands using optical, radar and DEM data. International Journal of Remote Sensing, 26, 5051-5069(19).

Li, J., & Chen, W. (2005). A rule-based method for mapping Canada's wetlands using optical, radar and DEM data. *International Journal of Remote Sensing, 26*(22), 5051-5069.

Lozano-Garcia, D. F., & Hoffer, R. M. (1993). Synergistic effects of combined Landsat-TM and SIR-B data for forest resources assessment. *International Journal of Remote Sensing, 14*(14), 2677.

Lu, Z., Crane, M., Kwoun, O., Wells, C., Swarzenski, C., & Rykhus, R. (2005). C-band radar observes water level change in swamp forests. EOS, TRANSACTIONS AMERICAN GEOPHYSICAL UNION, 86(14)
Meinel, G. and M. Neubert. 2004. A comparison of segmentation programs for high resolution remote sensing data. International Archives of Photogrammetry and Remote Sensing, XXXV(Part B): 1097-1105.

Moore, I. D., O'Loughlin, E. M., & Burch, G. J. (1988). A contour-based topographic model for hydrological and ecological applications. *Earth Surface Processes and Landforms, 13*(4), 305-320.

Moore, I. D., R. B. Grayson, and A. R. Ladson. 1991. Digital terrain modeling: a review of hydrological, geomorphological, and biological applications. Hydrological Processes 5:3–30

Murphy, P. N. C., Ogilvie, J., Connor, K., & Arp, P. A. (2007). Mapping wetlands: a comparison of two different approaches for New Brunswick, Canada. *Wetlands, 27*(4), 846-854.

Neuenschwander, A. L., Crawford, M. M., & Provancha, M. J. (1998). *Mapping of coastal wetlands via hyperspectral AVIRIS data*

Ozesmi, S. L., & Bauer, M. E. (2002). Satellite remote sensing of wetlands. *Wetlands Ecology and Management, 10*(5), 381-402.

Parmuchi, M. G., Karszenbaum, H., & Kandus, P. (2002). Mapping wetlands using multi-temporal RADARSAT-1 data and a decision-based classifier. Canadian Journal of Remote Sensing, 28(2), 175-186.

Ramsey III, E. W. (1998). Radar remote sensing of wetlands. In R. Lunetta, & C. Elvidge (Eds.), *Remote sensing change detection: Environmental monitoring methods and applications* (pp. 211-243). Ann Arbor, MI: Ann Arbor Press Inc.

Ramsey, E. W. (1995). Monitoring flooding in coastal wetlands by using radar imagery and ground-based measurements. International Journal of Remote Sensing, 16(13), 2495.

Ramsey, E. W., Nelson, G. A., & Sapkota, S. K. (1998). Classifying coastal resources by integrating optical and radar imagery and color infrared photography. Mangroves and Salt Marshes, 2(2), 109-119. Retrieved from http://dx.doi.org.floyd.lib.umn.edu/10.1023/A:1009911224982

Ramsey, E., Rangoonwala, A., Middleton, B., & Lu, Z. (2009). Satellite optical and radar data used to track wetland forest impact and short-term recovery from Hurricane Katrina. Wetlands, 29(1), 66-79. doi:10.1672/08-103.1

Repaka, S.R., Truax, D. D., Kolstad, E., and O'Hara, C. G. 2004. Comparing spectral and object based approaches for classification and transportation feature extraction from high resolution multispectral imagery, in *Proceedings form ASPRS Annual Conference.*

Rosenqvist, A., Shimada, M., Chapman, B., McDonald, K., De Grandi, G., Jonsson, H., et al. (2004). *An overview of the JERS-1 SAR global boreal forest mapping (GBFM) project*

Sader, S. A., Ahl, D., & Liou, W. (1995). Accuracy of Landsat-TM and GIS rule-based methods for forest wetland classification in Maine. *Remote Sensing of Environment, 53*(3), 133-144.

Shaw, Samuel P. and C. Gordon Fredine 1956. *Wetlands of the United States - their extent and their value to waterfowl and other wildlife*. U.S. Department of the Interior, Washington, D.C. Circular 39. 67pp.

Shuman, C. S., & Ambrose, R. F. (2003). A comparison of remote sensing and ground-based methods for monitoring wetland restoration success. *Restoration Ecology, 11*(3), 325-333.

Slatton, K. C., Crawford, M. M., & Chang, L. D. (2008). Modeling temporal variations in multipolarized radar scattering from intertidal coastal wetlands. ISPRS Journal of Photogrammetry and Remote Sensing, 63(5), 559-577. doi:DOI: 10.1016/j.isprsjprs.2008.07.003

Stuckens, J., Coppin, P. R., & Bauer, M. E. (2000). Integrating contextual information with per-pixel classification for improved land cover classification.71(6), 282-296.

Tarboton, D. G. 1997. A new method for the determination of flow directions and upslope areas in grid digital elevation models. Water Resources Research 33: 309-319

Thompson, J. A., Bell, J. C., & Butler, C. A. (2001). Digital elevation model resolution: Effects on terrain attribute calculation and quantitative soil-landscape modeling. *Geoderma, 100*(1-2), 67-89.

Tiner Jr., R. W. (1990). Use of high-altitude aerial photography for inventorying forested wetlands in the United States. *Forest Ecology and Management, 33-34*, 593-604.

Townsend, P. A. (2001). Mapping seasonal flooding in forested wetlands using multi-temporal radarsat SAR. Photogrammetric Engineering & Remote Sensing, 67(7), 857-864.

Townsend, P., & Walsh, S. (2001). Remote sensing of forested wetlands: Application of multitemporal and multispectral satellite imagery to determine plant community composition and structure in southeastern USA. *Plant Ecology, 157*(2), 129-149.

Töyrä, J., Pietroniro, A., Martz, L. W., & Prowse, T. D. (2002). A multi-sensor approach to wetland flood monitoring. Hydrological Processes, 16(8), 1569-1581.

Wang, J., Shang, J., Brisco, B., & Brown, R. J. (1998). Evaluation Of multi-date ERS-1 and multispectral Landsat imagery for wetland detection in southern Ontario. *Canadian Journal of Remote Sensing, 24*(1), 60-68.

Wang, J., Zheng, L., & Tong, Q. (1998). Derivative spectra matching for wetland vegetation identification and classification by hyperspectral image. *3502*(1) 280-288.

Wang, Y., Hess, L. L., Filoso, S., & Melack, J. M. (1995). Understanding the radar backscattering from flooded and non-flooded Amazonian forests: Results from canopy backscatter modeling. *Remote Sensing of Environment, 54*(3), 324-332.

Wdowinski, S., Kim, S., Amelung, F., Dixon, T. H., Miralles-Wilhelm, F., & Sonenshein, R. (2008). Space-based detection of wetlands' surface water level changes from L-band SAR interferometry. *Remote Sensing of Environment, 112*(3), 681-696.

Whitcomb, J., Moghaddam, M., McDonald, K., Podest, E., & Kellndorfer, J. (2007). *Wetlands map of alaska using L-band radar satellite imagery*

Wright, C., & Gallant, A. (2007). Improved wetland remote sensing in Yellowstone National Park using classification trees to combine TM imagery and ancillary environmental data. *Remote Sensing of Environment, 107*(4), 582-605.

Zribi, M., & Dechambre, M. (2003). A new empirical model to retrieve soil moisture and roughness from C-band radar data. Remote Sensing of Environment, 84(1), 42-52. doi:DOI: 10.1016/S0034-4257(02)00069-X

Wetland Mapping Methods for the Twin Cities Metropolitan Area

Joseph F. Knight, Ph.D.
Jennifer Corcoran, M.S.
Lian Rampi
Bryan Tolcser
Margaret Voth

Remote Sensing and Geospatial Analysis Laboratory
Department of Forest Resources
University of Minnesota

6/18/2009

Contents

1. Introduction 4
   1.1. Objectives 4
   1.2. Background 4
      1.2.1. Classification Methods 5
      1.2.2. Multitemporal Data 6
      1.2.3. Hyperspectral Data 7
      1.2.4. Radar Imagery 7
      1.2.5. Ancillary Data Sets 8
2. Methods/Results 10
   2.1. Wetland Mapping using Terrain Indices 10
      2.1.1. Terrain Indices Introduction 10
      2.1.2. Terrain Indices Methods 10
      2.1.3. Terrain Indices Results 15
      2.1.4. Terrain Indices Discussion 22
      2.1.5. Terrain Indices Conclusions 23
   2.2. Wetland Mapping using Object Oriented Algorithms 24
      2.2.1. Introduction to Object-Oriented Classification 24
      2.2.2. Segmentation Methodology 25
      2.2.3. Pilot Segmentation Results 27
      2.2.4. Segmentation Discussion 31
   2.3. Wetland Typing using Decision Trees 32
      2.3.1. Wetland Typing Introduction 32
      2.3.2. Wetland Typing Methods 32
      2.3.3. Wetland Typing Results 35
      2.3.4. Wetland Typing Discussion 41
      2.3.5. Wetland Typing Conclusions 42
   2.4. Wetland Mapping using RADAR Imagery 42
      2.4.1 Introduction to Wetland Mapping with Radar Imagery 42
      2.4.2 Planned Methodology 43
      2.4.3 Expected Results 45
      2.4.4 RADAR Summary and Conclusions 45
   2.5. Field Wetland Data Collection in Carlton County 46
3. Recommendations and Protocol for Wetland Mapping in the Metro Area 47
   3.1. General Recommendations 47

3.2. Mapping Protocol 48
3.2.1 Data Types and Software 48
3.2.2 Preprocessing 49
3.2.3 Data display and Interpretation 49
3.2.4 Data Post-processing and Delivery 49
3.2.5 Quality Assurance / Quality Control 50
4. Conclusions 50
5. References 51

Funding for this project was provided by the Minnesota Environment and Natural Resources Trust Fund as recommended by the Legislative-Citizen Commission on Minnesota Resources (LCCMR). The Trust Fund is a permanent fund constitutionally established by the citizens of Minnesota to assist in the protection, conservation, preservation, and enhancement of the state's air, water, land, fish, wildlife, and other natural resources.

1. Introduction

1.1. Objectives

This document is a report to the Minnesota Department of Natural Resources (MNDNR) that provides a review of research conducted on wetland mapping methods for the Twin Cities Metropolitan Area (TCMA) in Minnesota. Given herein are recommendations for wetland mapping methods appropriate for the ongoing National Wetlands Inventory update in Minnesota. This document is provided to MNDNR by the University of Minnesota's Remote Sensing and Geospatial Analysis Lab (RSGAL) in partial fulfillment of a contractual agreement between the two parties. The structure of this report is as follows: 1) background information about wetlands and a review of relevant literature regarding wetland mapping, 2) detailed summaries of the research undertaken by RSGAL under this agreement, 3) Recommendations and a suggested protocol for wetland mapping in the TCMA.

1.2. Background

For regulatory purposes, wetlands are jointly defined by the U.S. Army Corps of Engineers (USACE) and the U.S. Environmental Protection Agency (EPA) as: "those areas that are inundated or saturated by surface or ground water at a frequency and duration to support, and under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions" (Federal Register, 1982; Federal Register, 1980). Wetlands are valuable natural resources, as they play a crucial role in the ecology of a landscape. Wetlands function as a buffer to open water bodies and provide an important ecosystem functions by filtering nutrients and pollutants, storing floodwater and mitigating its effects on water bodies, and providing habitat to a variety of wildlife that have adapted to life in saturated environments. Wetlands also play a role in the global carbon cycle, acting as carbon sinks.

The United States has experienced significant wetland loss. In a 200 year period between colonization and the 1980's, the lower 48 states lost an estimated 53% of wetland acreage due to a variety of human activities such as agriculture, urbanization and development, and pollution (Dahl, 1990; Johnston, 1989). In Minnesota, over 50% of the state's 3.6 million ha of wetlands have been lost, mostly due to land drainage for agriculture in southern Minnesota and the Red River Valley. Urbanization causes small wetland area losses, but significantly alters a wetland's physical, biological, and chemical properties (Johnston, 1989). The loss of wetlands continues, but the rate of loss may be slowing (Dahl and Johnson, 1991). Accurate mapping of the spatial distribution of wetlands is important for understanding the effects of wetland loss (Baker, et al. 2006).

Mapping wetlands can be achieved through a variety of methodologies. Remote sensing has been used as a wetland mapping tool since the 1960's (Cowardin and Myers, 1974) but recent advances in remote sensing technologies may offer considerable increases in accuracy and cost-efficiency. The following presents a review of the current status and trends of the remote sensing of wetlands and examines the usefulness of a variety of data sources in enhancing the accuracy of wetland classification and mapping.

Wetland delineation and classification can be achieved using several methods. The most accurate method is field wetland delineation, where a wetland expert defines the boundary between wetland and upland using vegetative, soil, and hydrology field indicators. Field wetland delineation methods are described by the U.S. Army Corps of Engineers (1987). This method produces very accurate results but is also the most laborious and expensive. While required for regulated activities within wetlands, field delineation is often unnecessary for other wetland management uses.

Aerial photography is another data type that can be used to determine wetland boundaries. This type of inventory requires a trained interpreter to define wetland boundaries based on features distinguishable to the human eye on aerial photographs. Problems and inconstancies may arise when multiple interpreters attempt to interpret the same photographs, as the accuracy of this method is determined by interpreter skill and experience (Baker, et al. 2006). A main disadvantage of aerial photograph interpretation is that inaccuracies are possible if the timing of the photography coincides with abnormal rainfall. (Ozesmi and Bauer, 2002). Harvey and Hill (2001) were able to achieve 90% accuracy when manually interpreting 14 land cover classes, including wetlands, in Australia using aerial photography (1:15,000 scale). The Minnesota Wetland Status and Trends Monitoring Program also relies on manual stereo-photo-interpretation and managed to achieve overall accuracies of 94% for wetland identification and 89% for wetland classification (Kloiber ,2010)

A third data type for mapping wetlands is remotely sensed satellite images. Use of satellite images has several advantages over aerial photography. Many satellites have sufficiently high temporal resolution to allow the acquisition of several images of the same location throughout a growing season. Satellites carrying sensors such as the Landsat Thematic Mapper (TM) allow for multispectral data collection at different wavelengths. The main disadvantage of satellite imagery is the lack of spatial resolution when compared to aerial photography. Harvey and Hill (2001) were unable to classify the same 14 land cover classes using satellite imagery that they were able to classify with aerial photography. An accuracy of 90% was achieved using satellite imagery only when the 14 classes were aggregated into three broader land cover classes.

1.2.1. Classification Methods

Several image classification methods have been developed and used historically to classify wetlands. No standard wetland classes are used, and target classes are often land-cover based and include types such as hardwood wetland, coniferous wetland, and herbaceous wetland. Henderson and Lewis (2008) point out inconsistencies in land cover definitions and, as an example, ask what percentage of canopy cover should be used to discriminate between open water and flooded forest. Specificity of wetland classes varies with classification goals and quality of input data.

The traditional and most commonly used classification method is an unsupervised classification of TM imagery (Ozesmi and Bauer, 2002; Sader et al., 1995). Although recognized as the least accurate method, unsupervised classification is often applied due to its elimination of time consuming training steps.

Hybrid classifications, described by Jensen (2005), combine unsupervised clusters with supervised training sets of known land cover. The training phase involves defining spectral signatures of known land cover and then incorporating those signatures into a classification model.

Another classification method uses TM derivatives to discriminate image texture. Vegetation indices such as the normalized difference vegetation index (NDVI), the TM Band 4:5 ratio, and the TM tasseled-cap model are used as textural information to further discriminate wetlands, particularly forested wetlands (Wright and Gallant, 2007; Hodgson et al., 1987).

Several researchers (Wright and Gallant, 2007; Sader et al., 1995) report a decrease in overall error when additional predictors are added to TM imagery classification. Wright and Gallant (2007) report an overall accuracy of 92.2% when discriminating palustrine wetlands from uplands. They further classified

the palustrine wetlands into five Cowardin types (aquatic bed, emergent, forested, scrub shrub, and unconsolidated shore) with an overall accuracy of 83%, consistent across 7 years of data. Sader et al. (1995) classified four land cover classes at two locations in Maine, and reported overall accuracies of 72% and 74% for unsupervised classification of TM imagery, 74% and 75% for unsupervised classification of the tasseled-cap transformation, and 81% and 78% for the hybrid classification (but with decreased producer's accuracy).

In addition to automated processes, visual interpretation of imagery can be a useful element in the classification process. Harvey and Hill (2001) reported that these semi-automated maps produced 9% more accurate results than completely automated approaches. Islam, et al. (2008) compared automated and semi-automated techniques and found that automated techniques using ETM+ imagery, Shuttle Radar Topography Mission (SRTM) data, and topography derivatives produced unacceptable results, while the use of semi-automated techniques produced 87% accuracy in distinguishing 15 wetland classes. However, the study was limited by the use of low resolution (90m) topographic data in automated classification. While shown to improve classification accuracy, the use of human interpreters introduces potential biases and inconsistencies into the classification process and certain training and methodological techniques must be utilized to prevent bias from affecting experimental results.

1.2.2. Multitemporal Data

Confusion between upland and wetland forested habitats is consistently reported when performing land cover classification based on one image (Lunetta and Balogh, 1999; Wang, 1998; Townsend and Walsh, 2001). Accuracy improvements in mapping of wetland habitats, especially forested wetlands, can be achieved using multiple dates of imagery collected throughout a growing season. This technique provides images of the same location with distinguishing features, such as canopy cover, biomass, and soil moisture, in various states.

Wolter et al. (1995) reported good results differentiating tree species in northwest Wisconsin using multitemporal data. Using five images, collected May through February in varying years, the author was able to achieve species level classification with an accuracy of 80.1%. Accuracy for Anderson Level II (hardwood, conifer, mixed) was 93.6%. Overall accuracy for 22 forest types was 83.2%. Successfully classified species included quaking aspen, sugar maple, northern red oak, northern pin oak, and tamarack (Wolter et al. 1995). Lunetta and Balogh (1999) compared single date to two date classification in wetland identification. Two dates of Landsat 5 TM data, leaf-on imagery to differentiate land cover types and spring leaf-off data to identify areas exhibiting wetland hydrology, produced an accuracy of 88% compared to 69% for single date. Wang (1998) reported an accuracy improvement in land cover classification from 51% with a single date image to 85% with multiple dates using JERS imagery. Likewise, Costa (2004) reported 93% accuracy for floodplain forest classification using JERS-1 and Radarsat-1 data collected throughout the wet season in the Amazon, with a drop in accuracy to 59% if only the one image was used during the first month of the dry season. However, Arzandeh and Wang (2003) reported that single date, single polarization, JERS imagery can be useful in delineating wetlands from non-wetlands, citing 88% accuracy in a study conducted in Ontario.

Townsend and Walsh (2001) combined multispectral and multitemporal techniques as they mapped wetland plant communities in North Carolina. Twenty-one forested communities were distinguished using Landsat TM data from three seasons (March-April, May-June, and July-August) in a single year. A hierarchical classification scheme was developed using feature sets from TM bands and their

combinations (NDVI, TM5/TM4). The authors report overall accuracy of 92.1% using discrete classification. When fuzzy class relationships were considered, accuracy increased to 96.6%.

1.2.3. Hyperspectral Data

Sensors such as the Airborne Visible/Infrared Imaging Spectrometer (AVIRIS) collect hyperspectral data in 224 spectral bands allowing for discrimination of individual species from images (Hirano et al. 2003).

Neuenschwander et al. (1998) used AVIRIS data to map coastal wetlands in Florida. The authors reported increased accuracy of identification of wetland vegetation (ranging from 85.0% to 93.5%, depending on classifier) when compared to using Landsat TM multispectral data. However, wetlands and uplands were separated based on biomass (NDVI). Willow swamps and forested swamps were included as uplands due to their high biomass. In addition, only 12 vegetative communities (upland and wetland) were distinguished, leading to high accuracy (Neuenschwander et al. 1998).

Hirano et al. (2003) mapped wetland vegetative communities in the Everglades National Park with hyperspectral AVIRIS data. Using only pure pixels from training sites established by manually interpreted CIR aerial photographs, the authors were able to distinguish 133 unique vegetative classes, which were compressed into 23 classes based on dominant vegetation. Accuracies varied between 40% and 100%, with an overall accuracy of 65.7%. Accuracy was limited by relatively poor spatial resolution (20m). Other reported problems with hyperspectral data are data volume and complex data pre-processing techniques (Hirano et al. 2003).

Becker et al. (2005) attempted to reduce hyperspectral data volume by isolating optimal spectral bands for use in mapping coastal wetland vegetation in the Great Lake region. The authors were able to isolate eight spectral bands that contained information enough to distinguish the regional vegetation. However, these spectral bands are specific to the coastal vegetative plant communities in the Great Lakes region. Becker et al. (2007) used seven of these eight spectral bands to classify wetland vegetation. Tests were also conducted to determine optimal spatial resolution. The greatest accuracy was reported with spatial resolution less than 2m. An overall accuracy of 86.3% was reported for the 7-band combination at under 2m resolution (Becker, et al. 2007).

1.2.4. Radar Imagery

Most of the focus of remote sensing of wetlands has been on sensors operating in the optical and infrared range of the electromagnetic spectrum, the limitations of which have been noted (Ozesmi and Bauer, 2002). Unlike optical sensors, radar sensors are unique in that they operate in the microwave portion of the electromagnetic spectrum and are insensitive to atmospheric conditions (e.g. cloud cover) and low light conditions, and can therefore offer more consistent multi-temporal images. Radar backscatter is sensitive to soil and vegetation moisture properties and can, to some degree, penetrate the forest canopy and provide sub-canopy vegetation and soil saturation information (Whitcomb et al., 2007; Henderson and Lewis, 2008). Because radar is sensitive to texture, techniques using inferometric analysis of radar data can identify changes in water levels down to the centimeter (Wdowinski, 2007).

Radar antennas can transmit radar waves of varying wavelengths. Common radar bands are C-band, L-band, and P-band, in order of increasing wavelength. Longer wavelengths tend to penetrate much farther into the forest canopy, thus providing a backscatter signal that conveys information about sub-canopy vegetation and moisture conditions (Whitcomb et al., 2007). Woody wetlands have high

backscatter and appear white, and are often confused with urban areas, while herbaceous wetlands have less backscatter and appear darker (Wdowinski, 2007). Wang (1995) used C-band, L-band, and P-band radar and found that high leaf area indices had an effect on C-band radar only, not L-band or P-band. Thus, L-band radar is significantly better at detecting flooded forests with intact canopy cover than C-band (Kasischke, 1997; Rosenqvist et al., 2004; Hess et al., 2003). Conversely, C-band radar is better at identifying herbaceous wetlands (Henderson and Lewis, 2008).

Radar waves can be sent and received at similar or dissimilar polarizations. Similar polarizations (HH, VV) are reported as useful in discriminating forested wetland/non-wetland by providing better image contrast than cross-polarization (HV), whereas cross-polarizations were preferable when distinguishing between forested swamps and herbaceous marshes (Hess et al., 1990; Hess et al., 1995).

Multiple studies report that a combination of C-band and L-band radar, as well as mixed polarizations, significantly increased accuracy of wetland/non-wetland discrimination and wetland vegetation classification (Hess et al., 1990; Hess et al., 1995; Dobson, 1995; Whitcomb et al., 2007; Henderson and Lewis, 2008). Henderson and Lewis (2008) wrote that cross-polarized imagery can be as valuable as single-polarized, multitemporal imagery. Studies also found that vegetation information is enhanced by using multitemporal and cross-polarized imagery and reported land cover accuracies above 90% when using SAR imagery (Kasischke, 1997; Dobson, 1995). Lozano-Garcia and Hoffer (1993) reported increased accuracy in land cover classification when they combined SIR-B data with Landsat TM data.

Whitcomb et al. (2007) used JERS to collect two seasons of L-band SAR imagery to produce a wetland map throughout the state of Alaska. Ancillary data sets including DEM (66m spatial resolution), map of open water, and latitude were included in the classification model. The Random Forests decision tree algorithm (Breiman, 2001) was used as a classifier. Nine wetland classes were aggregated which roughly correlated to the U.S. Fish and Wildlife Service's Circular 39 wetland classification (Shaw and Fredine, 2971). The authors reported accuracies ranging from 69.5% to 95%, depending on wetland class, with an overall accuracy of 89.5%. The NWI map for Alaska was used as test data set in the accuracy assessment. The authors suggest L-band in combination with C-band SAR will better distinguish between emergent wetland types (Whitcomb et al. 2007).

Henderson and Lewis (2008) provide the most recent review of usage of radar data to detect and classify wetlands. They reported that distinguishing wetlands and non-wetlands is consistently done with higher accuracy than discriminating wetland vegetative species. However, they noted that when mapping wetland species, most of the confusion is between wetland types and not between wetland and non-wetland vegetation. (Henderson and Lewis, 2008).

1.2.5. Ancillary Data Sets

In addition to imagery, ancillary data sets may be used to derive valuable information. Digital elevation models (DEM) are most commonly used, from which can be derived a number of applicable datasets including slope, flow accumulation, and probability of soil wetness. Digital soil surveys such as the Soil Survey Geographic (SSURGO) product from the Natural Resources Conservation Service (NRCS) are also used to highlight areas of mapped hydric soils. GIS data sets are integrated into classification models using rule based classification or decision trees. Bolstad and Lillesand (1992) reported land-cover classification accuracy 16% higher (73-89%) for a GIS rule-based model incorporating TM imagery, soils, and terrain data than for traditional maximum likelihood TM imagery classification.

Creed et al. (2003) investigated optimal DEM spatial resolution and source while locating "cryptic wetlands" (i.e. "closed canopy wetlands with no distinct wetland-specific canopy species, as indicated by analysis of aerial photography and/or satellite images") to determine their effects on dissolved organic carbon. LiDAR was found to be better at discriminating wetlands when compared to field based delineations ($r^2 = 0.98$, $p<0.001$) than photogrammetric based DEMs. Comparisons of ability of automatically derived wetlands from scaled DEMs to manually derived wetlands were found to be significant up to 100m ($p<0.05$) with 5m, 10m, and 25m showing the greatest strength ($r^2 = 0.98$, $r^2 = 0.97$, $r^2 = 0.99$; $p<0.001$) of correlation. Similarly, Thompson et al. (2001) attempted to predict the depth of the soil A-horizon using 10m and 30m DEMs and noted that, while differences in DEM resolution affect model coefficients and the DN values of terrain derivatives, each displayed similar capabilities in prediction A-horizon depth.

Murphy et al. (2007) compared vector based wetland polygons derived from manual aerial photography interpretation and wetlands areas in New Brunswick, Canada modeled using a depth-to-water index. The depth-to-water index uses the compound topographic index (CTI) and correlates the CTI value with depth to groundwater to determine wet areas. The authors report 51% - 67% of discrete wet areas are within the 0-10cm depth-to-groundwater class. The continuous (raster) depth-to-groundwater layer was derived from DEM with 70m grid spacing and used the D8 flow direction algorithm. The authors note that an improvement in DEM spatial resolution may increase accuracy, and that smaller (<1ha) wetlands were likely missed. Authors also point out that raised bogs characterized by a higher elevation due to accumulation of peat are sources of error when using derivations of elevation data to determine likeliness of saturation (Murphy et al., 2007).

Hogg and Todd (2007) also used DEM data and compared the effectiveness of several delineation methods in distinguishing several wetland types (marsh, swamp, bog, fen, etc). Many DEM derivations were calculated, and the CTI (using the D-infinity algorithm) and the positive balance hydraulic slope (PMNB) were determined to be the best at distinguishing wetlands and threshold values were established for input into a classification and regression tree (CART). The authors compared several statistical methods and found the CART to be the most accurate, reporting results of 90% calibration accuracy and 84% validation accuracy. The authors stress the usefulness of terrain data above optical data because its delineations of wetland boundaries are easily repeatable; however, unlike optical data it lacks sensitive wetland mapping triggers such as observable moisture (Hogg and Todd, 2007; Lang and McCarty, 2009)

Baker et al. (2006) used Landsat ETM+ data from May and September to classify land cover and wetland/riparian systems in Montana. Multitemporal images were used only to assess changing hydrology throughout the growing season and were not used to classify vegetation. Ancillary data included a 30m DEM and hydric soils maps. Authors compared accuracy of Classification Tree Analysis (CTA) and Stochastic Gradient Boosting (SGB) classifiers and reported an overall accuracy of 73.1% with the CTA and 86.0% with the SGB (Baker et al. 2006).

Li and Chen (2005) present an easily comparable analysis between assessment methods. The authors used multiple dates of DEM, Landsat ETM+, as well as Radarsat-1/SAR data and a rule-based classification method to distinguish between bogs, fens, swamps, marshes, and shallow water habitats in eastern Canada. Authors report accuracy of 71% to 92%, depending on wetland type, compared to traditional methods using ETM+ alone (24-89%) and ETM+ and SAR in combination (78-85%). The rule-based method is presented in a clear, stepwise manner. The authors also report that the addition of radar data to optical data helped delineate shrub/tree wetlands from shrub/forest upland, but it may

have had a negative effect on the overall land cover classification accuracy from the introduction of speckle and noise.

In summary, while numerous approaches have been used in wetland mapping, there is no universally applicable method. The choice of data source and mapping method is governed by the types of wetlands being mapped and the desired level of thematic detail. The following sections of this document describe mapping method experiments conducted using Minnesota's wetlands.

2. Methods/Results

2.1. Wetland Mapping using Terrain Indices

2.1.1. Terrain Indices Introduction

Recent technological advances have allowed the acquisition of elevation data at higher resolutions than ever before. With this new data (i.e. LIDAR) comes opportunities to derive more accurate topographic attributes for landscapes. A Digital Elevation Model (DEM) provides the base data to calculate catchment area, upslope area, slope, aspect, and secondary information such as terrain indices. Terrain indices such as the Compound Topographic Index (CTI) and Slope Cost-Distance Index (SCDI) are indicators of the expected "wetness" of an area based on the amount and direction of surface water flow (Blyth et al., 2004; Guntner et al., 2004; Moore et al., 1991). Such terrain indices can identify parts of the landscape where sufficient wetness could be present to allow the formation of wetlands. Therefore, topographic information can assist in mapping depressional and flat areas that may contain wetlands. This information can provide more accurate and timely wetland maps than the current Minnesota National Wetlands Inventory (NWI), which is of limited utility because of the scale of the aerial photos used to do the mapping and the significant changes that have occurred since the maps were created. As a consequence, there is a great need to update wetlands maps with more accurate boundaries, better type classifications, and improved delineation of smaller wetlands.

In this study, four approaches were evaluated to determine how topographic data can assist with wetland mapping in Minnesota. The first and second approaches involved assessing the effectiveness of two topographic indices: CTI and SCDI derived from a 3m resolution DEM. The third approach evaluated the resolution sensitivity of the CTI and SCDI created from 9 m, 12 m, 24 m, and 33 m LiDAR DEMs; the 10 m National Elevation Data; and a 30 m USGS DEM. The fourth approach evaluated combining CTI, aerial imagery, and soil data to map wetlands. The goal of this evaluation is to identify methods to increase the accuracy and decrease the cost of mapping wetlands.

2.1.2. Terrain Indices Methods

The study area for this project was the city of Chanhassen in Carver County, Minnesota. This area was chosen because it represents the range of Minnesota Metro area wetland types and because high quality field reference data was available for this area. Spatial data development, manipulation, and analysis were completed using ESRI's ArcGIS 9.3 with the Spatial Analyst, 3-D Analyst, and TauDEM (Terrain Analysis Using Digital Elevation Models) tools. All data sets were projected to UTM Zone 15N, NAD83. The following data sets were used in this study:

I. Hydrographic Datasets

a. DNR 24K streams
b. DNR 24K lakes
c. USFWS National Wetland Inventory
d. City of Chanhassen Wetland Inventory (August 2006, data collected using GPS equipment in 2004-2005)

II. Topographic Datasets
a. LIDAR elevation data: 3m DEM
b. NED elevation data: 10 m DEM
c. USGS elevation data: 30 m DEM

III. Aerial Photography
a. U.S. Department of Agriculture's National Agriculture Imagery Program (NAIP), 1-meter resolution, 2008 digital images with four bands: red, green, blue, color-infrared (CIR)

IV. Soil Survey Geographic (SSURGO) Database
a. Hydric Soils
b. Very poorly drained

2.1.2.1. Approach 1 – Compound Topographic Index (CTI)

The CTI is an indicator of potential saturated and unsaturated areas within a catchment area (e.g. a watershed). The CTI is the natural log (ln) of the ratio of the Specific Catchment Area (As) expressed as m^2 per unit width orthogonal to the flow direction divided by the tangent of the slope (β). Thus, CTI = ln [(As)/ (Tan (β)]. For comparison purposes, two types of CTI were created for the city of Chanhassen; one was created using the D-8 flow modeling approach and the other one using the D-Infinity (D-inf) flow modeling approach.

Prior to calculating the CTIs the 3m LiDAR, 10 m NED and 30 m USGS DEM were clipped to the boundary of the city of Chanhassen. The following steps were performed to create the two types of CTI:

Step 1 - DEM Reconditioning and Fill Sinks

Elevation irregularities (e.g. erroneous sinks and peaks) that could interfere with the correct hydrologic flow were removed using the ArcHydro and TauDEM tools. A hydrology layer was used to burn in streams to the DEM. Road berm dams were manually corrected in situations where they appeared to affect water flow.

Step 2 - Flow Direction

After removing elevation irregularities, the next step was to create a flow direction grid for each DEM, one using the D-8 method and the other using the D- inf method. The D8 method is limited to one of eight directions and assumes that flow is limited to one cardinal direction and one of two specific widths, routing the flow from one cell to a single neighbor. This has the effect of representing convergent flow (multiple cells flowing to a single cell), while stopping the representation of divergent flow (a single cell flowing to multiple cells). In the real world, flow most likely diverges and converges at different places and periods.

The D-inf algorithm assigns a flow direction based on the steepest slope on a triangular facet by constructing facet from the DEM (Tarboton 1997, Douglas 1986). This method is capable of creating a multi-directional flow, representing a divergent flow. D-inf offers an alternative method of calculating slopes, flow directions, and contributing area through the accumulation of converging and diverging flow directions.

Step 3 - Contributing Area

A watershed is the upslope area contributing flow to a given location. This area is also referred sometimes as a basin, catchment, or contributing area. A contributing area grid was delineated for each algorithm method. In the ArcHydro tool this was done using the D-8 flow direction grid. Alternatively, in TauDEM tool the D-inf algorithm approach was taken to calculate the contributing area. This gives a contributing area grid evaluated by accumulating the area or weight loading upslope of each location.

Step 4 - Specific Catchment Area (As)

Specific Catchment Area is a raster grid representing upslope contributing area. A specific catchment area grid was created for each approach. This is measured in specific catchment area units, i.e. area per unit contour width, using grid cell as the unit width and grid cell size squared as grid cell area.

Step 5 - Slope Grid

The slope grid is a raster grid representing change in elevation between adjacent pixels. A slope grid was derived directly from the DEM and a minimum value of 0.0001 was imposed on the resulting calculated slope to avoid division by zero for future CTI calculations. This was created using the raster calculator from Spatial Analyst extension: Slope grid + 0.001

Step 6 - Map Algebra – CTI Calculation

Once all the required grids were created (Specific catchment area and Slope), the raster calculator from Spatial Analyst extension was used to calculate the CTI using the CTI equation: CTI: Ln [(As)/ (Tan (β)], where As is the specific catchment area expressed as m^2 per unit width orthogonal to the flow direction and β is the tangent of the slope in Radians.

Step 7 - Low Pass Filter Operation

A low pass filter was used for each type of CTI created to reduce the significance of anomalous cells.

2.1.2.2. Approach 2 – Slope Cost-Distance Index (SCDI)

The SCDI calculates for each cell the least accumulative cost to specified location. This is a function of the drainage line and slope grid. The first five steps of the computation of the SCDI are the same as those for the CTI. The following additional steps were performed.

Step 6 - Stream Definition

The stream definition function from ArcHydro was used to extract cells with flow accumulation grid values above a certain threshold. This threshold was defined as a number of cells, for this study a 1% area threshold was used.

Step 7 - Stream Segmentation
The stream segmentation function from ArcHydro was used to break up the streams into head segments and joint segments.

Step 8 - Drainage Line Processing
This function from ArcHydro was used to convert the stream segmentation grid into a vector layer.

Step 9 - Spatial Analyst Calculation to obtain the Slope Cost-Distance Index
The Cost-Distance function from Spatial Analyst tool was used to create the SCDI. This function finds the path of least resistance in which water is assumed to flow. The drainage network vector layer (Drainage Line) was used as an input direction and the slope grid was used as the cost grid. Since, the SCDI is a comparative function rather than a calculated function like the CTI, absolute values of slope do not matter and degrees or percentage are acceptable as units.

2.1.2.3. Approach 3 – CTI & SCDI Resolution Sensitivity

To assess the resolution sensitivity of the CTI & SCDI the 3 m LiDAR DEM was degraded to 9, 12, 24, and 33 meters. This degradation process was done using the degrade tool from ERDAS IMAGE 9.3. This tool uses an average pixel method to make up the new larger pixels. Once all the new DEMs were created, the next step was to proceed with the creation and evaluation of the CTI & SCDI for each DEM.

2.1.2.4. Approach 4 – Use of CTI, NDVI & Soils Data to Identify Wetlands

Three data sets were used to develop this approach. The first data set was the CTI layer previously explained, the second was the soil layer obtained from Soil Survey Geographic (SSURGO) extracting only the hydric and very poorly drained soils were used, and the third was the NAIP imagery 2008.

For the NAIP imagery, a Normalized Difference Vegetation Index (NDVI) was calculated, NDVI = (NIR – RED) / (NIR + RED), where NIR represent the near infrared band and RED represent the red band. This is a numerical indicator of the amount of live green vegetation in an image pixel. The purpose of the NDVI in this analysis was to exclude areas that are topographically suitable for wetlands but contain non-vegetated or impervious cover. A threshold of less or equal to 0.18 NDVI was used. Anything less or equal to this value was considered to be impervious, and anything greater than this value was considered to be vegetation. The NDVI was calculated from the NAIP imagery (2008), using band 4 = NIR and band 1 = Red. A hydrology layer was used to ensure that open water such as lakes and rivers was not removed due to its low NDVI.

Boolean and Arithmetic Steps

Once the CTI, NDVI, and soil layer were ready, boolean and arithmetic steps were used to determine whether each pixel was considered to be wetland or upland. The following steps were performed to combine these three layers.

1) **Reclassification of CTI values:** Based on threshold values, the CTI was reclassified either as wet represented by number 1 or dry represented by number 0. Any value greater or equal than the mean + ½ standard deviation of the CTI values was reclassified as wet (1), the rest was considered dry (0).
   Output = *CTI_R* (new CTI reclassified layer)

2) **Reclassification of NDVI values**
   Based on threshold values the NDVI was reclassified either as vegetated or non-vegetated. In this model the number 0 was assigned to all the values representing non-vegetated, which in this model represented upland. Threshold < = 0.18 = Impervious (0); Output = *NDVI_R* (new NDVI reclassified layer)

3) **Reclassification of Soil values**
   For the reclassification of soil values the Hydric soil + Very Poorly Drained soils were converted from vector to raster, reclassified as wet, and assigned the value of 1, representing wetness.
   Output = *Soil_R* **(**new Soil reclassified layer)

4) **Raster Calculator:** this tool was used to create the first combination of NDVI and CTI in one layer. The following equation was used for this calculation:
   Equation 1: (*NDVI_R*) AND* (*CTI_R*) = *Input_A*

   * CAND is a logical tool from ArcGIS that performs a Combinatorial And operation on the cell values of two input rasters.

5) **Raster Calculator:** The second equation was the combination of the Input_A (NDVI + CTI) and the soil layer
   Equation 2
   (*Input_A*) AND (*Soil_R*) = *Input_B*

6) **Reclassification of Input_B grid:** This was the final step performed to reclassify the values from input_B, either as wet =1 or dry =0, which at the end the number 1 is translated as the potential pixel wetland value.
   1 = wet
   0 = Dry

2.1.2.5. Accuracy Assessment of the Four Approaches

A pixel by pixel accuracy assessment was carried out to evaluate the four approaches taken for the use of topographic data in identifying potential wetlands. This was done by comparing the results from each of the four approaches to a "boots-on-the-ground" wetland delineation for Chanhassen, MN. An error matrix which compares the reference class values to the assigned class values in a *c x c* matrix, where *c* is the number of classes was generated. In addition, an error matrix was created to provide summarize information on classification accuracy.

The following statistics were computed:

- Percent overall accuracy
- Error matrix
- User's accuracy (considers commission errors)

- Producer's accuracy (considers omission errors)

2.1.3. Terrain Indices Results

2.1.3.1. Study Area

Figures 1 and 2 show the city of Chanhassen geographic location and elevation data. The city of Chanhassen is located in the southwest metropolitan area of the Twin Cities of Minneapolis and St. Paul. While the bulk of Chanhassen is in Carver County, it also extends into Hennepin County. The City is approximately 23 square miles.

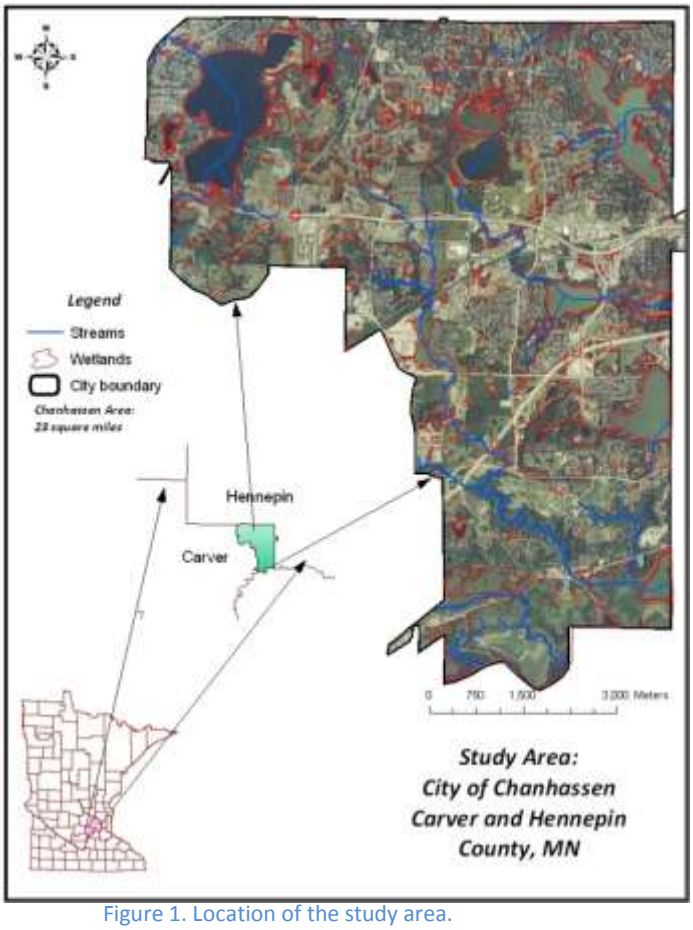


Figure 1. Location of the study area.

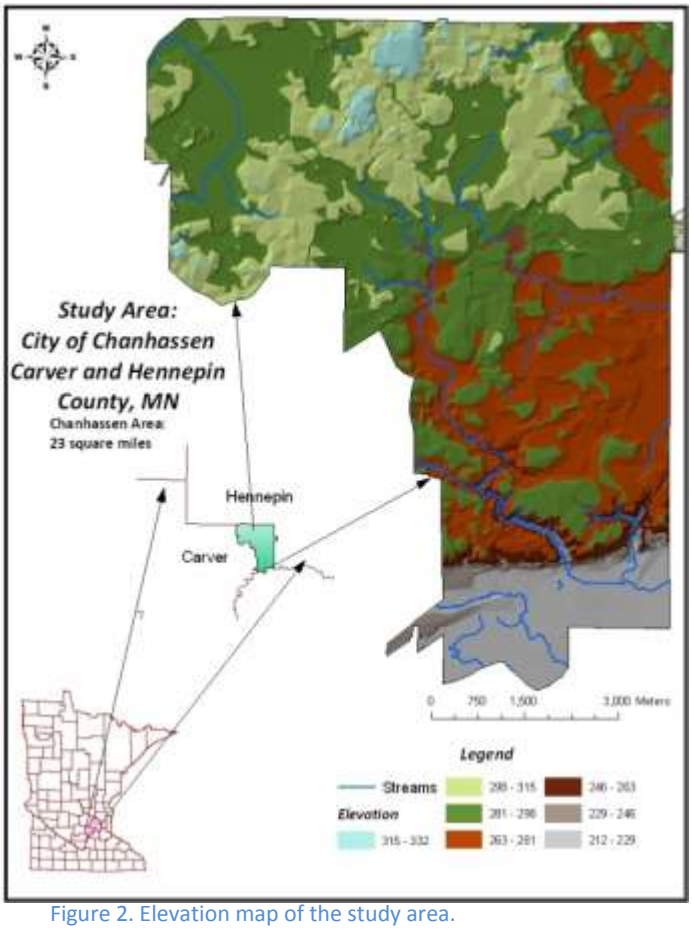


Figure 2. Elevation map of the study area.

2.1.3.2. Wetland Sizes in the Study Area

Table 1 shows the different size of wetlands existing in the city of Chanhassen. More than 60% of its wetlands are less than 1 acre. Only 7.7% are greater than 10 acres.

Table 1. Wetland size for the city of Chanhassen.

Acre Size	# of Wetlands	% of study area	Cumulative %
0.1 - 0.5	202	46.9	61.7
0.5 - 1	64	14.8	
1 - 2	61	14.2	75.9
2 - 3	27	6.3	
3 - 6	24	5.6	
6 - 10	20	4.6	92.3
10 - 25	14	3.2	
25 - 50	9	2.1	
50 - 70	2	0.5	
70 - 100	2	0.5	
100 - 150	3	0.7	
> = 150	3	0.7	
Total	431	100	

2.1.3.3. Comparison between the USFWS National Wetland Inventory (NWI) and the City of Chanhassen Wetland Inventory

Figures 3 and 4 show some of the problems of the USFWS NWI. Some of the problems represented in these figures are the significant changes that have occurred due to urban development in five years.

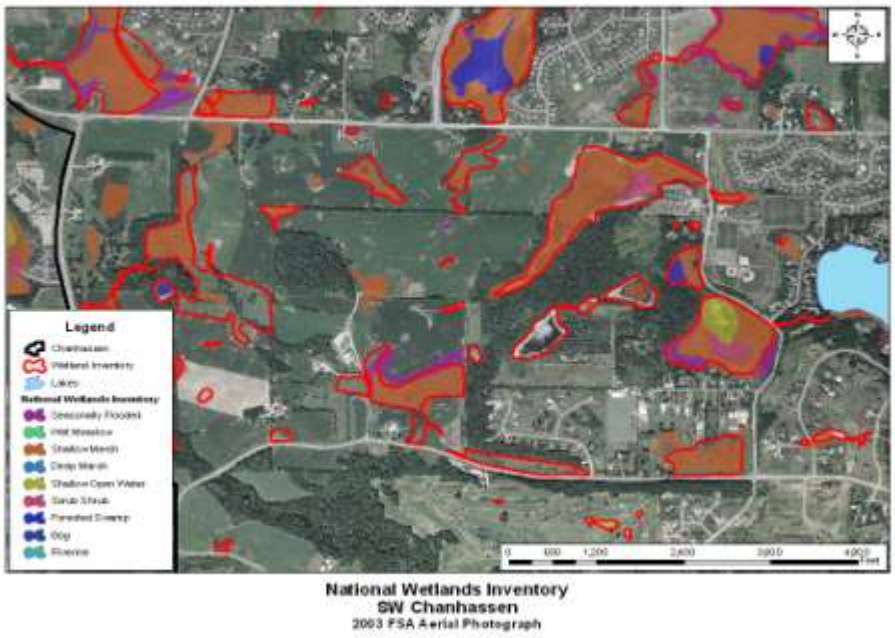


Figure 3. Comparison between the USFWS NWI and the City of Chanhassen Wetland Inventory on 2003 NAIP images.

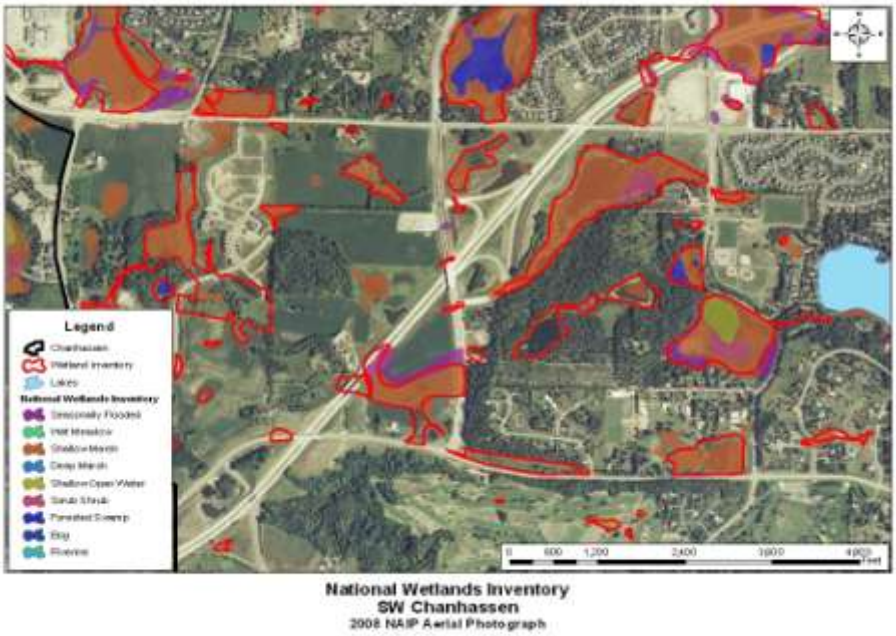


Figure 4. Comparison between the USFWS NWI and the City of Chanhassen Wetland Inventory on 2008 NAIP images.

2.1.3.4. Accuracy Assessment results for Approach 1 (CTI) and Approach 3 Resolution Sensitivity (CTI)

An accuracy assessment tool was used in ArcGIS 9.3 to generate an accuracy assessment report for each resolution. Table 2 shows the results of this evaluation. This table shows clearly that the best resolution for identifying potential wetlands was 24 m with the highest producer accuracy percentage compared to the 10 m NED and 30 m USGS DEM.

It is notable that the highest errors of omission (omitting wetlands) were for the CTI derived from the NED and USGS DEM (Figure 5). At the same type the LiDAR data presented some problems due to the amount of details in the 3 m resolution (Figure 6), causing that resolution to have the highest percentage of error of commission (classifying pixels as wet when they are not) compared to the rest of the derived resolutions.

Table 2. Accuracy assessment results for CTI using the D-inf algorithm and created for the 3, 9, 10, 12, 24, 30, 33 m resolution.

CTI – D-infinity algorithm			
CTI from DEM	**Overall Accuracy**	**Users Accuracy**	**Producers Accuracy**
3m	86	68	85
9m	88	72	88
12m	89	73	88
24m	90	76	87
33m	90	77	86
10 m NED	88	76	77
30 m (USGS)	84	74	69

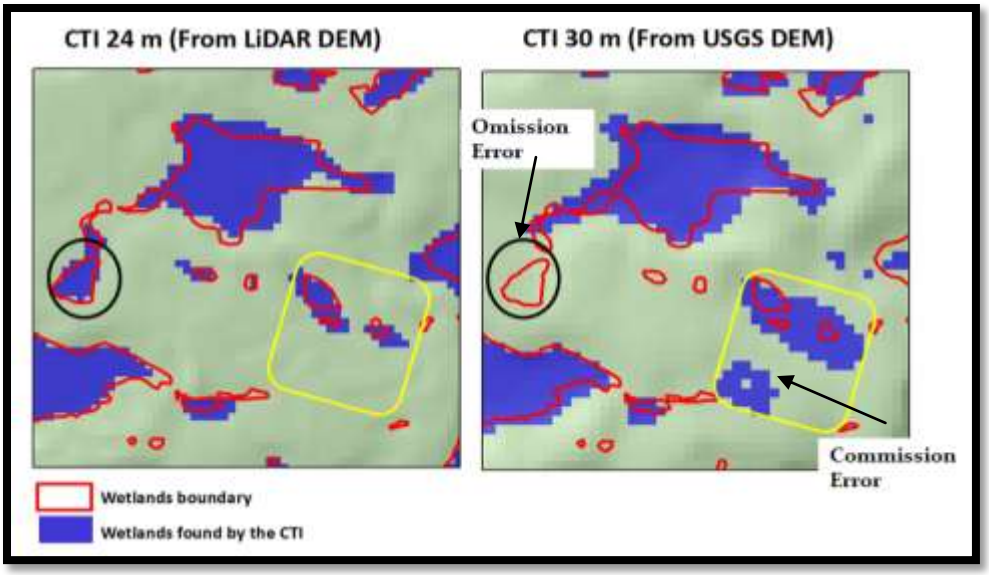


Figure 5. Comparisons between the CTI 24 m derived from LiDAR DEM & the CTI 30 m derived from the USGS DEM.

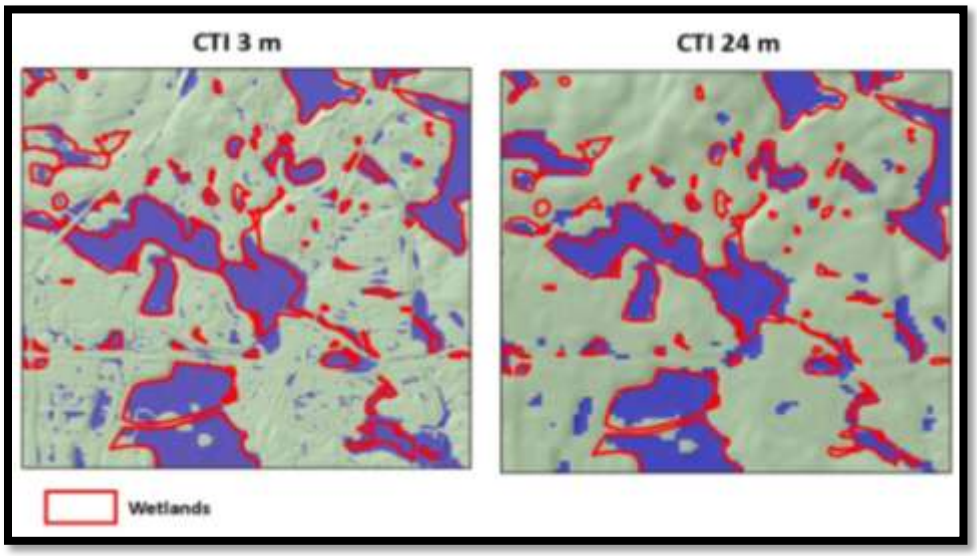


Figure 6. Comparisons between the CTI 3 m & CTI 24 m derived from LiDAR DEM.

2.1.3.5. Comparison between D-8 vs. D- infinity

The D-8 and D-infinity (D-inf) approaches were evaluated and the CTI was created for each method. Results (Table 3) indicate that both approaches have their benefits and disadvantages. Table 3 shows that the CTI derived from the D-inf approach has the highest producer's accuracy, which means the errors of omission are lower than those for the D-8 method. On the other hand the CTI derived from the D-8 approach has the highest user's accuracy, which means the errors of commission are less compared to the other approach. Figures 7 and 8 show the D-8 and D-inf CTI layers.

Table 3. Comparison between D-inf and D-8 algorithm method

CTI	DEM	Overall Accuracy	Users Accuracy	Producers Accuracy
CTI - D-Inf	24m	90	76	87
CTI- D-8	24m	90	83	77

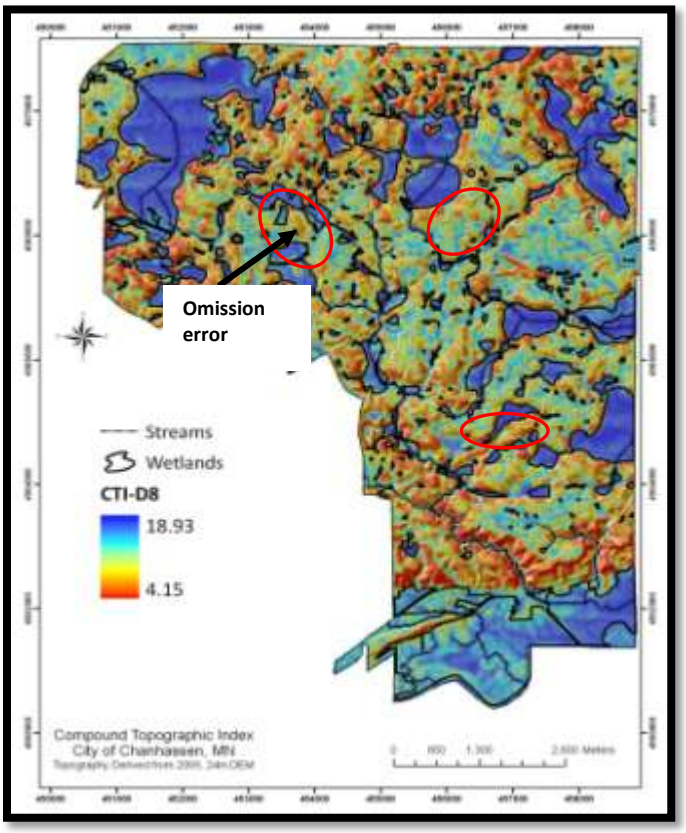


Figure 7. CTI 24 m derived from LiDAR DEM using the D-8 algorithm

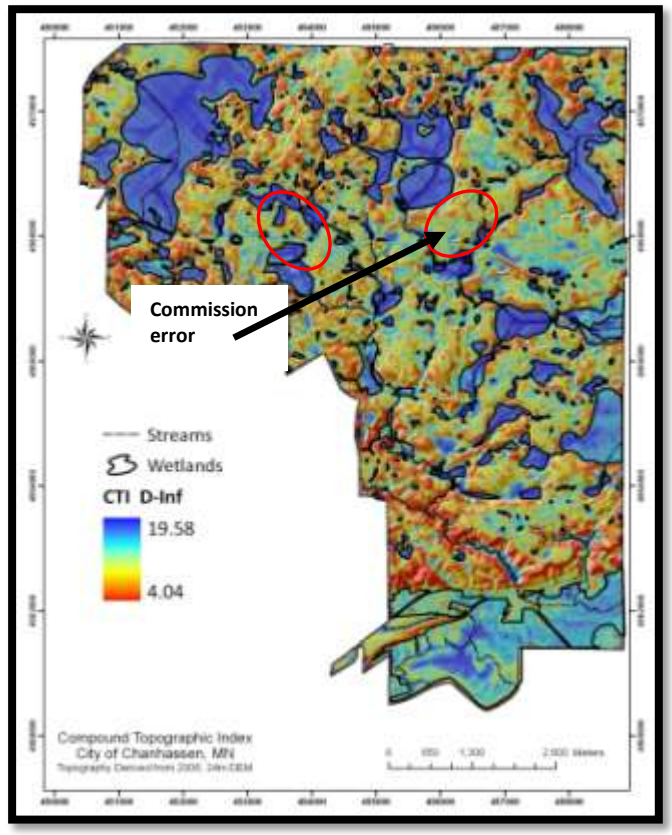


Figure 8. CTI 24 m derived from LiDAR DEM using the D-inf algorithm

2.1.3.6. Accuracy Assessment results for Approach 2 (SCDI) and Approach 3 Resolution Sensitivity (SCDI)

Table 4 shows the results for the accuracy totals for the SCDI. This table shows clearly that the highest overall accuracy and producer accuracy was for the SCDI derived from the 24m DEM. This indicates that resolution affects the efficiency of this index to identify potential wetlands (Figure 9).

Table 4. Accuracy assessment results for SCDI using the D-8 algorithm, created for the 3, 9, 12, 24, 33 m resolution.

SCDI			
DEM	**Overall Accuracy**	**Users Accuracy**	**Producers Accuracy**
3m	87	79	72
9m	88	77	81
12m	88	77	81
24m	88	76	82
33m	87	75	79

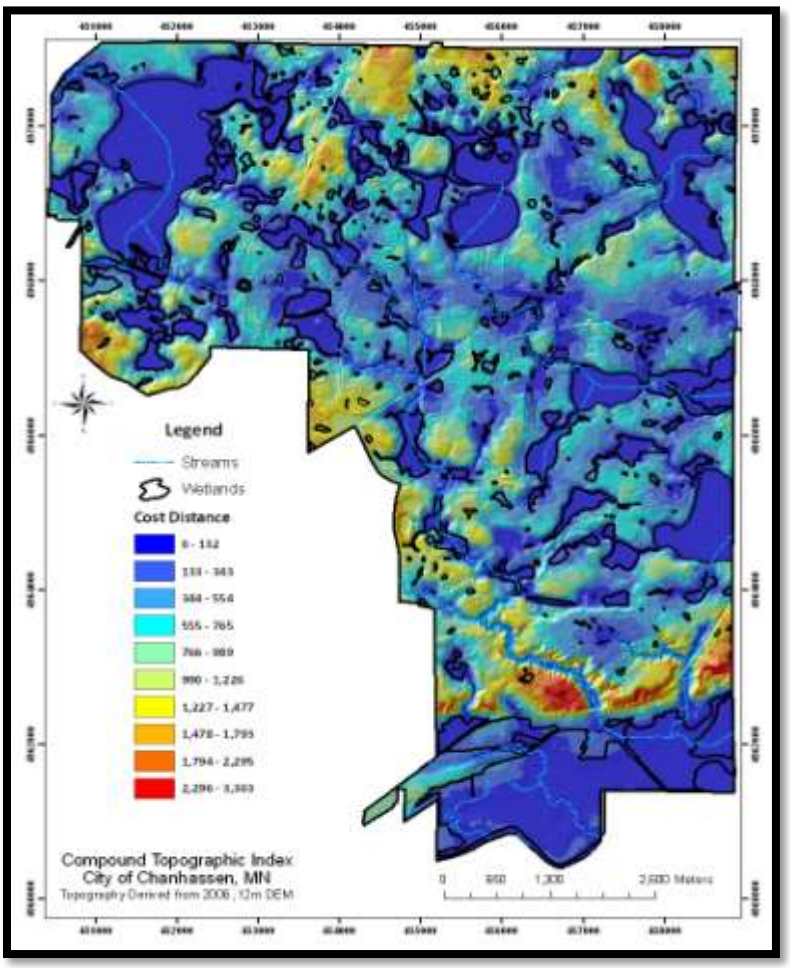


Figure 9. SCDI 24 m derived from LiDAR DEM using the D-8 algorithm

2.1.3.7. Results and accuracy assessment percentages for approach # 4 Combination of CTI, NDVI & Soil

Including the NDVI in the model improved the results by eliminating flat impervious surfaces, such as parking lots, from the wetland class predicted by the CTI alone (Figure 10 and 11). The NDVI values for image pixels containing buildings are low in Figure 10. In the NDVI shown in Figure 11, these areas are indicated as non-vegetated, and so are removed from consideration as potential wetlands, even if they are topographically suited to be wet.

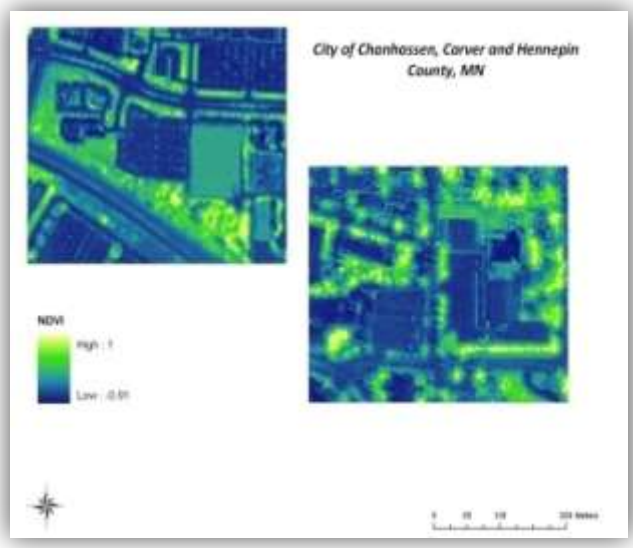


Figure 10. Low (wet) CTI values in impervious surface areas.

Figure 11. Areas removed from consideration as wetlands due to NDVI values.

Since the 24 m DEM provided the highest accuracy, for the combined model only the 24 m DEM was used. Table 5 shows the results of the inclusion of soil and NDVI data. The user's accuracy increased sharply when these data were added to the model. Figure 12 shows a graphical depiction of the benefits of using soils and NDVI data in wetlands mapping.

Table 5. Accuracy assessment results for the combination of CTI, NDVI & Soil for 24 m

Acres	Combinations	DEM	%Overall Accuracy	% User Accuracy	% Produser Accuracy
0.1 to 788	CTI	24m	90	76	87
0.1 to 788	CTI + NDVI + Soils	24m	92	82	86
>= to 1	CTI + NDVI + Soils	24m	92	82	89

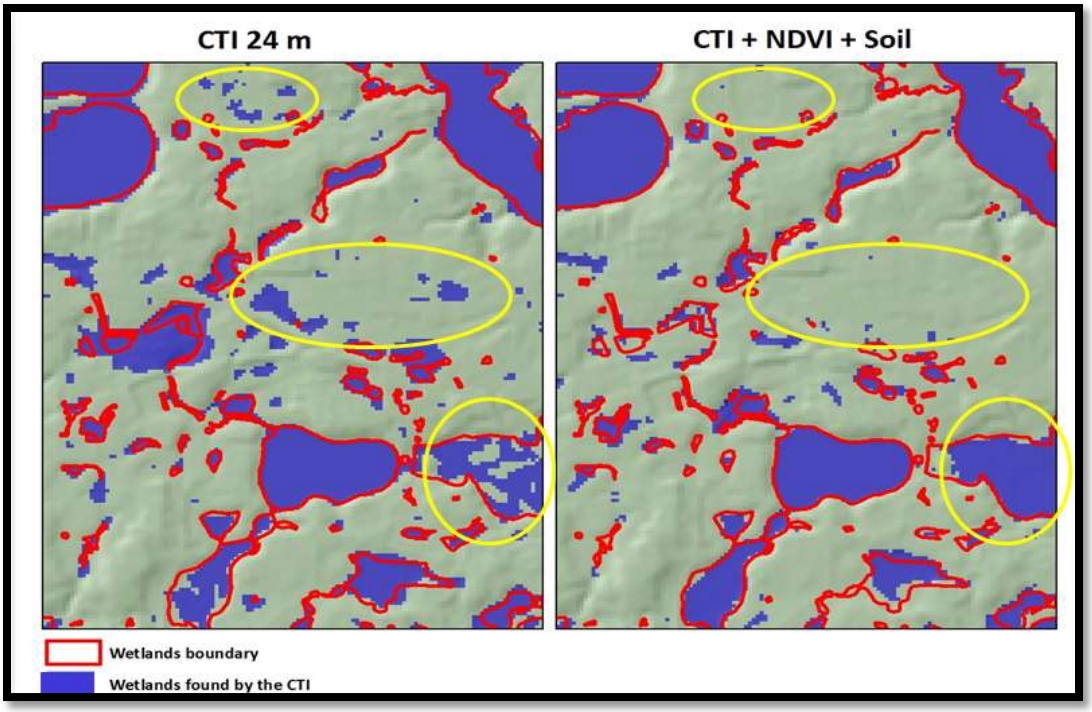


Figure 12. Comparison between CTI alone and the combination of the three layers.

2.1.4. Terrain Indices Discussion

A comparison of the two methods (D-8 and D-inf) show that both methods have similar overall accuracy results, nevertheless, there is a slight difference between the producer's and user's accuracy estimates for both methods.

The CTI/D-inf/LiDAR derived map is significantly more accurate in producer's accuracy (87%) compared to the CTI/D-8/LiDAR derived map (77 % producer's accuracy), and has a lower rate of wetland omissions (Table 3, Figure 8). On the other hand, the CTI/D-8/LiDAR derived map had a much lower 17% commission error and higher user's accuracy (83%) relative to the CTI/D-inf/LiDAR derived map (76% user's accuracy and 24% commission error), which means that this method is able to classify more pixels correctly as wetland compared to the D-inf. (Table 3, Figure 7).

There are a few general issues that are important to consider when using these methods. The TauDEM tool/D-inf method will only work with DEM grids smaller than 7000 * 7000 cells (approximately 100-miles by 100-miles with a 24-m resolution DEM) and it requires Windows 2000 or higher, plus ArcGIS 8.2 or higher version to run this tool. Alternatively, ArcHydro tool/D-8 method can work with any DEM grid size and works with any type of ArcGIS desktop version. Both tools are available to be run with an ArcGIS desktop version, with the only limitation for TauDEM tool regarding the DEM grid size.

We observed classification accuracies for the SCD/LiDAR derived maps (Table 4) that were similar to the CTI/LiDAR derived maps (Table 2).Omission errors were lower in the CTI/LiDAR derived maps relative to the other index. Thus, CTI surpasses SCD almost in every aspect such as better delineation boundaries and less wetlands omission (Figures 8, 9).

The SCD/LiDAR derived map also has some limitations such as the error of misclassifying many pixels as wet because of the method used to create this index. This index calculates water accumulation based in finding the path of least resistance in which water is assumed to flow based on a drainage line. This principle limits the potential of finding wetlands that are far away of a drainage line or streams. Thus, this may not be a good index to use in areas with a few streams or drainage lines.

LiDAR data proved useful in increasing classification accuracy in our study area, primarily in identifying wetland/upland types, local low areas in the terrain based on elevation differences and flow direction. (Figures 5, 6). For example the CTI/USGS derived map show higher errors of omission (Table 2, Figure 5) compared to the CTI/LiDAR derived maps. Simply replacing the USGS 30-meter DEM with a 24-m DEM derived from LiDAR significantly improved wetland identification from 84% overall accuracy to 90% overall accuracy .

High resolution images such as NAIP are useful for mapping wetlands, and are actually better than the aerial photographs used to create the original NWI. While mapping accuracies using terrain indices alone were reasonable (84 to 92%), accuracies improved when the CTI/LiDAR map was combined with the high resolution imagery (NDVI) and soil data (Table 5, Figure 13). Our result shows that errors of commissions were significantly reduced from 24% (CTI/LiDAR) to 18% (combination of CTI/LiDAR, NDVI, soils), while not significantly increasing omission error rates. This combination of data types better performance than using LiDAR data alone.

Based on these observations, we can infer that LiDAR data may help identify terrain features such as steep local gradients, the edges of flat areas, and delineation of a more accurate wetland/upland boundary. However, these terrain indexes may work better in conjunction with spectral data and other type of ancillary data such as soils type. Therefore, it is necessary to explore other types of LiDAR/ancillary data combinations to continue to improve accuracy in wetland boundary delineations. One possible option is the use of other algorithms such as decision trees or models that could automate the process of combining several layers (CTI, NDVI, soils) instead of the use of Boolean steps to create this type of combinations as was done in this study.

In terms of wide scale use, this method would be difficult to scale up to the entire state. Processing a state-wide DEM to compute CTI may present a significant computing challenge. Possible solutions include using migrating the processing to a supercomputer or tiling the study area.

2.1.5. Terrain Indices Conclusions

- CTI does better job than SCDI in finding potential wetlands.

- DEM resolution is an important factor affecting the potential use for mapping wetlands, but quality of the source data can also have a significant effect on results.

- There is a great need to obtain higher resolution elevation data such as LiDAR, because this type of data may offer better results in the development of terrain indices and hence the automation for finding wetlands using topographic data. In this study a LiDAR DEM outperforms a 30 m (USGS) in overall accuracy

- From the four approaches evaluated in this study the best approach to use for finding wetlands using a GIS approach is the combination of CTI + Soil +NDVI. This approach does better job than terrain indices alone.

- The use of topographic data in combination with other ancillary data allows for automated delineation of wetlands in a more accurate way.

2.2. Wetland Mapping using Object Oriented Algorithms

2.2.1. Introduction to Object-Oriented Classification

Supervised and unsupervised classification approaches in remote sensing assign each pixel to a known information class or cluster class without regard to location or spatial relationships. These per-pixel classifiers have no way to account for spatial patterns in the classes, nor any way to examine adjacent pixels in the image for similarities. In contrast, object-oriented classifications first group pixels into clusters of homogeneous pixels based on set maximum heterogeneity thresholds, and then classify those clusters based on their aggregated statistics rather than individual pixels. Also, because pixels are grouped prior to any analysis, object-oriented classifications help reduce image speckle (Hess et al, 2003), decrease the effects of shadows within an image, and eliminate the need for post-classification smoothing, since the use of image objects prevents the "salt and pepper" effect of per-pixel classifications.

Wetland vegetation is highly heterogeneous, both within a single wetland and among wetland classes, making discrimination between wetland classes difficult (Grenier et al, 2007; Fournier et al, 2007; Bruzzone and Carlin, 2006). In addition, wetlands have complex spatial arrangements often characterized by alternating patches of open water and vegetation interspersed throughout the wetland, which complicates the delineation of wetland patches as a contiguous whole. Because object-oriented methods are able to connect neighboring pixels, they are also the better choice for creating ecology-based classification rules and combining the ancillary environmental datasets that are best able to identify wetlands (Fournier et al, 2007; Grenier et al, 2007).

When using high spatial resolution imagery, as required by the Federal Geographic Data Commission (FDGC) wetland mapping standard, the spectral variability within each wetland class increases at the expense of between class variability (Bruzzone and Carlin, 2006; FGDC, 2008). Therefore, object-oriented methods are advantageous when attempting to identify and classify wetlands in accordance with the FGDC standard. For example, a pixel-based classification scheme identifying adjacent open water and forest wetland pixels would likely separate the two into separate classes due to their spectral differences. This is the most significant limitation of the pixel-based classifier's is its inability to view similarity and distance between pixels. For wetlands exhibiting high spatial patchiness or heterogeneity, accurate delineation and classification of the wetland as a whole depends on the ability to group adjacent pixels and to represent spectrally different patches within a single wetland polygon.

Object-oriented classifications require two steps. First, image segmentation, the prerequisite to object-oriented classification, divides an image into segments or pixel objects by merging adjacent pixels into statistically homogeneous groups (Fournier et al, 2007; Repaka et al, 2004). Variation within a segment is minimized using user-identified criteria, and any pixels beyond a set similarity threshold are merged into adjacent image segments. Each segment contains statistical attributes, including the internal pixels'

histogram and additional information derived from the image object such as texture, segment size and shape, and relationships to object super or sub-classes (Fournier et al, 2007; Hess et al, 2003; Repaka et al, 2004). Second, object-oriented classifications take advantage of the variety of available segment statistics in order to split the segments into information classes. Wetland segmentation could also integrate GIS and other ancillary data sources to identify the spatial extent of wetlands (Fournier et al, 2007; Huan and Zhang, 2008). Hess et al (2003) and Grenier et al (2007) both found segmentation to be highly accurate for partitioning wetland and non wetland areas (95% and 80% accuracy, respectively). This effort focuses only on image segmentation to facilitate wetland mapping and not automated object classification.

2.2.2. Segmentation Methodology

The segmentation parameter settings best attuned to wetland delineation depend greatly on the spatial and spectral resolution of the images to be segmented and the size of the features to be identified. Optimal settings would yield an image segmentation with polygons small enough to capture the smallest target features, yet large enough to prevent shadows from being isolated into individual polygons. Under the FGDC Wetland Mapping Standards, the primary imagery for wetland delineation and classification must have a spatial resolution of at least one meter or smaller, is recommended to include a color infrared band, and must identify 98% of wetlands larger than 0.5 acres or 2023.4 square meters (FGDC, 2008). To meet these requirements, all segmentation parameter trials were conducted with a subset of the USDA Farm Service Agency's one meter resolution color-infrared National Agricultural Imagery Program (NAIP) imagery.

We used a multi-resolution image segmentation algorithm (Definiens Professional Version 5) to test image segmentation for wetland mapping. Within the segmentation algorithm, four adjustable parameters can be used to adjust the size of the segmented polygons and determine how the segments are calculated (Figure 13). The scale parameter sets a limit on the heterogeneity within each segment. The higher the scale parameter is set, the more within-segment variation is allowed, and the larger the relative range of polygon sizes. Low scale parameter values (10-20) result in small image objects relative to the image pixel size, while large scale parameter values (100) result in very large super- objects than can be further broken down by successive segmentations. Though adjusting this parameter provides a fast way to create larger image objects, its purpose is to ensure that the pixels within each object are truly related; object size can be increased by merging adjacent segments together when necessary (Definiens AG, 2006).

The other three parameters determine the ratio of color or shape used to segment polygons and the degree of polygon compactness and smoothness imposed upon the polygons (Figure 13). A color and shape criterion identifies the relative importance of shape and spectral information used to create homogeneous segments. The total parameter must always equal 1, so when shape is maximized (0.9), color comprises only 0.1 of the calculation and when color is maximized (1), only color is used to calculate segment homogeneity. A balanced segmentation would utilize both shape and color at 0.5 to create segments. When the shape parameter is higher than zero, compactness and smoothness are invoked to set limits on long or narrow features as well as features with very rough boundaries, respectively (Definiens AG, 2006).

In addition, ancillary vector and raster data including GIS layers, actively sensed radar and LIDAR data, and additional remote sensing imagery at varied spatial resolutions can be integrated with the primary imagery during segmentation without resampling or degrading the ancillary data quality (Fournier et al,

2007; Huan and Zhang, 2008). It should be noted that while data with any spatial resolution can be input to a segmentation algorithm, pilot tests suggest that the spatial resolution of included ancillary data should be similar in resolution to the primary segmentation imagery. Tests using 24 meter CTI data resulted in very angular, polygonal boundaries between segments rather than the natural, smooth boundaries desired for wetland delineation (Figure 14). In Definiens Professional 5, ancillary data layers and primary imagery bands can also be weighted to allow certain layers a greater influence on the resulting segmentation. For example, RADAR and NDVI layers may provide key information for identifying forested wetlands, and could be weighted twice as high as accompanying infrared or green bands.

In the case of wetlands, image segment need enough internal variation to encompass spatially heterogeneous wetlands. For example, many wetland classes include patches of open water and vegetation that would be misclassified by a per-pixel classifier. The scale of the image segments should be large enough to include such patchiness within a single segment, which may also require creating multiple image segmentations with different scale and homogeneity parameters to accommodate wetland types with various amounts of internal patchiness or spatial heterogeneity (Fournier et al, 2007; Huan and Zhang, 2008; Grenier et al , 2007). In per-pixel classifiers, a vegetation patch can be identified reliably only when pixels fall within ½ to ¼ of the patch's size (Hunt et al, 2007). If the same logic also holds for identifying patches using image segments, then the 0.5 acre (2024 square meter) target wetland mapping unit can be identified by image segments covering at least 500-1000 square meters.

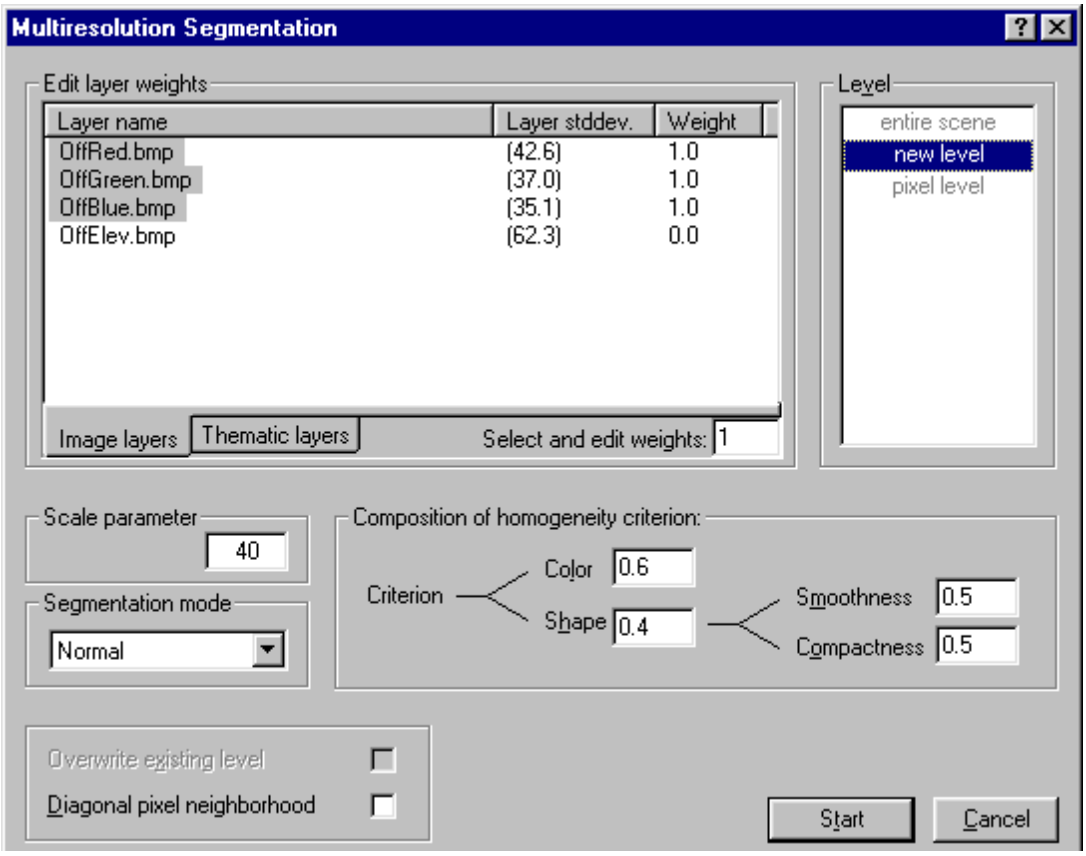


Figure 13. Multi-resolution segmentation dialog box from Definiens Professional 5. (From eCognition (aka, Definiens) basic training, URL http://www.rstc.msstate.edu/wfd/ecog/docs/course_material.pdf)

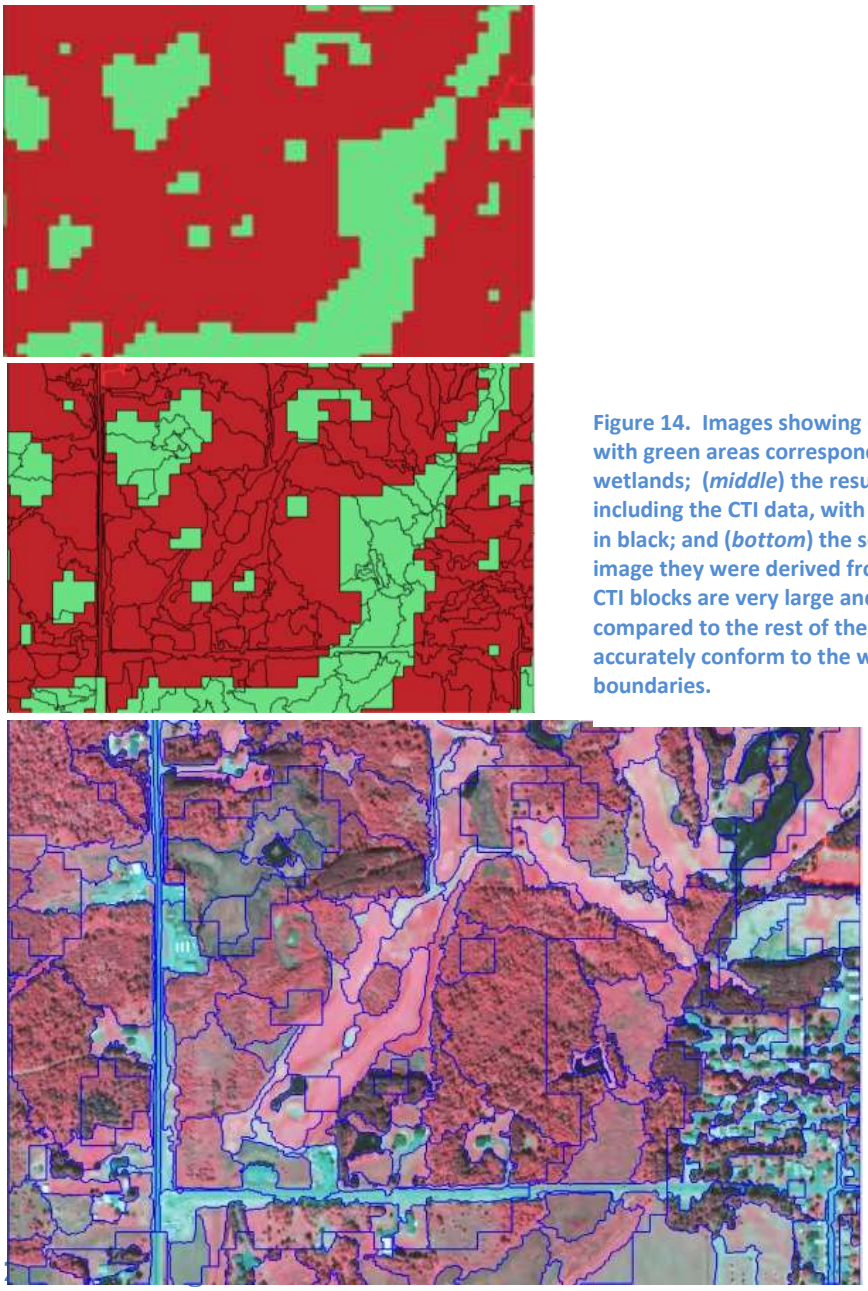


Figure 14. Images showing (*top*) the 24 meter CTI, with green areas corresponding to potential wetlands; (*middle*) the result of a segmentation including the CTI data, with each segment outlined in black; and (*bottom*) the segments shown with the image they were derived from. As you can see, the CTI blocks are very large and oddly shaped compared to the rest of the segments and do not accurately conform to the wetland's natural boundaries.

A series of segmentation trials were completed with a subset of the 2008 CIR NAIP imagery for Cloquet, Minnesota. Selected results showing the effects of the scale parameter value and the shape/color parameter on resulting image segmentations can be seen in Table 5 and Figure 15. As expected, the lowest scale parameter (10) created the largest number of image segments. This scale parameter was a poor choice for wetlands: the segments were more than five times smaller than the minimum wetland size and unnecessarily separated shadows as unique features. At the highest scale parameters (75-100), the opposite was true and segments included so much internal variation that visually distinct classes were aggregated. The optimal scale parameter (50) identified 2-4 times the number of segments as the 100 scale parameter, and 23 times less than the 10 scale parameters. It should be noted that due to a

random seed used during segmentation, even when repeated with the same imagery and the same parameters, will produce slightly different segment boundaries and a slightly different number of image objects. The differences get more pronounced as segment size (scale parameter value) decreases, so that at a scale of 100, the segment boundaries are nearly identical and at a scale of 50, only 36% of image objects remain identical.

Shape and color parameter combinations tested with the 50 scale parameter value are also shown in Table 5 and Figure 15. The most highly shape-dependent segmentation scheme (shape .9, color .1) was almost entirely calculated based on shape, resulting in very compact polygons with few long or narrow areas identified only when extremely spectrally unique (such as the roads in Figure 15). Segmentation based primarily upon color (shape .1, color .9) creates polygons with a wider range of sizes and splits polygons that otherwise appear spectrally similar. The balanced approach with shape and color at .5 emphasizes internal spectral homogeneity while allowing the shape parameter sufficient flexibility to group wetland patches with slightly different spectral signatures. The 50 and 75 scale parameter segmentations fit the minimum wetland area (patch identification) requirements very well, and the balanced color and shape parameters ensure segment polygons based solidly upon internal spectral homogeneity while creating polygons of similar sizes.

Table 5. Parameters for multi-resolution segmentation trials in Definiens Professional 5. The area column refers to the range of areas in pixel objects containing field GPS points (presumably, wetland objects). Total image area of the NAIP image subset is 27,751,825 square meters.

Scale Parameter	Shape /Color	Compactness and Smoothness	No. of segments in subset	Area (m^2)	Comments
10	.5/.5	.5	544,324	61-107	Objects much too small. Shadows become independent features rather than blending in. Very low segmentation heterogeneity threshold results in many very similar and adjacent polygons.
50	.5/.5	.5	23,667	796-8135	Can still pull out very small homogeneous areas (35 pixels for a pond, for example). Shadows are no longer unique features. Segmentation no longer artificially splits similar areas. Highest detail of the three 50 scale tests.
50	.9/.1	.5	13,419	796-10593	Higher focus on the shape homogeneity in resulting objects, which tends to merge otherwise spectrally unique polygons.
50	.1/.9	.5	10,156	796-14386	Higher focus on spectral homogeneity, which merges areas of like color and splits those slightly different.
75	.5/.5	.5	13,170	1483-13640	Larger objects with high internal heterogeneity.
100	.5/.5	.5	4936	1485-23123	Much larger objects with very high internal heterogeneity. Many image objects were lumped with fairly spectrally different, though adjacent polygons.

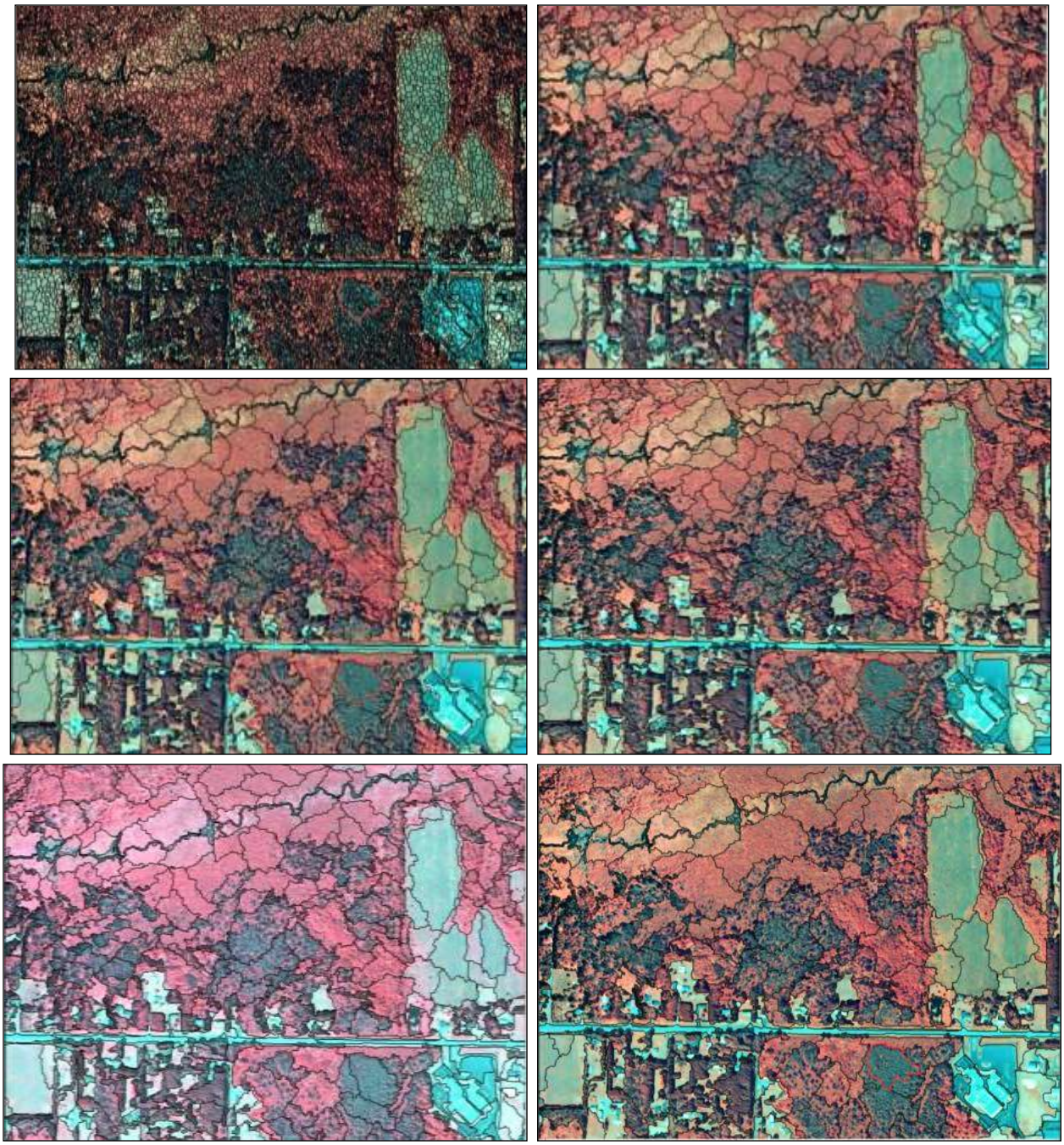


Figure 15. These images show the affects of various segmentation parameters on the size and location of segment boundaries in the one meter 2008 CIR NAIP imagery. From top left, (*top row)* scale parameter 10, balanced shape and color (.5 each) and scale 50, balanced shape and color, (*middle row*), scale 50, shape .9, color .1 and scale 50, shape .1 color .9, (*bottom row*) scale 75, balanced shape and color and scale 100, balanced shape and color.

In-depth visual assessments of the various segmentation results identified the segmentation with scale parameter 50 and balanced color and shape parameters as the best fit with one-meter CIR NAIP imagery. In this segmentation, the locations of polygon boundaries and segment sizes adequately fit the photo-interpreted land use and land cover. The segments successfully delineated roads, fields, forest stands, wetlands, water bodies, and urban areas, and also separated natural land cover categories, such

as open water and floodplain meadow or deciduous and evergreen forests. To further examine the segmentation boundaries for wetlands, the image objects were compared against the current National Wetland Inventory (NWI) vector data for Cloquet, MN. To directly compare the segmentation against NWI data, the segmented layer was first exported to a vector layer and input into ArcGIS. The NWI layer was then used as a template to select wetland segments touching the NWI polygons. As is shown in the series of figures below, the wetland polygons from the segmentation layer include water bodies and split wetland vegetation from upland vegetation extremely well (Figure 16). In many areas, the segmented wetland polygons identified obvious wetlands that the NWI omitted and delineated the wetland boundaries with more realistic, natural variations and much higher detail than the NWI.

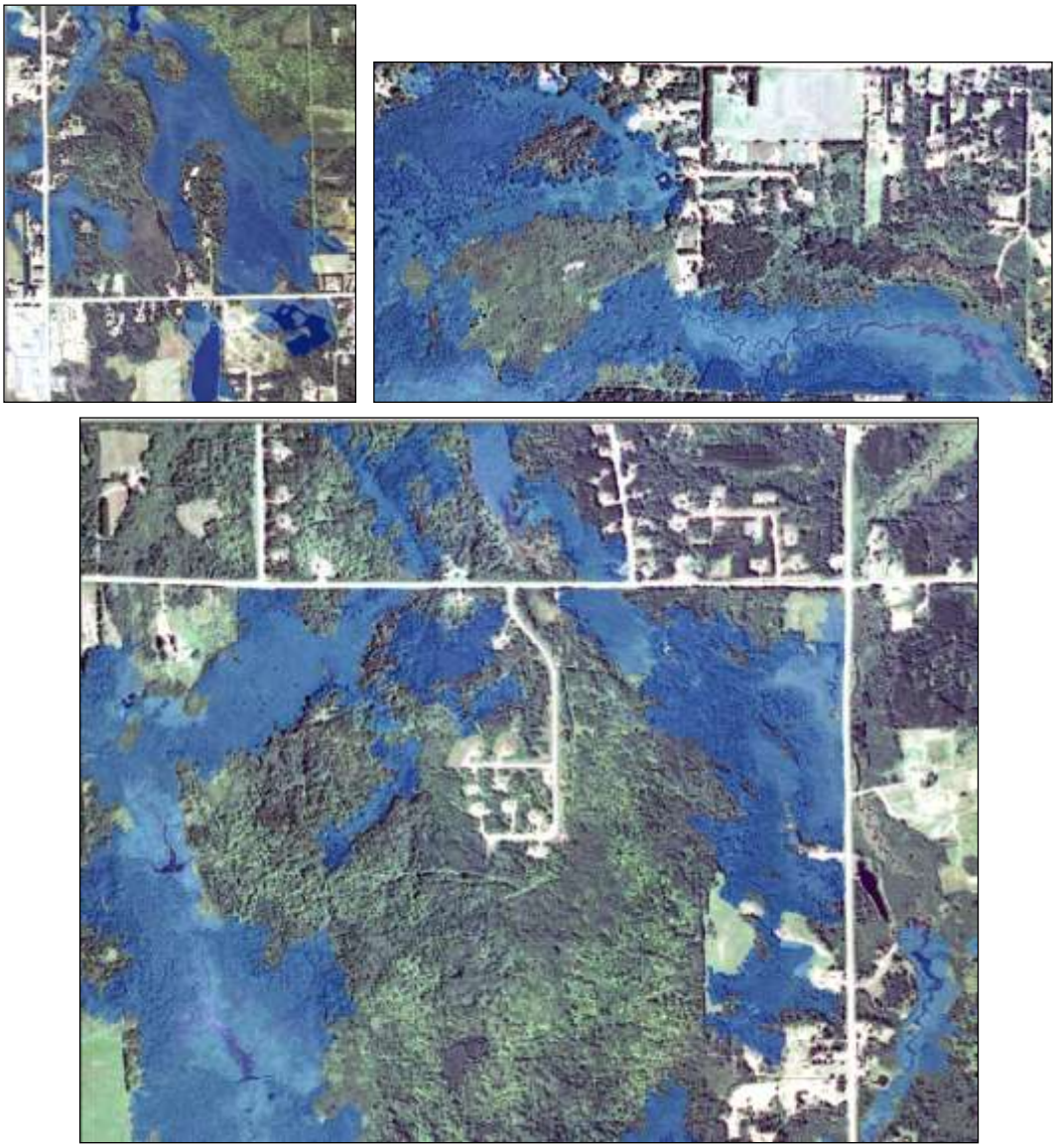


Figure 16. The blue areas correspond to Definiens Professional 5 wetland polygons. Included polygons overlapped with areas within the NWI layer.

2.2.4. Segmentation Discussion

Depending on the scale parameter setting and the size of the image, segmentation can be extremely time consuming and computationally expensive. Attempts to segment the entire county composite image were unsuccessful do to limitations in computing power; however, processing of USGS quarter quad tile images were feasible with a desktop computer.Despite the addition time required to segment the imagery, working with image objects rather than individual pixels for wetland classification would significantly reduce the overall time necessary for wetland mapping and classification (Meinel and Neubert, 2004).

The benefits to be gained from segmentation are well worth the added processing steps. Segments can be easily converted to vectors and brought into alternate software programs. Definiens exports vector polygons in shapefile format, which would make them usable in ArcGIS, ERDAS Imagine, and most other GIS packages (the shapefile vector data format is an Open Geospatial Consortium standard format, which means the source code is universal and public, and ensures that the majority of GIS packages can read them).

When working from the segment layer, wetland delineators have only to select, copy, and paste a segment or set of segments to add them to the NWI polygon dataset. The hybrid process of segmentation and manually editing, merging, or clipping wetland polygons would be much faster, since the segments provide delineators with a ready starting point (Hess et al, 2003). As noted above, the segmented polygons include much more spatial detail and finer-scale edge delineation than polygons currently in the NWI dataset. This extra detail may increase the overall accuracy of the NWI at local scales by accounting for seasonal variations and small but important drainage systems otherwise omitted by the NWI. Because the wetland delineation process is automated, Definiens Profession 5 could be used to both increase wetland boundary detail in the NWI and to keep that level of detail consistent among different interpreters. Even if the level of detail is too high for the NWI, any segmented polygons added to the NWI could be simplified and smoothed in ArcGIS – a process which could easily be automated – prior to manual editing. Overall, using Definiens software to obtain wetland boundaries either should reduce or eliminate the need for manual edge editing of wetland polygons in the NWI.

Since the segmentation uses the spectral data to segment the landscape, any wetlands (regardless of location or surrounding land use) with unique spectral characteristics should be discernable with the right combination of imagery and ancillary data. However, to delineate wetlands beneath a forest canopy, leaf-off imagery or radar capable of penetrating the canopy would be a prerequisite to accurate segmentation. As long as a wetland is large enough to be detected at the imagery's spatial resolution, ancillary remote sensing and other data should be sufficient to delineate the wetland, though classification requires a much more specific set of spectral bands and ancillary data to classify wetlands with any degree of accuracy. When combining images, mosaicking and histogram matching may be necessary to ensure that the segments do not identify image edges as segment boundaries.

Care should be taken to ensure that the tiles are edge matched. Edge matching algorithms available.

2.3. Wetland Typing using Decision Trees

2.3.1. Wetland Typing Introduction

The mapping of wetlands boundaries is only one goal of the National Wetlands Inventory (NWI). Additional wetland characteristics such as classification type are also important goals. The current NWI characterizes wetlands using the Cowardin classification system (Cowardin et al., 1979) and the U.S. Fish and Wildlife Service (USFWS) Circular 39 classification system (Shaw and Fredine, 1971); however, Minnesota's wetland regulatory agencies have begun advocating the use of wetland plant community types (Eggers and Reed, 1997) for use in wetland delineation and permitting. Further work will be required to include it in a future update of the NWI.

There are many remote sensing classification techniques, each with unique advantages and disadvantages. An unsupervised classification is one common technique (Ozesmi and Bauer, 2002; Sader et al., 1995). Unsupervised classification is often applied because it eliminates the need for a time consuming training step. Hybrid classifications, described by Jensen (2005), combine unsupervised clusters with supervised training sets of known land cover. The training phase involves defining spectral signatures of known land cover and then incorporating those signatures into a classification model, typically done using the ERDAS software package. Other classification methods use image derivatives to discriminate image texture. Vegetation indices such as the normalized difference vegetation index (NDVI), the TM Band 4:5 ratio, and the TM tasseled-cap model are used as textural information to further discriminate wetlands, particularly forested wetlands (Wright and Gallant, 2007; Hodgson et al., 1987). Automated processes, however, tend to confuse some types wetlands with other land cover classes. This is particular problem with wetland classification because of the temporal variability of wetland characteristics over the course of a growing season and is especially a problem with forested wetlands whose tree canopies have spectral reflectance characteristics similar to upland forests.

In addition to automated processes, visual interpretation of imagery can be a useful element in the classification process. Harvey and Hill (2001) reported that these semi-automated maps resulted in wetland maps that were 9% more accurate results than completely automated approaches. An expert classifier is one that is guided by an interpreter, the "expert," and can incorporate attributes such as image texture, topography, and other GIS based datasets that can aid the automated processes with the hope of ultimately increasing classification accuracy. The Knowledge Engineer, an ERDAS software product, is an expert classifier that was evaluated in this study. An expert classification system was chosen because of its ability to combine traditional automated processes with expert knowledge to provide the optimal accuracy and efficiency in classifying wetland type. This study will focus on classifying seven Eggers and Reed forested wetland types: deciduous forest, floodplain forest, shrub carr, alder swamp, coniferous swamp, coniferous bog, and open bog.

2.3.2. Wetland Typing Methods

2.3.2.1. Field Data Collection

The Fond du Lac Reservation, located northwest of the City of Cloquet, Minnesota, was selected as the pilot study area because of the availability of high quality GIS data sets, namely a reservation wide wetland inventory completed in 2008 and high resolution (2 ft) topography data. A field study was conducted July 13-17, 2009 by researchers from the University of Minnesota, including one MN Certified

Wetland Delineator. 250 points were randomly generated within wetland types in a stratified random sampling scheme. The points were loaded into Trimble GeoXT and GeoXH handheld GPS units, which are sub-meter accurate under optimal conditions. A minimum of 50 positions were collected for each GPS point collected during the field study. Data were post processed and corrected using Pathfinder Office.

2.3.2.2. Imagery and GIS Data Layers

Two primary sources of aerial photography were used throughout the study. The National Agriculture Imagery Program (NAIP) imagery from 2008 has four spectral bands (B, G, R, NIR), a spatial resolution of 1m, and was collected mid to late August in the study area. In addition, the MN Department of Natural Resources (DNR) acquired imagery flown by Keystone Aerial Surveys Inc. in May 2009, prior to leaf out in the study area. This imagery has four spectral bands (B, G, R, NIR) and a spatial resolution of 0.5m.

Other data sets that currently comprise variables in the decision tree include the Natural Resources Conservation Service (NRCS) Soil Survey Geographic (SSURGO) Database, specifically spatial data and soil pH attributes, and the compound topographic index (CTI) that can be used as a measure of soil wetness. In addition, a wetland inventory was completed in 2008 in the area of the Fond du Lac Reservation. This dataset was used in preliminary decision tree development.

2.3.2.3. Conceptual Decision Tree

A conceptual tree was constructed in order to visualize the classification process. Figure 17 is the conceptual tree for forested wetland classification, based on Eggers and Reed's (1997) wetland community classification key. The tree does not follow the Eggers and Reed key exactly, as each directional node in the tree must be based on a difference in vegetative cover detectable by remote sensing or another GIS variable.

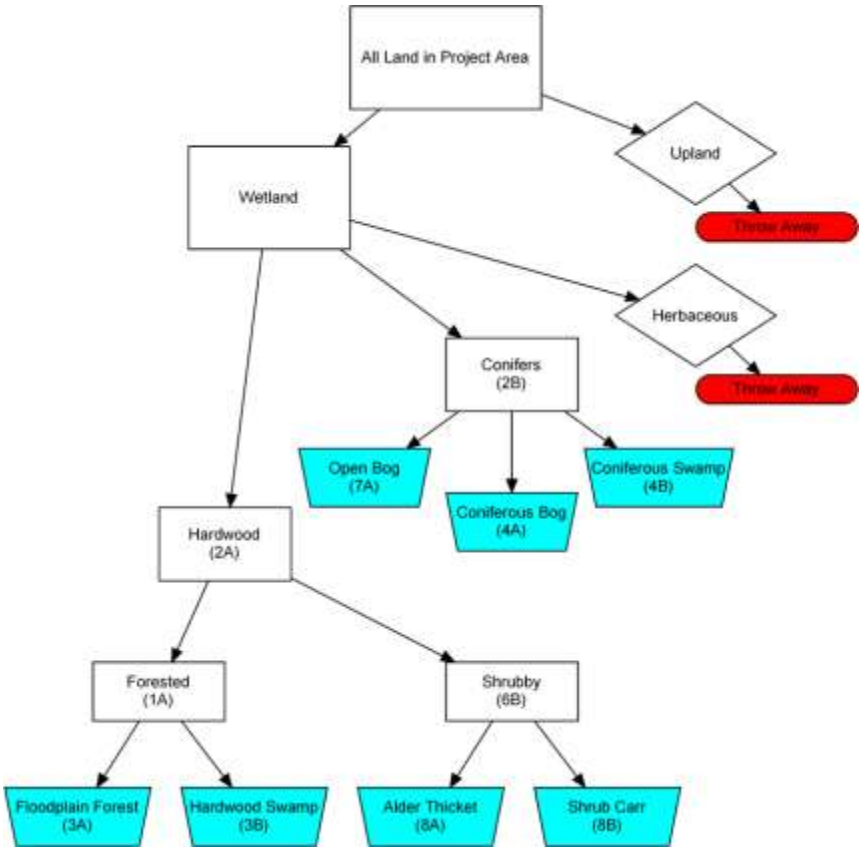


Figure 17. Conceptual classification tree for Eggers and Reed wetland types.

2.3.2.4. Determination of Variables

A portion of the field collected data was used in combination with imagery and ancillary GIS data sets to examine potential differences between wetland types. Eighty-one polygons were created around wetland points of different classes. Polygons were created manually by an interpreter to ensure wetland homogeneity. These polygons were used to generate statistics for a number of variables in an effort to distinguish between wetland types. Polygons were also created using Definiens eCognition software and then those polygons surrounding the wetland points were extracted and aggregated by wetland type. Statistics based on interpreter and eCognition polygons were examined. The high resolution imagery was degraded to 1m and 3m data sets in order to decrease the effects of solar angle, shadows, and speckle common to imagery with very high spatial resolution.

Statistics have been generated for the following attributes for use in the decision tree classifier:

- individual B, G, R, NIR bands for 2008 NAIP imagery and 2009 leaf off imagery
- NDVI for 2008 NAIP imagery and 2009 leaf off imagery
- NDVI difference image (leaf on – leaf off)
- Soil pH

2.3.2.5. ERDAS Knowledge Engineer

ERDAS Knowledge Engineer is a per pixel decision tree based classifier that is comprised of end or intermediate hypotheses, rules, and variables. End hypotheses are output classes from Knowledge Engineer, in this case the end hypotheses are the seven Eggers and Reed forested wetland types. Intermediate hypothesis are classes that are nodes in the decision tree but not output from the model, such as coniferous and deciduous land cover, from which further classification can take place. Hypotheses are evaluated by rules, which determine whether or not an input variable meets a given criterion. A variable can be defined from a raster or vector data set. For example, a variable could be the calculated NDVI layer, and a rule could be that if the NDVI value for a pixel is greater than 0.4 then it would fall within the intermediate hypothesis of vegetation. The decision tree is based on a logical progression. All variables must be verified if a rule is to be correct, and a hypothesis is true if one or more rules relating to the hypothesis are correct. Figure 18 shows the decision tree being developed for this study.

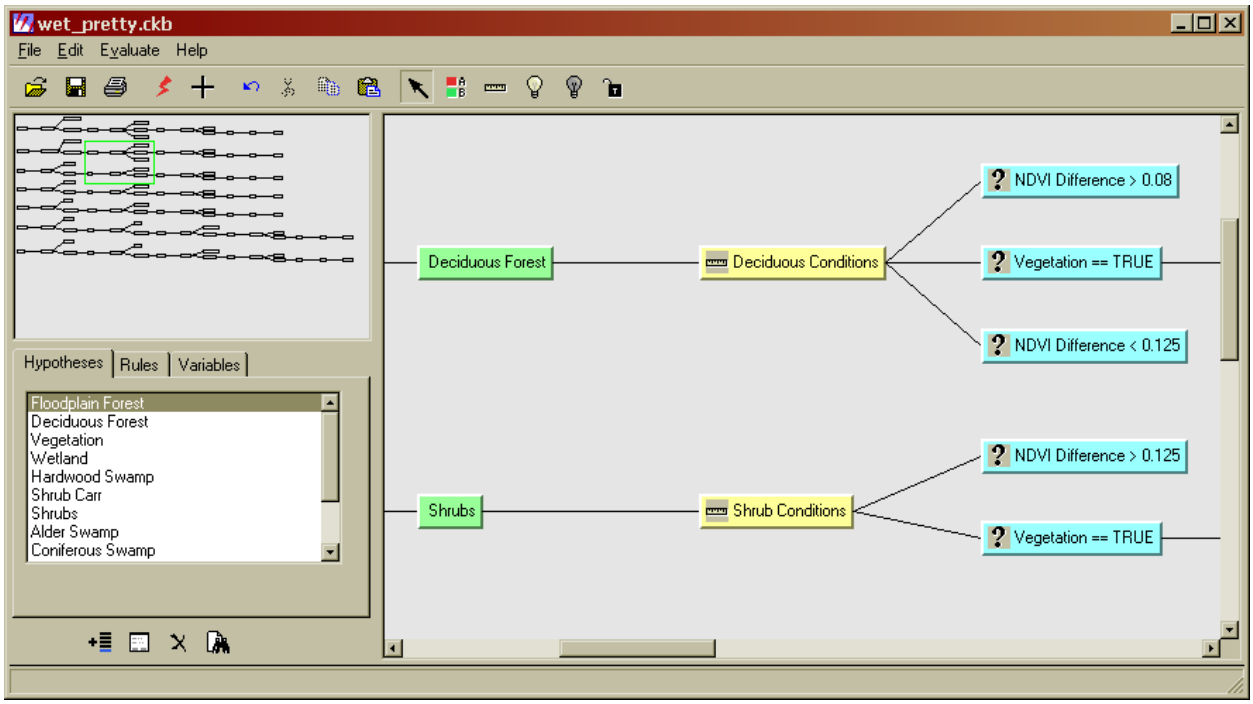


Figure 18. Sample variables, rules, and intermediate hypotheses in ERDAS Knowledge Engineer.

2.3.2.6. Accuracy Assessment

Accuracy assessments were conducted using 146 field collected, forested wetland points. A 10m buffer was created surrounding each point, and accuracy was assessed based on the majority of the classified wetland type within the buffer. This method ensures classification homogeneity, reduces errors due to GPS inaccuracy, and reduces the chance that a single pixel classified incorrectly in a group of correctly classified pixels negatively affects the accuracy assessment.

2.3.3. Wetland Typing Results

2.3.3.1. Data Collection

GPS post processing accuracy reports show that approximately 50% of positions collected were sub-meter accurate, approximately 80% of positions were accurate to two meters, and approximately 96% of positions were accurate to five meters. Table 6, below, is an example of the field data collected. A total of 151 wetland (146 forested) and 31 upland data points were collected.

Table 6. Sample of wetland data collected during July, 2009.

ID	Wet/Up	Eggers & Reed Type	Cowardin Type	Cowardin Hydrology	Vegetation
11	Wetland	Open Bog	PEM3	B	labrador tea, bog rosemary, sphagnum
14	Wetland	Shrub-Carr	PSS1	B	dogwoods, other mixed deciduous shrubs
260	Wetland	Alder Thicket	PSS1	B	alder, some spruce, tamarack
15	Wetland	Alder Thicket	PSS1	B	alders, some dogwood, sedge, bluejoint grass
362	Wetland	Hardwood Swamp	PFO1	B	black ash, birch, maple, some alder
101	Upland				red pine plantation, no understory vegetation
67	Wetland	Coniferous Bog	PFO2	B	tamarack, bog rosemary, labrador tea, black spruce
64	Wetland	Coniferous Bog	PFO2	B	tamarack, bog birch, alders
97	Upland				area of aspen regrowth, scattered red pine and basswood
60	Wetland	Coniferous Swamp	PFO4	B	cedar, balsam fir, tamarack, sedge
112	Wetland	Coniferous Bog	PFO2	B	tamarack, black spruce

2.3.3.2. Determination of Variables

Image statistics for interpreter and eCognition polygons were examined. eCognition polygons exhibited a different mean, higher variability, and higher standard deviation than those created manually by the interpreter. Further statistics used in determining differences between vegetative classes were calculated using the interpreter based polygons.

Image statistics for 1m and 3m degraded images were examined. Statistics calculated for data sets degraded to 3m showed less variability and smaller standard deviations per wetland class, and thus the high resolution images were degraded to 3m for further classification. Degradation reduces noise in the data and decreases the computer processing time considerably.

Image statistics for several variables were examined. Differences were found between vegetative classes, and the following describes the use of variables in the decision tree classifier:

- The NIR band was extracted from both the 2008 NAIP leaf on image and the 2009 leaf off image. The lowest NIR value was 23 for all wetland classes. All NIR values less than 23 were assumed to

be water, as clear deep water reflects NIR very poorly, and were not included in the decision tree.

- The NDVI was calculated for the 2008 NAIP leaf on imagery and normalized to a 0 – 1 scale. This gives a good indication of maximum annual greenness, as the imagery was flown during late summer. If an NDVI value was low for the leaf on image, it can be generally assumed that the area is not vegetated at any point during the year.
- The NDVI was calculated for the 2009 leaf off imagery and normalized to a 0 – 1 scale. This gives a good indication of minimum annual greenness, as the imagery was flown prior to deciduous leaf out. A high NDVI value for this date is generally indicative of evergreen vegetation.
- An NDVI difference image was created by subtracting the leaf off NDVI from the leaf on NDVI. This eliminates background greenness that is present year round. A high NDVI difference value indicates substantial vegetative growth. Figure 19 shows the NDVI difference for six wetland classes (hardwood swamp and floodplain forest are lumped into a deciduous forest category). The mean NDVI difference values for the deciduous and coniferous classes were 0.15 and 0.01, respectively. The NDVI difference value is used to distinguish deciduous and evergreen classes in the decision tree.

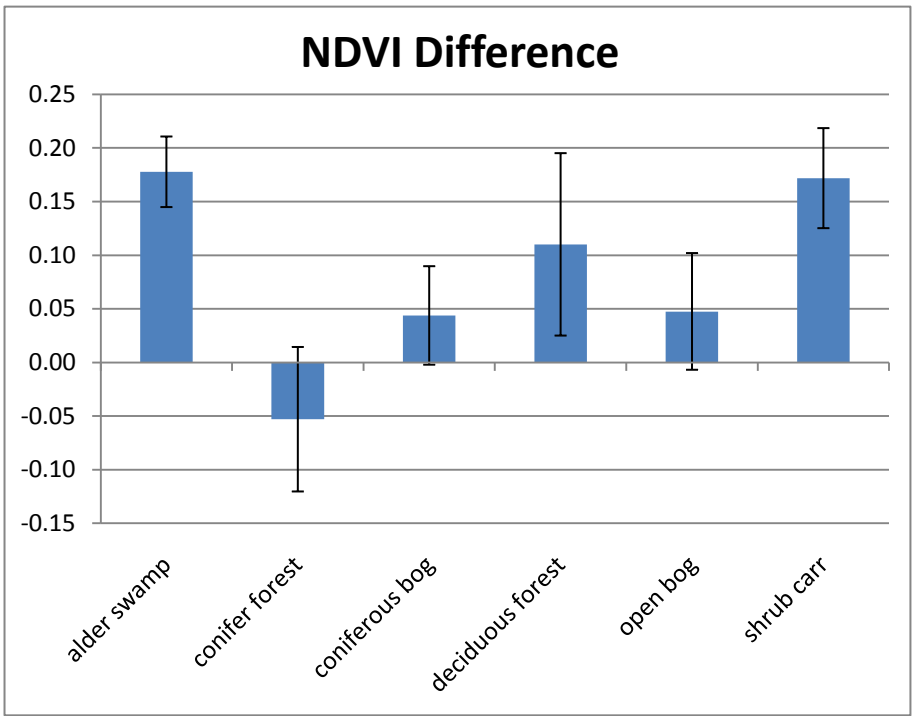


Figure 19. NDVI difference for six wetland classes. Error bars are one standard deviation.

- Soil pH for each class was derived from the SSURGO database and was used to distinguish coniferous and open bogs from coniferous swamps. The mean soil pH for the coniferous swamps was 4.36, while the mean soil pH for the coniferous and open bogs combined was 3.86. It is noted that shrub carr and alder swamps also tend to have a low pH but have already been separated as deciduous vegetation at this point.
- Subtle differences were noted in some of the individual bands that could be used to differentiate wetland classes, specifically coniferous and open bogs as well as alder swamps and shrub carrs. The mean leaf off NIR value for shrub carrs and alder swamps were 162 and 182,

respectively. The mean leaf off B band value for coniferous bogs and open bogs were 119 and 138, respectively. However, these differences alone are weak andadditional discriminatory variables will be needed for adequate class separation.

2.3.3.3. ERDAS Knowledge Engineer

The ERDAS Knowledge Engineer uses a linear model of the variables, rules, and hypotheses for each class rather than a bi-directional decision tree (Figure 18). This makes it difficult to visually assess the model as a whole. A binary decision tree better represents the process (Figure 20).

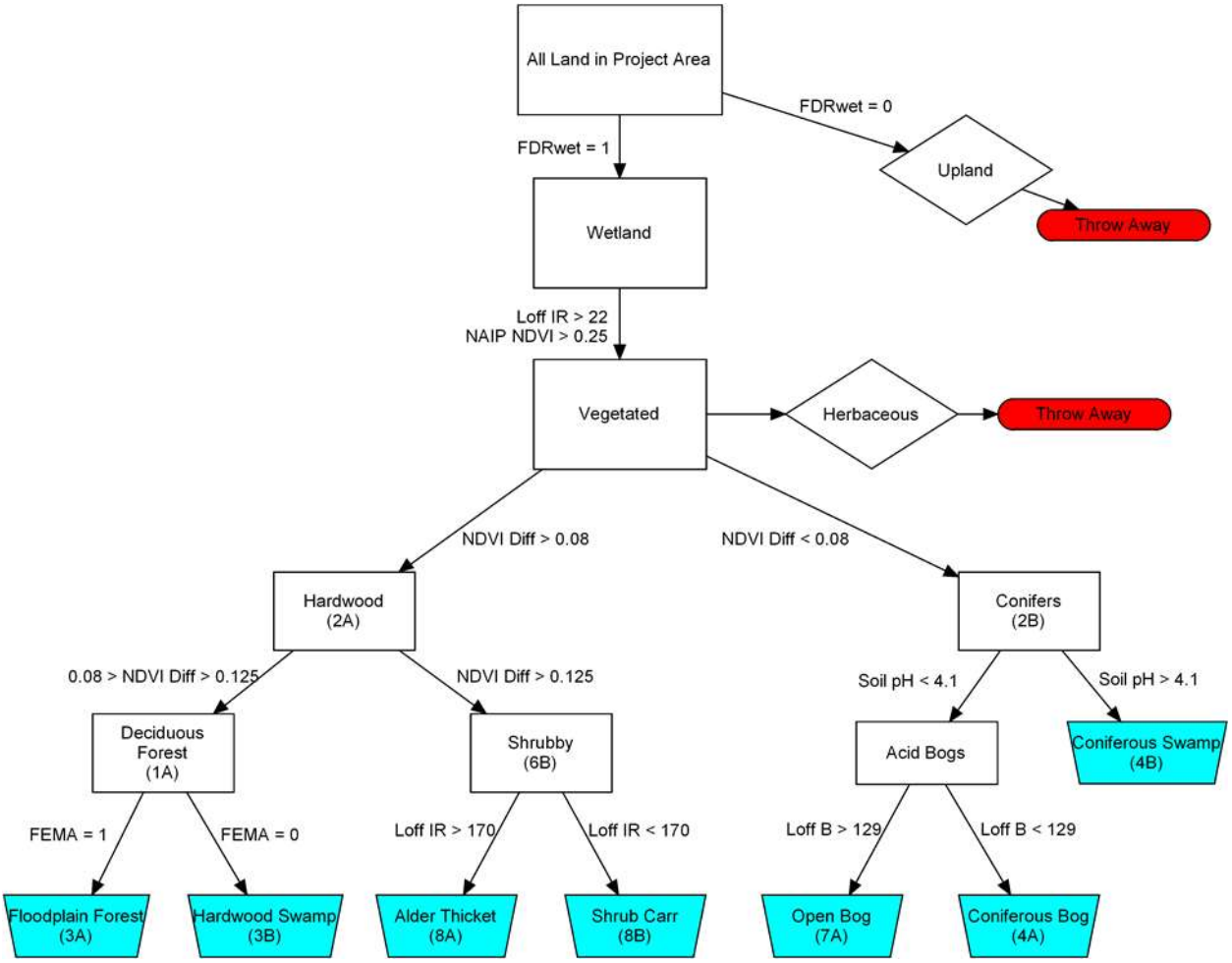


Figure 20. Draft decision tree used for wetland classification.

2.3.3.4. Classification

The results of the preliminary classification are shown in Figure 21, below. Figure 22 is a zoomed portion of the classification map.

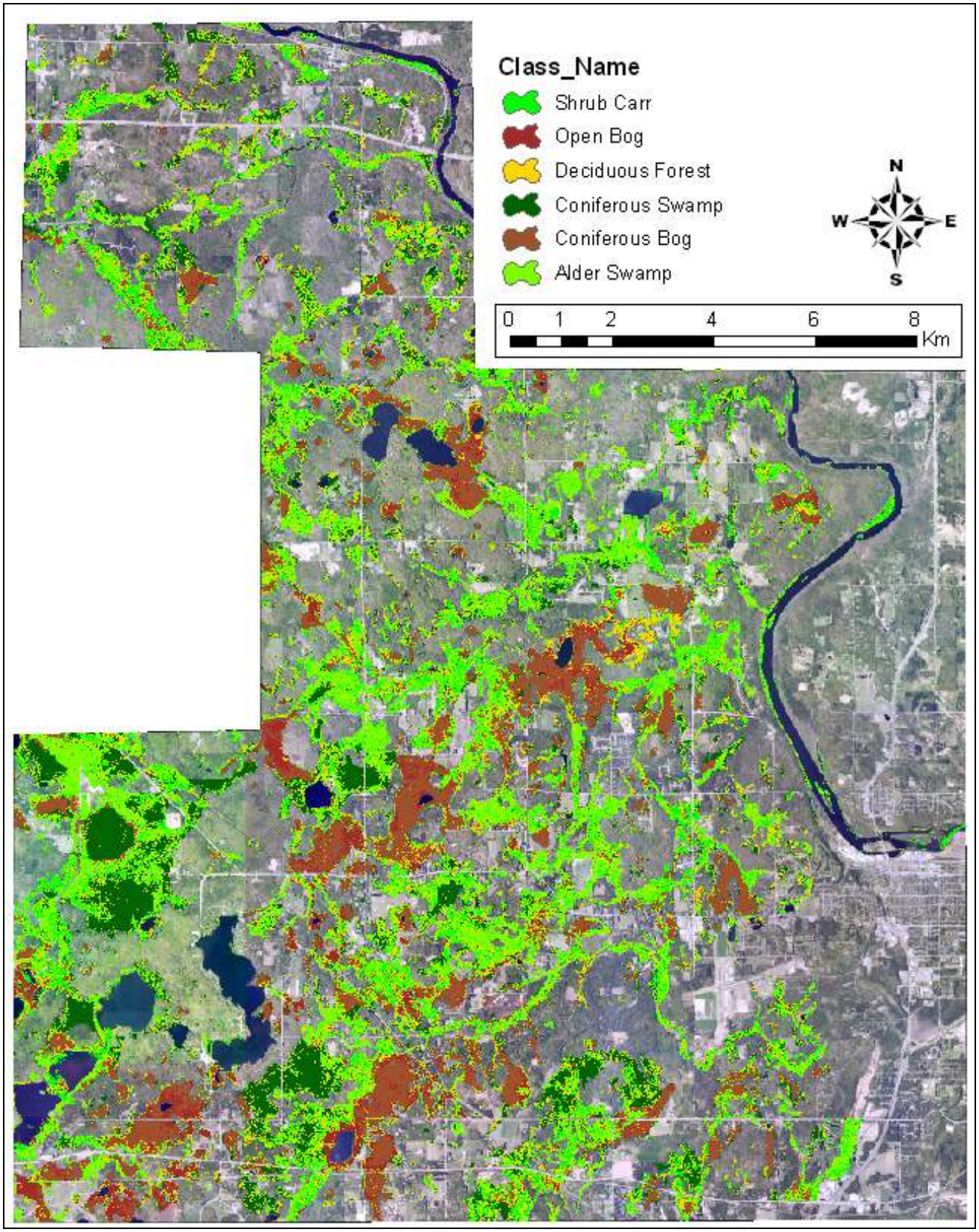


Figure 21. Preliminary forested wetland classification map.

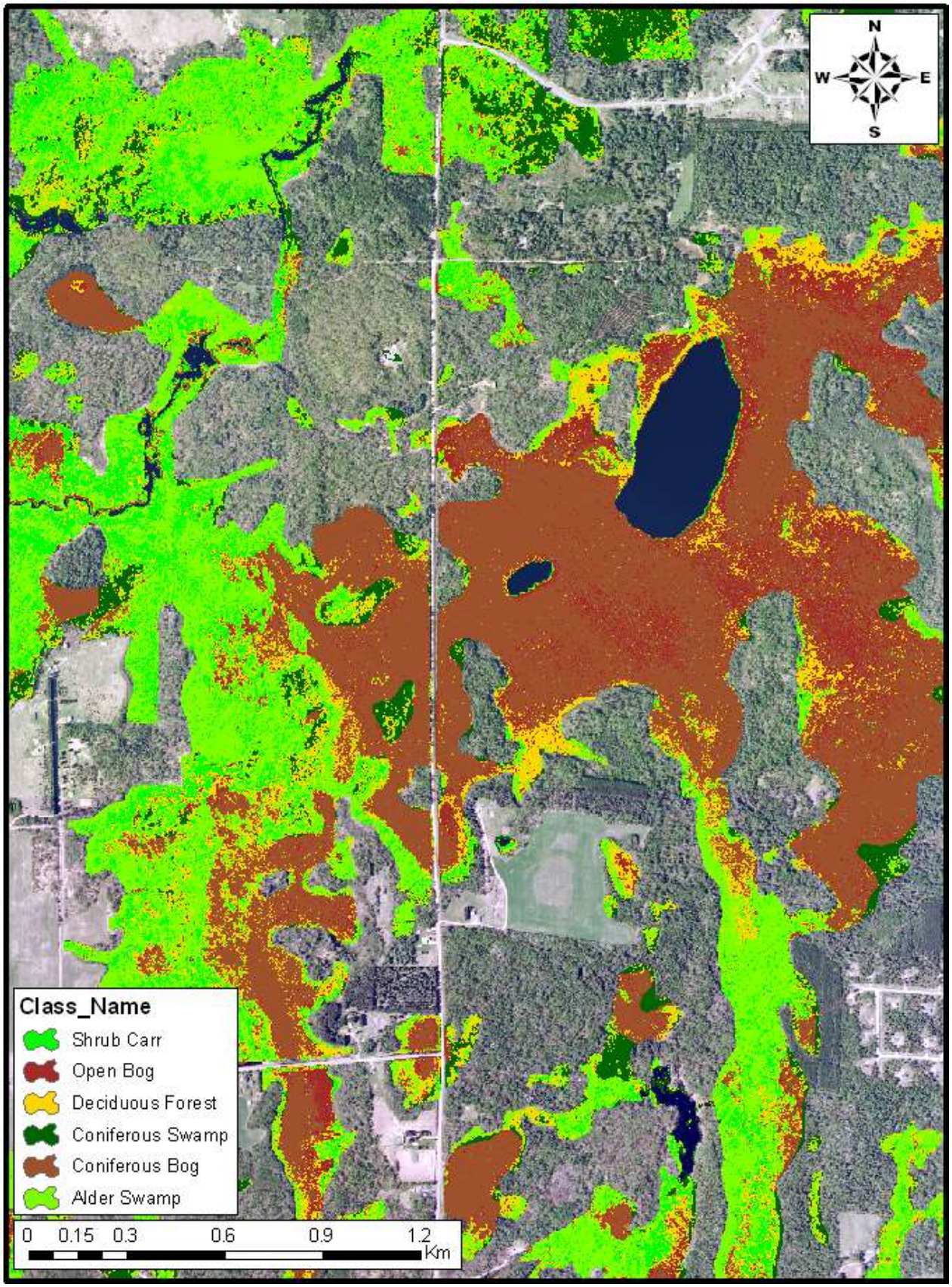


Figure 22. Zoomed portion of preliminary wetland classification map.

2.3.3.5. Accuracy Assessment

The overall accuracy of the preliminary decision tree classifier was 47.9% (Table 7).

Table 7. Error Matrix for preliminary forested wetland classification.

		Reference Data							
		HW Swamp	Shrub Carr	Alder Thicket	Conif. Swamp	Conif. Bog	Open Bog	Total	User's Accuracy
Map Data	HW Swamp	11	4	4	4	2	1	26	42.3%
	Shrub Carr	15	9	4	0	0	0	28	32.1%
	Alder Thicket	8	20	13	0	0	1	42	31.0%
	Conif. Swamp	1	0	0	9	5	0	15	60.0%
	Conif. Bog	0	0	0	3	23	0	26	88.5%
	Open Bog	0	0	0	0	1	2	3	66.7%
	Totals	35	33	21	16	31	4	141	
	Producer's Accuracy	31.4%	27.3%	61.9%	56.3%	74.2%	50.0%		
							Overall Accuracy	**47.9%**	

2.3.4. Wetland Typing Discussion

2.3.4.1. Data Collection

At the time of the field study, the open bog class was not considered for classification. Future iterations of the forested classification decision tree may not include open bogs because of the lack of reference information. Reference information may also be obtained using the Minnesota County Biological Survey (MCBS) dataset.

2.3.4.2. Determination of Variables

The determination of variables is the major shortcoming of the wetland classification process thus far. There are multiple steps that require improvement, perhaps most importantly the removal of emergent vegetation from the “vegetation” intermediate hypothesis. The model currently overestimates shrub carr and alder thicket, and qualitative investigation shows that many of these areas are actually wet meadow, shallow marsh, or other vegetative communities dominated by herbaceous cover. Analysis of imagery statistics for herbaceous wetland classes will be examined and a rule for removal of herbaceous vegetation will be established in future iterations of the decision tree model.

Currently the model relies on the Fond du Lac wetland inventory to determine if an area is wetland or upland. The inventory was created by expert interpreters and thus the confidence of the wetland/upland discrimination power of the inventory is high. The inventory has been helpful in model development for this specific area, but no such data set exists throughout Minnesota. The use of the CTI

to discriminate wetland and upland is being evaluated and will be incorporated into future iterations of the decision tree model.

The current version of the model does not discriminate floodplain forests and hardwood swamps. Analysis of imagery statistics reveals that these two wetland classes have very similar spectral reflectance characteristics and it is not possible to confidently distinguish between these floodplain forests and hardwood swamps using imagery alone. Ancillary data sets based on topographic data are being evaluated.

The current version of the model relies on several weak differences between classes, including those based on single band imagery and on soil pH. Soil pH data are taken from the SSURGO dataset, which maps soils at a landscape scale. Fine scale pH differences will not be distinguishable using this data set. Furthermore, soils data are not yet available statewide in digital formats, although the development of digital data is ongoing. Further investigation will be conducted to determine differences between wetland types that can be combined with soils and single band image data to provide a more confident distinction of wetland classes.

The use of radar data is also being evaluated for its use in discriminating vegetated wetland classes. Numerous studies (Hess et al., 1990; Hess et al., 1995; Whitcomb et al., 2007; Henderson and Lewis, 2008) report the usefulness of radar data in discriminating between wetland and upland, as well as vegetative species differentiation. Future studies will be conducted to determine the usefulness of radar data in the Fond du Lac study area. However, radar images are not currently available statewide and are expensive to obtain.

The expert classification and decision tree methods allow for a variety of local data to be used when discriminating wetland types. The applicability of data varies throughout the state depending on dominant land use. Remote sensing techniques that distinguish forested wetland types may need to be further refined in the northern lakes and forests region, whereas springtime determination of agricultural wetlands will likely be the focus of the studies in the western corn belt plains. The expert classifier model allows for use of data sets that are the most applicable for a particular area.

2.3.5. Wetland Typing Conclusions

As shown in Table 7, the overall accuracy of the preliminary forested wetland classification is 47.9%, which is not adequate to meet the FGDC mandated thematic accuracy standard of 85%. Further modeling is expected to enhance the accuracy somewhat. Accurately classifying forested wetlands is a difficult task for a variety of reasons, and further investigation will be needed to determine whether it is possible to confidently and accurately classify forested wetlands without expert interpretation using Knowledge Engineer or other expert classifiers. The availability of high resolution leaf off and leaf on aerial photography as well as high resolution topography data has the potential to be the basis for more accurate automated classification. Further investigation will continue with the goal of determining this potential.

2.4. Wetland Mapping using RADAR Imagery

2.4.1 Introduction to Wetland Mapping with Radar Imagery

Wetland boundaries are dynamic in both space and time, with fluctuation depending on many hydrologic factors such as precipitation, evapotranspiration, and ground water flow. Traditional wetland mapping methods which rely on aerial photograph interpretation and simple classification techniques have several disadvantages: they are typically based on single-date imagery, are often several years old, may not be representative of the current state of the environment, and do not take into account the seasonal nature of wetland boundaries. Such traditional maps are not reliable for two particular wetland types: forested and ephemeral.

Separating forested wetlands from forested uplands with optical imagery is problematic because the imagery, even if collected during leaf-off conditions, may not reveal the underlying hydrology of a site. The collection of optical imagery can also be hindered by cloud cover (Baker, Lawrence, Montagne, & Patten, 2006; E. W. Ramsey, 1995; E. W. Ramsey et al., 1998; Töyrä, Pietroniro, Martz, & Prowse, 2002), thus potentially missing a critical period for ephemeral wetland assessment.

Radar imagery may provide a solution to traditional wetland mapping concerns. In areas of frequent cloud cover, optical imagery has an obvious disadvantage. Long wave radar signals, on the other hand, are not sensitive to the atmosphere, nor require daylight hours for acquisition, and thereby increase the possibility for frequent and quality data collection (Parmuchi, Karszenbaum, & Kandus, 2002; Townsend, 2001). A review of radar detection of wetlands by Henderson & Lewis (2008) illustrates the complexity and dependence on local environmental conditions for wetland mapping accuracy.

Wetland maps made using satellite imagery with larger spectral and spatial resolution incorporate more information about surface characteristics. Empirical models can be developed to estimate soil moisture and potential wetness, thus increasing the feasibility of differentiating between a broad range of wetland types (Arzandeh & Wang, 2002; Li & Chen, 2005; Ozesmi & Bauer, 2002; E. W. Ramsey, Nelson, & Sapkota, 1998). There are many different methods to use radar imagery to map wetlands; however, the classification technique which is the most accurate may not always be the most feasible.

Rule-based classifiers require prior knowledge about the surface properties such as: radar speckle and radar backscattering effects from changes in soil moisture and dielectric properties of vegetation and soil (Kasischke et al., 2003; Parmuchi et al., 2002). On the other hand, object-based classifiers take into account neighboring pixels to classify segments of homogeneous boundaries using measures such as texture, shape, pattern, size, as well spectral-radiometric information. This method is also called image segmentation and is computationally expensive (Grenier et al., 2007; Harken & Sugumaran, 2005; Stuckens, Coppin, & Bauer, 2000).

Evaluation is needed of multiple combinations of input datasets and classification techniques in order to strike a balance between accuracy, economic and feasibility. Using radar imagery and modern classification techniques, the accuracy of locating and differentiating between wetland types is increased and the time it would traditionally take to map difficult wetland types is significantly reduced.

2.4.2 Planned Methodology

A series of comparisons will be drawn from the results of several classification techniques with the following data inputs: different types of radar imagery, high resolution topography and potential wetness models, soil survey maps, and leaf-on and leaf-off optical imagery. Accuracy will be assessed by utilizing ground reference data from pilot sites. Evaluation of the results will ultimately be used to design a recommendation for the most effective and feasible wetland mapping statewide.

The mapping methods discussed here will utilize Radarsat-2 and PALSAR imagery (C- and L-bands, 5.66 cm and 23.5 cm wavelength, respectively). The dynamic nature of wetland areas will be explored by acquiring imagery for three dates per year (May, July, and September) in pilot study areas over a two year period. Radar backscatter directly relates to the surface properties and the spectral band utilized. Longer wavelengths are more able to penetrate through rough or densely vegetated surfaces and reach the soil surface (Campbell, J.B, 2007). The C and L wavelengths will be evaluated for accuracy in mapping forested wetlands.
The radar images will be acquired with varying signal polarizations (horizontal-horizontal, HH; vertical-vertical, VV; horizontal-vertical, HV; and vertical-horizontal, VH). Polarization signifies the orientation of the energy transmitted or received by the radar antenna, which is directly related to the physical and electrical properties of surface features (Campbell, J.B, 2007). Combinations of polarizations have been shown to detect vegetation differences and differentiate between ground cover types reasonably well (Baghdadi, Bernier, Gauthier, & Neeson, 2001; Henderson & Lewis, 2008; Slatton, Crawford, & Chang, 2008). Polarization, wavelength, and combinations thereof, will be evaluated for accuracy in differentiating various wetland types.

Provided resources for field data collection are available, relationships between measured soil moisture and backscatter or polarization effects will be developed to estimate soil moisture with remotely sensed data. Soil moisture maps are important for identifying the hydrology of an area. Using empirical models, the differentiation between a broader range of wetland types is possible (Arzandeh & Wang, 2002; Li & Chen, 2005; Ozesmi & Bauer, 2002; E. W. Ramsey, Nelson, & Sapkota, 1998). If resources are not available or feasible, other empirical models found in the literature for estimating soil moisture with radar imagery will be explored.

The reference data will be collected from randomly distributed points (the minimum number of points for statistical significance is to be determined), generated within both pilot study areas. The reference points will be revisited at least three times per season over two years of this project (during times coincident with radar image acquisition). The field procedures will involve locating and physically visiting each point with a GPS unit, identifying the dominant wetland type and taking notes on vegetation species, approximating the ground cover density, measuring the soil moisture content within a specific area surrounding the point (to be determined) using a time domain reflectometry (TDR) soil moisture probe, and taking representative photographs. This intensive field work will determine how soil moisture and other observed characteristics change seasonally, from year to year, and within different wetland types.

The classification techniques that will be explored include: a) supervised classification with combined optical and radar imagery and using ground reference data as training for the classifier algorithm; b) image segmentation using combined optical and radar imagery; and c) wetland probability maps, using decision tree classifier with combined optical and radar imagery and soil moisture measured in the field pilot study areas.

Each of the above classification techniques for wetland mapping will be compared to traditional methods and the relative feasibility of each technique will be determined. Accuracy assessment results will show which method offers both the highest accuracy for specific wetland types and the most feasible implementation for large geographical areas. The final results will be used to develop a recommendation for the most cost-effective and reliable statewide wetland mapping.

2.4.3 Expected Results

Results from this research will substantially improve the information available to wetland mapping personnel and those charged with identifying restorable wetlands, mapping ecosystem function, and quantifying wetland change. This additional information is expected to save time and money for mapping wetlands that are traditionally difficult to map, such as forested and ephemeral wetlands. The seasonal behavior of different wetland types will be better understood by monitoring both the effects of radar backscatter via multi-temporal imagery and actual soil moisture content measured on the ground in pilot study areas.

Empirical models of radar-derived soil moisture will be used to determine the seasonal and inter-annual surface water cycle dynamics of the study sites. Existing approaches for determining soil moisture from radar data will be evaluated (Kasischke et al., 2003; Lu et al., 2005; Zribi & Dechambre, 2003). This research will also seek to develop new techniques to decouple the soil moisture signal from vegetation in order to differentiate between more wetland types (Frappart, Seyler, Martinez, León, & Cazenave, 2005; E. Ramsey, Rangoonwala, Middleton, & Lu, 2009).

The following specific questions will be answered by this research: 1) How can radar imagery improve mapping accuracy of two important wetland types found in Minnesota: forested and ephemeral wetlands; 2) What are the data requirements for maximizing classification accuracy and which method has the most reliable results; and 3) What is the feasibility, both economic and operational, of statewide application of each classification method.

Research has shown that combining data from multiple sources and sensors can increase the overall accuracy of wetland classification results anywhere from 15-20% (Baker, Lawrence, Montagne, & Patten, 2006; E. W. Ramsey, 1995; E. W. Ramsey et al., 1998; Töyrä, Pietroniro, Martz, & Prowse, 2002). Though data acquisition for this research will be relatively expensive and the evaluation of all of the wetland mapping methods with multiple input data types will be computationally intensive, there may be a significant cost savings in the end due to the time savings compared to traditional heads-up digitizing.

Instead of starting off with a single image and manually delineating boundaries, information about surface features is gathered from multiple types of data (optical, radar, topographical, soil survey) and used in a classifying algorithm. Ground reference data in pilot study areas will aid in both in the implementation of the classification and accuracy assessment of the results. The resulting wetland map can be given to wetland mapping professionals as an aid in traditional heads-up digitizing, especially for the notoriously difficult to map wetlands.

Challenges remain in implementing the new classification techniques, particularly in terms of the underused input data such as radar imagery and high resolution topographic data. Research has been done on the observed backscatter and speckle from radar data as a function of the sub-canopy vegetation, surface dielectric properties, and surface orientation with respect to the satellite (Wdowinski et al., 2008; Zribi & Dechambre, 2003). More information is needed on the effects of polarization, radar signal pulse and magnitude, and soil moisture content effects on radar backscatter.

2.4.4 RADAR Summary and Conclusions

Results from the classification techniques and combinations of input data explored in this research will

contribute to the field of wetland science and management significantly. By starting off broad and evaluating several different methods, the scope can be narrowed in on the most feasible and accurate technique.

In this research, surface hydrologic cycle dynamics, as measured by multi-temporal satellite-based radar image data, will be examined. This data will be used in conjunction with optical imagery and other ancillary data (e.g. soil survey data and topographical models) to develop innovative mapping methods to locate and classify difficult to map wetlands (e.g. ephemeral and forested wetlands). These methods will be tested using ground reference data and are expected to achieve mapping accuracies higher than those achieved using existing traditional methods.
Ultimately, this research will produce the following: needed testing of new radar technologies, methods for more frequent and more accurate wetland mapping for monitoring purposes, much needed data on the hydrologic cycle dynamics of wetlands, and better information about water retention in wetland landscapes.

2.5. Field Wetland Data Collection in Carlton County

A field data collection trip was conducted from July 12-17, 2009 in the Fond du Lac Native American reservation in Carlton County, MN. The purpose of the trip was to develop a reference data set that could be used to test the techniques developed in the wetland tying work described herein and subsequent projects. A total of 182 points (151 wetland, 31 upland) were visited. Table 8 summarizes the field sites by Cowardin Code. Figure 23 shows the site locations. Data collected included location, vegetation type(s), wetland type(s), general site description, and panoramic and canopy photos.

Table 8. Field wetland site summary by Cowardin Code

Number of Sites	Cowardin Code
5	PEM1
1	PEM2
37	PFO1
4	PFO2
42	PFO4
59	PSS1
2	PSS3

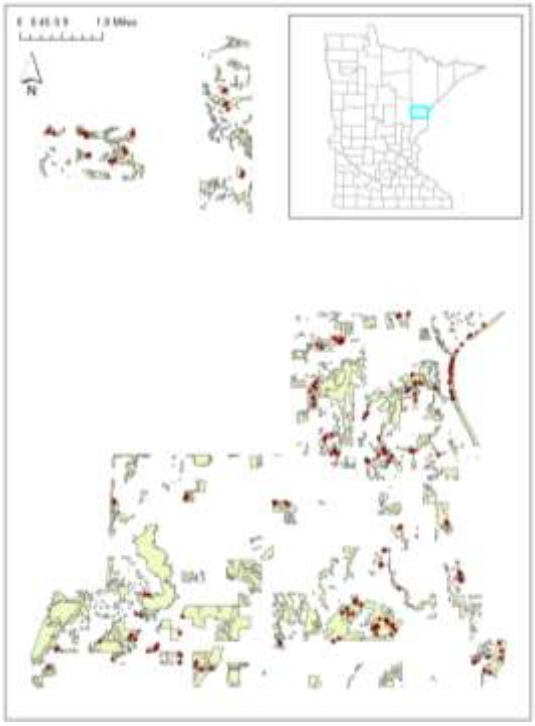


Figure 23. Left: Field sampled points (red) over wetland boundaries (tan) in Fond du Lac reservation (Carlton County, MN). Right: a wetland in the study area.

3. Recommendations and Protocol for Wetland Mapping in the Metro Area

3.1. General Recommendations

The results presented above suggest that an ideal geospatial dataset for wetland mapping, whether for automated analysis or interpretation by analysts, would include recent high resolution color infra-red images in both leaf-on and leaf-off conditions, high resolution LIDAR data providing both a bare earth DEM and vegetation height information, RADAR image data for several dates in spring and summer, and comprehensive soil type data for the study area. The TCMA has the most geospatial data available for any location in Minnesota, but even this is not sufficient to create such an idea dataset. Thus, a wetland mapping approach for the TCMA must identify the most useful of the available data types and analysis approaches. The following are general recommendations for conducting an NWI update in the TCMA:

- *Base image data for interpretation*: 2008 NAIP 1 meter color infra-red imagery. NAIP imagery was collected in Minnesota in 2009 but it does not have a color infra-red band. An important characteristic of infra-red images is that water and saturated areas appear significantly darker than non-wet areas because of the absorption of infra-red wavelengths by water. Thus, while the 2009 NAIP images are newer and will provide a more recent wetland map, the spectral information present in the 2008 images is likely to be more advantageous in both manual interpretation and image segmentation.
- *Ancillary image data*: 2009 NAIP. The new NAIP could be viewed side-by-side with the 2009 images, providing improved spectral and temporal information.

- *Elevation data*: LIDAR DEMs where available (soon to be statewide), National Elevation Data in LIDAR coverage gaps. Elevation data are critical for identifying depressional areas that may not be readily visible on optical imagery.
- *Soils data*: NRCS SSURGO layers. The SSURGO database, while at relatively coarse spatial resolution, provides useful information about the general soil characteristics of an area. Parameters drawn from the database, such as hydric and poorly-drained designations and soil acidity data, can be used to distinguish some commonly confused wetland types – particularly in the Eggers and Reed classification system.
- *Image preprocessing*: The base image data should be segmented using an object oriented algorithm prior to interpretation. While very time consuming initially, creating image segments will substantially reduce manual interpretation time and subjectivity in drawing wetland polygon boundaries.
- *Classification system*: The Cowardin classification system should be the main wetland typing method used; however, the Eggers and Reed type for each wetland should be identified during the interpretation process. Increasing nationwide adoption of the Eggers and Reed indicates that failing to collect such data would be a substantial oversight – particularly given the difficulty of developing a robust crosswalk between Cowardin and Eggers and Reed.

3.2. Mapping Protocol

The following is a set of detailed guidelines and protocol steps for mapping wetlands in the TCMA. The project steps are presented in order: data acquisition, pre-interpretation data processing, data display and interpretation, post processing, delivery, and quality control.

3.2.1 Data Types and Software

The following data types should be acquired for use in this project:

- 2008 National Agriculture Imaging Program (NAIP) images for the study area
- 2009 National Agriculture Imaging Program (NAIP) images for the study area
- Spring leaf-off imagery
- USDA NRCS Soil Survey Geographic (SSURGO) soils data
- High resolution LiDAR DEMs where available
- National Elevation Data at 10 meter spatial resolution
- Metro counties contour maps
- MN DNR hydrology dataset (rivers, lakes, etc.)
- Optical images from other years as desired (e.g. 2005 Mark Hurd)
- USGS quarter quadrangle tile index from MN DNR
- Minnesota ecoregions layer from MN DNR

Software:

- ESRI ArcGIS
- Definiens Server 7 (or later)
- Python GDAL library
- TauDEM hydrology extension for ArcGIS

3.2.2 Preprocessing

- If necessary, prepare the summer aerial imagery and any available spring leaf-off imagery (all four bands) for image segmentation by splitting them into quarter quadrangle tiles using the tile index. This can be automated using Python and the GDAL library.
- Use the batch feature in Definiens to automate segmentation of the NAIP tiles using the following parameters:
    - Color/shape: 0.5 each
    - Scale 50-70 (lower for smaller wetlands)
- Generalize segment boundaries by a reasonable amount to reduce the number of vertices. This will make subsequent editing of segment boundaries much easier and will not significantly affect the segments shapes.
- Export segments from Definiens as ArcGIS Shapefiles. Ensure they are exported with projection/coordinate information.
- Create a Normalized Difference Vegetation Index layer from the NAIP infra-red and red bands
- Threshold the NDVI layer to include only pixels with values greater than 0.2
- Use the LiDAR or NED elevation layers to create a Compound Topographic Index layer using the d-infinity water flow algorithm in TauDEM
- Compute a rudimentary wetland likelihood map by using a Boolean "AND" operator with the CTI, SSURGO, and NDVI as input, where a pixel is identified as a wetland only if the CTI is above an appropriate threshold (we suggest ~11), the NDVI is above 0.2, and the soil type is either Hydric or Poorly Drained. This likelihood map is intended to assist the interpreter in identifying areas that may be wetlands, not to replace the interpreter.

3.2.3 Data display and Interpretation

- We recommend against viewing the old NWI polygons at any point in this procedure so as not to bias the results. The old NWI could perhaps be used after the initial interpretation as a comparison.
- A dual monitor setup is recommended if possible.
- Display in ArcGIS or other appropriate software the NAIP tile of interest, the wetland likelihood map, a topography layer (LiDAR, NED), and the image segments.
- Display NAIP images and segments for each adjacent NAIP tile so that local context can be used to inform the interpretation process at the edges of the tile of interest.
- For each segment:
    - Determine whether it is wetland or upland using the interpreter's best professional judgment.
    - If the segment is wetland, record the Cowardin and Eggers & Reed (E&R) types in the ArcGIS table associated with the segment layer. We recommend this be done using a constrained attribute domain to minimize data entry errors.
    - Edit the boundaries of the segment using the ArcGIS feature editing tools so that the boundaries correspond to the natural wetland edges.

3.2.4 Data Post-processing and Delivery

- Dissolve (merge) adjacent segments that have the same wetland type. This operation should not be done if the E&R types are different.
- Delete upland segments from the segment layer.
- Deliver final segment layer as NWI wetland map. The map should be delivered at a scale desired by MN DNR, either at the quarter quad, full quad, or county, and in a GIS format such as a geodatabase.

- The product should be fully compliant with all USFWS requirements so that it is ready for upload to the main NWI.

3.2.5 Quality Assurance / Quality Control

- The mapping contractor should perform comprehensive in-house validation of the data products both during and subsequent to interpretation work. These should include positional and thematic accuracy assessments.
- If a free text data entry approach is used (e.g. the interpreters type in rather than select Cowardin codes for wetland segments), attribute validity checks should be used to ensure consistency.

4. Conclusions

The research presented in this document is an in-depth analysis of selected wetland mapping techniques for the TCMA. While some work remains to be completed, such as the wetland typing using decision trees approach, the results are sufficient to draw conclusions and to make recommendations for the optimal approach to accomplishing the objectives of the Minnesota NWI update. The protocol provided above is expected to be suitable for meeting or exceeding the FGDC wetland mapping standard and thus allowing for the inclusion of Minnesota's updated wetland maps in the USFWS National Wetland Inventory.

5. References

Arzandeh, S., & Wang, J. (2003). Monitoring the change of *phragmites* distribution using satellite data. *Canadian Journal of Remote Sensing, 29*(1), 24-35.

Baghdadi, N., Bernier, M., Gauthier, R., & Neeson, I. (2001). Evaluation of C-band SAR data for wetlands mapping. International Journal of Remote Sensing, 22(1), 71-88.

Baker, C., Lawrence, R., Montagne, C., & Patten, D. (2006). Mapping wetlands and riparian areas using Landsat ITM+ imagery and decision-tree-based models. *Wetlands, 26*(2), 465-474.

Becker, B. L., Lusch, D. P., & Qi, J. (2005). Identifying optimal spectral bands from in situ measurements of great lakes coastal wetlands using second-derivative analysis. *Remote Sensing of Environment, 97*(2), 238-248.

Becker, B. L., Lusch, D. P., & Qi, J. (2007). A classification-based assessment of the optimal spectral and spatial resolutions for great lakes coastal wetland imagery. *Remote Sensing of Environment, 108*(1), 111-120.

Blyth E. M., Finch J., Robinson M., Rosier P.: Can soil moisture be mapped onto the terrain? Hydrology and Earth System Sciences 8 (2004) 923-93

Bolstad, P. V., & Lillesand, T. M. (1992). Improved classification of forest vegetation in northern Wisconsin through a rule-based combination of soils, terrain, and Landsat Thematic Mapper data. *Forest Science, 38*(1), 5-20.

Bolstad, Paul (2006); “GIS Fundamentals”, second edition, www.paulbolstad.net/gisbook.html

Bourgeau-Chavez, L. L., Kasischke, E. S., Brunzell, S. M., Mudd, J. P., Smith, K. B., & Frick, A. L. (2001). Analysis of space-borne SAR data for wetland mapping in Virginia riparian ecosystems. *International Journal of Remote Sensing, 22*(18), 3665.

Bruzzone, L. and Carlin, L. 2006. A multilevel context-based system for classification of very high spatial resolution images. IEEE Transactions on Geoscience and Remote Sensing, 44(9): 2587-2600.

Campbell, J.B. 2007. Introduction to Remote Sensing. 4th edition. The Guilford Press: New York, NY

Costa, M. P. F., & Telmer, K. H. (2006). Utilizing SAR imagery and aquatic vegetation to map fresh and brackish lakes in the Brazilian pantanal wetland. *Remote Sensing of Environment, 105*(3), 204-213.

Costa-Cabral, M. and Burges, S. J. (1994). Digital Elevation Model Networks (DEMON): A Model of Flow Over Hillslopes for Computation of Contributing and Dispersal Areas. Water Resources Research, 30(6): 1681-1692

Cowardin, L. M., & Myers, V. I. (1974). Remote sensing for identification and classification of wetland vegetation. *The Journal of Wildlife Management, 38*(2), 308-314.

Cowardin, L. M., Carter, V., Golet, F. C., & LaRoe, E. T. (1974). Classification of wetlands and deepwater habitats of the United States.

Craig Dobson, M., Ulaby, F. T., & Pierce, L. E. (1995). Land-cover classification and estimation of terrain attributes using synthetic aperture radar. *Remote Sensing of Environment, 51*(1), 199-214.

Creed, I. F., Sanford, S. E., Beall, F. D., Molot, L. A., & Dillon, P. J. (2003). Cryptic wetlands: Integrating hidden wetlands in regression models of the export of dissolved organic carbon from forested landscapes. *Hydrological Processes, 17*(18), 3629-3648.

Dahl, T. E. (1990). *Wetlands losses in the united states 1780's to 1980's*. Washington, D.C.: U.S. Department of the Interior, Fish and Wildlife Service.

Dahl, T. E., & Johnson, C. E. (1991). *Status and trends of wetlands in the conterminous United States, mid-1970's to mid-1980's*. Washington, D.C.: U.S. Department of the Interior, Fish and Wildlife Service.

Definiens AG. 2006. Definiens Professional 5 Reference Book. Trappentreustr, 1D-80339 München, Germany.

Douglas, D. H. 1986. Experiments to locate ridges and channels to create a new type of digital elevation model. Cartographic 23: 29-61

Eggers, S.D., Reed, D.M., 1997. Wetland plants and communities of Minnesota and Wisconsin. U.S. Army Corps of Engineers, St. Paul District, 263pp.

U.S. Army Corps of Engineers. (1987). *Corps of engineers wetlands delineation manual* No. Technical Report Y-87-1). Vicksburg, Miss.: U.S. Army Engineer Waterways Experiment Station.

ERDAS IMAGINE Expert Classifier, 2005. Leica Geosystems GIS and Mapping, LLC, http://gis.leica-geosystems.com.

Federal Geodetic Data Committee (FGDC) Wetlands Subcommittee. 2008. FGDC draft wetlands mapping standard. Environmental Protection Agency, Office of Water.

Federal Register. (1980). 40 CFR part 230: Section 404(b)(1) guidelines for specification of disposal sites for dredged or fill material.*45*(249), 85352-85353.

Federal Register. (1982). Title 33: Navigation and navigable waters; chapter II, regulatory programs of the corps of engineers. *47*(138), 31810.

Fournier, Grenier, Lavoie, & Helie, 2007. Towards a strategy to implement the Canadian Wetland Inventory using satellite remote sensing.

Frappart, F., Seyler, F., Martinez, J., León, J. G., & Cazenave, A. (2005). Floodplain water storage in the negro river basin estimated from microwave remote sensing of inundation area and water levels. Remote Sensing of Environment, 99(4), 387-399. doi:DOI: 10.1016/j.rse.2005.08.016

Grenier, M., Demers, A. M., Labrecque, S., Benoit, M., Fournier, R. A., & Drolet, B. (2007). An object-based method to map wetland using RADARSAT-1 and Landsat ETM images: Test case on two sites in Quebec, Canada. Canadian Journal of Remote Sensing, 33(Suppl. 1), S28-S45.

Grenier, M., Demers, A., Labrecque, S., Benoit, M., Fournier, R.A., and Drolet, B. 2007. An object-based method to map wetland using Radarsat-1 and Landsat ETM imagers: test case on two sites in Quebec, Canada. Canadian Journal of Remote Sensing. 33 (Suppl. 1), S28-S45.

Guntner A., Seibert J., Uhlenbrook S.: Modeling spatial patterns of saturated areas: An evaluation of different terrain indices. Water Resources Research 40 (2004) W05114

Harken, J., & Sugumaran, R. (2005). Classification of iowa wetlands using an airborne hyperspectral image: A comparison of the spectral angle mapper classifier and an object-oriented approach. Canadian Journal of Remote Sensing, 31(2), 167-174.

Harvey, K. R., & Hill, G. J. E. (2001). Vegetation mapping of a tropical freshwater swamp in the Northern Territory, Australia: A comparison of aerial photography, landsat TM and SPOT satellite imagery. *International Journal of Remote Sensing, 22*(15), 2911.

Healy, T. (2005). *Muddy coasts*

Henderson, F. M., & Lewis, A. J. (2008). Radar detection of wetland ecosystems: A review. *Int.J.Remote Sens., 29*(20), 5809-5835.

Hess, L. L., Melack, J. M., & Simonett, D. S. (1990). Radar detection of flooding beneath the forest canopy: A review. *International Journal of Remote Sensing, 11*(7), 1313.

Hess, L. L., Melack, J. M., Filoso, S., & Yong Wang. (1995). Delineation of inundated area and vegetation along the Amazon floodplain with the SIR-C synthetic aperture radar. *Geoscience and Remote Sensing, IEEE Transactions on, 33*(4), 896-904.

Hess, L. L., Melack, J. M., Novo, E. M. L. M., Barbosa, C. C. F., & Gastil, M. (2003). Dual-season mapping of wetland inundation and vegetation for the central amazon basin. *Remote Sensing of Environment, 87*(4), 404-428.

Hirano, A., Madden, M., & Welch, R. (2003). Hyperspectral image data for mapping wetland vegetation. *Wetlands, 23*(2), 436-448.

Hodgson, M. E., Jensen, J. R., Mackey, H. E., & Coulter, M. C. (1987). Remote sensing of wetland habitat: A wood stork example. *Photogrammetric Engineering and Remote Sensing, 53*, 1075-1080.

Huan, Y. and Zhang, S. 2008. Application of high resolution satellite imagery for wetlands cover classification using object-oriented method. The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences. 37(B7): 521-526.

Hunt, R., Hamilton, R., and Everitt, J. 2007. Mapping weed infestations using remote sensing, in *A Weed Manager's Guide to Remote Sensing and GIS – Mapping and Monitoring*, USDA Forest Service.

Islam, ,Md.A., Thenkabail, ,P.S., Kulawardhana, ,R.W., Alankara, ,R., Gunasinghe, ,S., Edussriya, ,C., et al. (2008). Semi-automated methods for mapping wetlands using Landsat ETM+ and SRTM data. *Int. J. Remote Sens., 29*(24), 7077-7106.

Jensen, John R., 2005, *Introductory Digital Image Processing*, 3rd Ed., Upper Saddle River, NJ: Prentice Hall, 526 pages.

Johnston, C. A. (1989). *Human impacts to Minnesota wetlands* No. PB-91-183160/XAB; EPA--600/J-89/519). Duluth, Minnesota: U.S. Environmental Protection Agency.

Kasischke, E. S., Melack, J. M., & Craig Dobson, M. (1997). The use of imaging radars for ecological applications - a review. *Remote Sensing of Environment, 59*(2), 141-156.

Kasischke, E. S., Smith, K. B., Bourgeau-Chavez, L. L., Romanowicz, E. A., Brunzell, S., & Richardson, C. J. (2003). Effects of seasonal hydrologic patterns in south Florida wetlands on radar backscatter measured from ERS-2 SAR imagery. Remote Sensing of Environment, 88(4), 423-441. doi:DOI: 10.1016/j.rse.2003.08.016

Kloiber, S. Personal communication, 1/4/2010.

Lang, M.W. and G.W. McCarty, 2009. Lidar intensity for improved detection of inundation below the forested canopy. *Wetlands* 29(4).

Li, J., & Chen, W. (2005). A rulebased method for mapping canada's wetlands using optical, radar and DEM data. International Journal of Remote Sensing, 26, 5051-5069(19).

Li, J., & Chen, W. (2005). A rule-based method for mapping Canada's wetlands using optical, radar and DEM data. *International Journal of Remote Sensing, 26*(22), 5051-5069.

Lozano-Garcia, D. F., & Hoffer, R. M. (1993). Synergistic effects of combined Landsat-TM and SIR-B data for forest resources assessment. *International Journal of Remote Sensing, 14*(14), 2677.

Lu, Z., Crane, M., Kwoun, O., Wells, C., Swarzenski, C., & Rykhus, R. (2005). C-band radar observes water level change in swamp forests. EOS, TRANSACTIONS AMERICAN GEOPHYSICAL UNION, 86(14)
Meinel, G. and M. Neubert. 2004. A comparison of segmentation programs for high resolution remote sensing data. International Archives of Photogrammetry and Remote Sensing, XXXV(Part B): 1097-1105.

Moore, I. D., O'Loughlin, E. M., & Burch, G. J. (1988). A contour-based topographic model for hydrological and ecological applications. *Earth Surface Processes and Landforms, 13*(4), 305-320.

Moore, I. D., R. B. Grayson, and A. R. Ladson. 1991. Digital terrain modeling: a review of hydrological, geomorphological, and biological applications. Hydrological Processes 5:3–30

Murphy, P. N. C., Ogilvie, J., Connor, K., & Arp, P. A. (2007). Mapping wetlands: a comparison of two different approaches for New Brunswick, Canada. *Wetlands, 27*(4), 846-854.

Neuenschwander, A. L., Crawford, M. M., & Provancha, M. J. (1998). *Mapping of coastal wetlands via hyperspectral AVIRIS data*

Ozesmi, S. L., & Bauer, M. E. (2002). Satellite remote sensing of wetlands. *Wetlands Ecology and Management, 10*(5), 381-402.

Parmuchi, M. G., Karszenbaum, H., & Kandus, P. (2002). Mapping wetlands using multi-temporal RADARSAT-1 data and a decision-based classifier. Canadian Journal of Remote Sensing, 28(2), 175-186.

Ramsey III, E. W. (1998). Radar remote sensing of wetlands. In R. Lunetta, & C. Elvidge (Eds.), *Remote sensing change detection: Environmental monitoring methods and applications* (pp. 211-243). Ann Arbor, MI: Ann Arbor Press Inc.

Ramsey, E. W. (1995). Monitoring flooding in coastal wetlands by using radar imagery and ground-based measurements. International Journal of Remote Sensing, 16(13), 2495.

Ramsey, E. W., Nelson, G. A., & Sapkota, S. K. (1998). Classifying coastal resources by integrating optical and radar imagery and color infrared photography. Mangroves and Salt Marshes, 2(2), 109-119. Retrieved from http://dx.doi.org.floyd.lib.umn.edu/10.1023/A:1009911224982

Ramsey, E., Rangoonwala, A., Middleton, B., & Lu, Z. (2009). Satellite optical and radar data used to track wetland forest impact and short-term recovery from Hurricane Katrina. Wetlands, 29(1), 66-79. doi:10.1672/08-103.1

Repaka, S.R., Truax, D. D., Kolstad, E., and O'Hara, C. G. 2004. Comparing spectral and object based approaches for classification and transportation feature extraction from high resolution multispectral imagery, in *Proceedings form ASPRS Annual Conference.*

Rosenqvist, A., Shimada, M., Chapman, B., McDonald, K., De Grandi, G., Jonsson, H., et al. (2004). *An overview of the JERS-1 SAR global boreal forest mapping (GBFM) project*

Sader, S. A., Ahl, D., & Liou, W. (1995). Accuracy of Landsat-TM and GIS rule-based methods for forest wetland classification in Maine. *Remote Sensing of Environment, 53*(3), 133-144.

Shaw, Samuel P. and C. Gordon Fredine 1956. *Wetlands of the United States - their extent and their value to waterfowl and other wildlife*. U.S. Department of the Interior, Washington, D.C. Circular 39. 67pp.

Shuman, C. S., & Ambrose, R. F. (2003). A comparison of remote sensing and ground-based methods for monitoring wetland restoration success. *Restoration Ecology, 11*(3), 325-333.

Slatton, K. C., Crawford, M. M., & Chang, L. D. (2008). Modeling temporal variations in multipolarized radar scattering from intertidal coastal wetlands. ISPRS Journal of Photogrammetry and Remote Sensing, 63(5), 559-577. doi:DOI: 10.1016/j.isprsjprs.2008.07.003

Stuckens, J., Coppin, P. R., & Bauer, M. E. (2000). Integrating contextual information with per-pixel classification for improved land cover classification.71(6), 282-296.

Tarboton, D. G. 1997. A new method for the determination of flow directions and upslope areas in grid digital elevation models. Water Resources Research 33: 309-319

Thompson, J. A., Bell, J. C., & Butler, C. A. (2001). Digital elevation model resolution: Effects on terrain attribute calculation and quantitative soil-landscape modeling. *Geoderma, 100*(1-2), 67-89.

Tiner Jr., R. W. (1990). Use of high-altitude aerial photography for inventorying forested wetlands in the United States. *Forest Ecology and Management, 33-34*, 593-604.

Townsend, P. A. (2001). Mapping seasonal flooding in forested wetlands using multi-temporal radarsat SAR. Photogrammetric Engineering & Remote Sensing, 67(7), 857-864.

Townsend, P., & Walsh, S. (2001). Remote sensing of forested wetlands: Application of multitemporal and multispectral satellite imagery to determine plant community composition and structure in southeastern USA. *Plant Ecology, 157*(2), 129-149.

Töyrä, J., Pietroniro, A., Martz, L. W., & Prowse, T. D. (2002). A multi-sensor approach to wetland flood monitoring. Hydrological Processes, 16(8), 1569-1581.

Wang, J., Shang, J., Brisco, B., & Brown, R. J. (1998). Evaluation Of multi-date ERS-1 and multispectral Landsat imagery for wetland detection in southern Ontario. *Canadian Journal of Remote Sensing, 24*(1), 60-68.

Wang, J., Zheng, L., & Tong, Q. (1998). Derivative spectra matching for wetland vegetation identification and classification by hyperspectral image. *3502*(1) 280-288.

Wang, Y., Hess, L. L., Filoso, S., & Melack, J. M. (1995). Understanding the radar backscattering from flooded and non-flooded Amazonian forests: Results from canopy backscatter modeling. *Remote Sensing of Environment, 54*(3), 324-332.

Wdowinski, S., Kim, S., Amelung, F., Dixon, T. H., Miralles-Wilhelm, F., & Sonenshein, R. (2008). Space-based detection of wetlands' surface water level changes from L-band SAR interferometry. *Remote Sensing of Environment, 112*(3), 681-696.

Whitcomb, J., Moghaddam, M., McDonald, K., Podest, E., & Kellndorfer, J. (2007). *Wetlands map of alaska using L-band radar satellite imagery*

Wright, C., & Gallant, A. (2007). Improved wetland remote sensing in Yellowstone National Park using classification trees to combine TM imagery and ancillary environmental data. *Remote Sensing of Environment, 107*(4), 582-605.

Zribi, M., & Dechambre, M. (2003). A new empirical model to retrieve soil moisture and roughness from C-band radar data. Remote Sensing of Environment, 84(1), 42-52. doi:DOI: 10.1016/S0034-4257(02)00069-X

2008 Project Abstract
For the Period Ending June 30, 2010

PROJECT TITLE: Soil Survey
PROJECT MANAGER: Megan Lennon
AFFILIATION: Minnesota Board of Water and Soil Resources
MAILING ADDRESS: 520 Lafayette Road N
CITY/STATE/ZIP: St. Paul, MN 55155
PHONE: (651) 296-1285
E-MAIL: megan.lennon@state.mn.us
WEBSITE: www. bwsr.state.mn.us
FUNDING SOURCE: Environment and Natural Resources Trust Fund
LEGAL CITATION: $400,000 is from the trust fund to the Board of Water and Soil Resources for soil survey mapping and interpretation efforts in areas of the state, including Crow Wing, Pine, Cook, Lake, and Isanti Counties, and to accelerate the delivery of soils data through the Internet as a Web-based soil survey. The new soil surveys must be done on a cost-share basis with local and federal funds.

APPROPRIATION AMOUNT: $400,000

Overall Project Outcome and Results
Accurate soils information is essential for evaluating the potential for land to support development, crop and forest production, and for identifying the most suitable locations for conservation practices and other land uses. Readily accessible local soil information is critical to informing conservation decisions and provides a foundation for sustainable land use planning. The soil survey is the mechanism for how this basic natural resource information is made available to land use authorities and landowners to make the best land use decisions.

In the ongoing, multi-year project to map, classify, interpret, and Web-publish an inventory of the soils of Minnesota, this one-year phase of the project focused on accelerating the completion of a Statewide soil survey, increase soil mapping in targeted areas, and enhancing soils data through increased sample collection, availability, and interpretation. Specifically:

1. 71,000 acres mapped in Crow Wing County;
2. 32,000 acres mapped in Pine County;
3. 85,000 acres mapped in Koochiching County;
4. 80,000 acres mapped in the Crane Lake subset of St. Louis County;
5. Data from 1,000 soil samples (some dating back to the 1970's) were interpreted for the first time and incorporated into Soil Surveys for many Minnesota counties;
6. Landuse effects on soil carbon were determined on 118 sites in 14 counties throughout the State, this data can be used to develop soil carbon management guidance.

The soil survey project was extremely successful and many of the mapping goals were exceeded. Mapping surpassed initial acreage goals in both Crow Wing and Pine Counties, and the soil surveys for Koochiching and St. Louis Counties were completed 1 year ahead of schedule. A report detailing the results of re-analysis of lab samples from the 1970's highlighting landuse impacts on soil carbon will be available in January 2011.

Project Results Use and Dissemination
The Soil Survey project funded by the Minnesota Environment and Natural Resources Trust Fund is highlighted as a BWSR feature project (www.bwsr.state.mn.us/projects/soil_survey.pdf) on the Agency's homepage. All the data, mapping information, and interpretations are available

on the Web Soil Survey as a user-friendly, GIS-based application. Web Soil Survey provides soil data and information produced by the National Cooperative Soil Survey. It is operated by the USDA Natural Resources Conservation Service (NRCS) and provides access to the largest natural resource information system in the world.

Trust Fund 2008 Work Program Final Report
Trust Fund 2009 Work Program

Date of Report:	December 28, 2010	
Final Report		
Date of Next Progress Report:	January 2011	
	M.L. 2008	**M.L. 2009**
Date of Work Program Approval:	June 10, 2008	June 16, 2009
Project Completion Date:	June 30, 2010	June 30, 2011

I. PROJECT TITLE: Soil Survey

Project Manager: Megan Lennon
Affiliation: Board of Water and Soil Resources
Mailing Address: 520 Lafayette Road North
Saint Paul, MN 55155
Telephone Number: (651) 296-1285
E-mail Address: megan.lennon@state.mn.us
Fax Number: (651) 297-5615
Web Page Address: www.bwsr.state.mn.us

Location: Crow Wing, Isanti, Koochiching, Lake, Cook and Saint Louis. Web-based delivery has statewide applicability.

Total Trust Fund Project Budget:	**M.L. 2008**	**M.L. 2009**	**Total**
Trust Fund Appropriation:	**$400,000**	**$400,000**	**$800,000**
Minus Amount Spent:	**$400,000**	**$219,395**	**$619,395**
Equal Balance:	**$0**	**$180,605**	**$180,605**

Legal Citation:
M.L. 2008, Chap. 367. Sec. 20, Subd. 5(b)
2008 Appropriation Language:
$400,000 is from the trust fund to the Board of Water and Soil Resources for soil survey mapping and interpretation efforts in areas of the state, including Crow Wing, Pine, Cook, Lake, and Isanti Counties, and to accelerate the delivery of soils data through the Internet as a Web-based soil survey. The new soil surveys must be done on a cost-share basis with local and federal funds.

Legal Citation: M.L. 2009, Chap. 143, Sec. 2, Subd. 3c
2009 Appropriation Language:
$400,000 is from the trust fund to the Board of Water and Soil Resources to accelerate the county soil survey and mapping and Web-based data delivery. This appropriation represents a continuing effort to complete the mapping. The soil surveys must be done on a cost-share basis with local and federal funds.

II. and III. FINAL 2008 PROJECT SUMMARY

Overall Project Outcome and Results

Accurate soils information is essential for evaluating the potential for land to support development, crop and forest production, and for identifying the most suitable locations for conservation practices and other land uses. Readily accessible local soil information is critical to informing conservation decisions and provides a foundation for sustainable land use planning. The soil survey is the mechanism for how this basic natural resource information is made available to land use authorities and landowners to make the best land use decisions.

In the ongoing, multi-year project to map, classify, interpret, and Web-publish an inventory of the soils of Minnesota, this one-year phase of the project focused on accelerating the completion of a Statewide soil survey, increase soil mapping in targeted areas, and enhancing soils data through increased sample collection, availability, and interpretation. Specifically:

1. 71,000 acres mapped in Crow Wing County;
2. 32,000 acres mapped in Pine County;
3. 85,000 acres mapped in Koochiching County;
4. 80,000 acres mapped in the Crane Lake subset of St. Louis County;
5. Data from 1,000 soil samples (some dating back to the 1970's) were interpreted for the first time and incorporated into Soil Surveys for many Minnesota counties;
6. Landuse effects on soil carbon were determined on 118 sites in 14 counties throughout the State, this data can be used to develop soil carbon management guidance.

The soil survey project was extremely successful and many of the mapping goals were exceeded. Mapping surpassed initial acreage goals in both Crow Wing and Pine Counties, and the soil surveys for Koochiching and St. Louis Counties were completed 1 year ahead of schedule. A report detailing the results of re-analysis of lab samples from the 1970's highlighting landuse impacts on soil carbon will be available in January 2011.

Project Results Use and Dissemination

The Soil Survey project funded by the Minnesota Environment and Natural Resources Trust Fund is highlighted as a BWSR feature project (www.bwsr.state.mn.us/projects/soil_survey.pdf) on the Agency's homepage. All the data, mapping information, and interpretations are available on the Web Soil Survey as a user-friendly, GIS-based application. Web Soil Survey provides soil data and information produced by the National Cooperative Soil Survey. It is operated by the USDA Natural Resources Conservation Service (NRCS) and provides access to the largest natural resource information system in the world.

IV. 2009 PROJECT SUMMARY AND RESULTS:

M.L. 2009

This project will continue to accelerate the completion of soil mapping and digitization by complementing efforts underway by the USDA Natural Resources Conservation Service. Specifically, this project will eventually produce detailed soil survey information for Crow Wing, Lake, Cook and (the Crane Lake subset of) Saint Louis Counties. Delivery of data will be Web-based. Efficiencies will be achieved by utilizing retired NRCS soil scientists and by detailing, to Minnesota, NRCS soil scientists employed in other states. Several soil scientists will be similarly employed and will map an additional 50,000 acres.

V. PROGRESS SUMMARY AS OF:

August 20, 2009:
M.L. 2009: N/A at this time. Contracts are being prepared.

January 19, 2010:
M.L. 2009: A contract with Crow Wing County is finalized and contracts with Lake and Cook Counties and the NRCS are in discussion.

April 15, 2010:
Amendment Request (April 15, 2010)
Funds are shifted from the NRCS (result 2) to Lake and Cook Counties (result 1) to contract for soil scientists to work under the direction of NRCS and BWSR. This will better facilitate the completion of mapping in Lake and Cook Counties. **Amendment Approved: 5/7/2010**

June 24, 2010
Amendment Request (6/24/2010)

Funds are shifted from NRCS (result 2) to a contract with a retired soil scientist (result 3). BWSR will be directly contracting with the retired soil scientist to do interpretation and database rather than NRCS contracting with the retired soil scientist as originally noted in the April 15, 2010 work plan. The completion date of result 2, deliverable 2 has been extended to June 30, 2011 to facilitate the completion of interpretation and web availability of an additional 1,000 samples. **Amendment Approved 6/24/2010**

July 13, 2010:

M.L. 2009: Contracts for all results have been encumbered and work is underway. These activities involve Crow Wing, Cook and Lake Counties, NRCS and a private sector soil scientist. As of 7/13/10 BWSR has not received an invoice for work done on the previously mentioned contracts.

December 30, 2010
M.L. 2009: Work in underway Crow Wing, Lake and Cook Counties as well as the St. Louis Crane Lake subsection of St. Louis County. Contracted work to complete lab interpretation and web availability (result 2, deliverable 2) is nearing completion.

VI. OUTLINE OF PROJECT RESULTS:

Soil surveys contain information essential to the management of natural resources. Many of the technical specifications for the protection and restoration of soil, water, wetlands and habitats require the consideration of soils data. For many years, the State of Minnesota has supported the efforts of the USDA Natural Resources Conservation

Service to map the soils of this state. During the last three years, soils data have become available through the Internet (Web Soil Survey). Before soils data can be delivered through the Internet, soils must be mapped and digitized. Progress is being made to complete this task. (Lake and Cook, the last two counties, have signed agreements with NRCS to complete their soil survey.) However, the NRCS estimates that at current staffing levels, ten or more years are needed to complete the state. This proposal will accelerate the completion and includes funding to continue county government support for soil mapping and digitizing, accelerate soil mapping and update and reinterpret older soils data. To accomplish these tasks, efficient and timely use will be made of former and current NRCS soil scientists. Soils data, some of it older, will be updated for modern interpretations and delivered through the Web Soil Survey.

Result 1: "Support county government efforts to complete the soil survey for the state". Crow Wing, Pine, Cook and Lake Counties are the final counties in the plan to complete a soil survey for the State. For Crow Wing and Pine Counties, the cost of completing the soil survey is borne by the USDA, state and county in (approximately) a 70/20/10 distribution, respectively. (Contributions to soil survey costs in Isanti and the survey areas in the NE are varied and include LCMR, USDA and county cost-sharing arrangements.) Result 1 will generate about $100,000 per year of local cost-share in the form of cash, office space and soil survey-related equipment and products.

Summary Budget Information for Result 1:

	M.L. 2008	M.L. 2009	Total
Trust Fund Budget:	**$150,000**	**$235,000**	**$385,000**
Amount Spent:	**$150,000**	**$0**	**$150,000**
Balance:	**$ 0**	**$235,000**	**$235,000**

Deliverable	Completion Date	Budget	General Status (See details below)
1. 2008: About 70,000 acres will be addressed in Crow Wing County by existing NRCS staff. The NRCS has now fully staffed this survey with three soil scientists.	June 30, 2010	$75,000	Acreage goals were met and budget was spent.
2. 2008: About 15,000 acres per year will be addressed in Pine County by existing NRCS staff. The NRCS intends to add two or more soil scientists to this survey. The state supported accelerated program is ending: no additional state funded soil scientists will be added for 2009.	June 30, 2010	$75,000	Although county and state participation has ended, NRCS exceeded acreage goals. The

			budget was spent.
3. 2009: About 150,000 acres will be addressed in Crow Wing County by existing NRCS staff.	June 30, 2011	$75,000	Ongoing. As of July 2010 about 250,000 acres have been addressed. Digital soils data for the 83,000 acre Glacial Lake Brainerd area will be posted on the WEB in September 2010. An additional 13,000 have been addressed as of 12/30/2010.
4. 2009: About 85,000 acres will be addressed in Lake County by existing NRCS staff and soil scientists contracted by the county. The NRCS currently has one soil scientist assigned to this survey who will also assist with quality control. **Amendment approved: 5/7/2010**	June 30, 2011	$107,000	NRCS is "gearing up", and are supervising four soil scientists jointly hired by Lake and Cook Counties. About 66,000 acres have been addressed as of December 2010.

5. 2009: About 42,000 acres will be addressed in Cook County by existing NRCS staff and soil scientists contracted by the county. The NRCS currently has one soil scientist assigned to this survey who will also assist with quality control. **Amendment approved: 5/7/2010**	June 30, 2011	$53,000	NRCS is "gearing up" are supervising four soil scientists jointly hired by Cook and Lake Counties. About 38,000 acres have been addressed as of December 2010.

Result Completion Date:
M.L. 2008: June 30, 2010. The proposed allocation is $75,000 each to Crow Wing and Pine Counties for 2008. These funds will be used to support their agreement with the USDA NRCS.
M.L. 2009: June 30, 2011. The proposed allocation is $75,000 to Crow Wing County and $37,500 each to Lake and Cook Counties for 2009. These funds will be used by the counties to support their agreement with the USDA NRCS.

Result Status as of August 20, 2009:

M.L. 2009: Contract discussions are underway with Crow Wing, Lake and Cook Counties and NRCS.

Result Status as of January 19, 2010:

M.L. 2009: NRCS addressed 30,000 acres in Crow Wing County, 60,000 acres in Lake County and 5,000 acres in Cook County. NRCS has provided 2 soil scientists to address Lake County and 1 fulltime and 1 part time soil scientist to address Cook County.

Result Status as of July 13, 2010:

M.L. 2009: Contracts have been completed with Cook and Lake Counties who have employed four soil scientists working under the direction of NRCS. Activities continue in Crow Wing County. BWSR has not received invoices for work done on these contracts.

Result Status as of December 30, 2010:

M.L. 2009: Four contracted soil scientists, with aid from NRCS detailees (Result 2), addressed 66,000 acres in Lake County, 13,000 acres in Crow Wing County, and 38,000 acres in Cook County.

Final Report Summary

M.L. 2008: The NRCS addressed 71,000 acres in Crow Wing County and 32,000 in Pine County (despite Pine County's withdrawal from the program). Portions of both Crow Wing and Pine Counties are available on the Web Soil Survey.

Result 2: "Increase soil mapping. Experience has shown that soil mapping can be accelerated by augmenting existing NRCS staff with experienced soil scientists familiar with NRCS mapping procedures and the soil landscape. For 2008, an additional 40,000 acres will be addressed by current NRCS soil scientists (detailees) brought to Minnesota on work assignments. For 2009, an additional 28,000 acres will be addressed**. Amendment approved: 6/24/2010**

Summary Budget Information for Result 2:

	M.L. 2008	M.L. 2009	Total
Trust Fund Budget:	**$100,000**	**$140,000**	**$240,000**
Amount Spent:	**$100,000**	**$0**	**$100,000**
Balance:	**$0**	**$140,000**	**$240,000**

Deliverable	Completion Date	Budget	General Status (See details below)
1. M.L. 2008: 40,000 acres addressed in several project areas including Pine, Saint Louis (Crane Lake) Lake, Cook and Koochiching. This deliverable will be completed by June 30, 2010. (Note: "New" surveys -Lake and Cook- received only federal funds.) Pine terminated the project July 7, 2009; funds, if any, to shift to NRCS in 2009.	June 30, 2010	$100,000	Acreage goals were met and budgeted amount was spent.
2. M.L. 2009: 28,000 acres addressed in several project areas including Saint Louis (Crane Lake), Koochiching, Lake and Cook Counties. Decreased acreage goal by NRCS due to increased acreage by private sector soil scientists working	June 30, 2011	$140,000	A contract with NRCS is complete and NRCS

under NRCS direction. This deliverable will be completed by June 30, 2011. **Amendment approved: 6/24/2010**			relocated existing soil scientists in MN to accelerate mapping.

Result Status as of August 20, 2009:

M.L. 2009: A plan for acceleration is being developed based on an assessment of 2008 activities.

Result Status as of January 19, 2010:

M.L. 2009: A plan for accelerating production in Lake and Cook Counties is being discussed and may include detailees, private sector soil scientists and new technology such as soil inference modeling techniques.

Result Status as of July 13, 2010:

M.L. 2009: NRCS is advertising for detailees, who will complement the existing work force in Lake, Cook and Crow Wing Counties.

Result Status as of December 30, 2010:

M.L. 2009: NRCS relocated 2 detailees to work on mapping in Northeast Minnesota. The increased 'man power' accelerated mapping in Lake, Cook and St. Louis Counties. About 20,000 acres were address in the Crane Lake Subsection of St. Louis County. The NRCS detailees and contracted soil scientists addressed 66,000 acres in Lake County, 13,000 acres in Crow Wing County and 38,000 acres in Cook County.

Final Report Summary

M.L. 2008: NRCS-employed soil scientists, assigned to Minnesota ("detailees"), addressed 85,000 acres in Koochiching County and 80,000 acres in the Crane Lake subset of Saint Louis County. As a result of these significant accomplishments, the surveys of Koochiching and the Crane Lake subset were completed one year ahead of schedule and will be posted on the WEB Soil Survey. Lake and Cook Counties received only Federal funds and the 'new' soil surveys are prioritized for mapping with 2009 Soil Survey Project appropriation.

Result 3: "**Accelerate data collection, availability and interpretation."**
By providing additional personnel (including professional/technical contracts) to update and interpret soils data, modern interpretations will be developed, some from older data. All data will be available for delivery on the Internet (Web Soil Survey). The USDA

NRCS has committed $8,000 cash and an equal amount of in-kind services to this effort. **Amendment approved 6/24/2010**

Summary Budget Information for Result 3:

	M.L. 2008	M.L. 2009	Total
Trust Fund Budget:	**$150,000**	**$25,000**	**$175,000**
Amount Spent:	**$150,000**	**$0**	**$150,000**
Balance:	**$0**	**$25,000**	**$25,000**

Deliverable	Completion Date	Budget	Status
1. M.L. 2008: A county-based soil productivity index for agricultural crops and forests will be developed for statewide use by June1, 2009. This project will be done in consultation with the NRCS who is responsible for posting the product on the WEB Soil Survey.	June 1, 2009	No 2008 funds were used for this deliverable. 2007 funds were used.	Crop productivity and forest productivity indices have been prepared for 85 and 20 soil survey areas, respectively.
2. M.L.2008 and M.L. 2009: Data from several hundred lab samples dating back to the 1970's will be interpreted and made Web-available. **Amendment approved 6/24/2010**	June 30, 2011	$175,000 (150,000 '08 and 25,000 '09)	The UM-led '08 project is nearing completion and additional samples will be characterized with '09 funding. A report is available in January 2011.

Result Completion Date: M.L. 2008: Deliverables 1 and 2 will be done by June 1, 2009 and June 30, 2011, respectively. For budget purposes, the budget for the entire Result is allocated among all deliverables.

Result Status as of March 11, 2009: Deliverable 1. (Soil productivity indices) are mostly done (funded with 2007 LCCMR appropriations) so attention has been given to the interpretation of historic data (deliverable 2). To that end, the UM has been working with USDA NRCS staff on database matters and will likely hire student workers to do the majority of data entry.

Result Status as of July 13, 2010

M.L. 2009: A retired NRCS soil scientist was hired to do interpretation of additional historic soil samples. These interpretations will augment existing data in the national NRCS soils data base. As of July 13, 2010, BWSR has not received an invoice for work done on this contract.

Result Status as of December 30, 2010

M.L. 2008: The $150,000 has been spent from the 2008 appropriation of funds for Result 3, deliverable 2. A report on analysis of historic lab samples compared to contemporary samples will be available in January 2011.

M.L. 2009: The retired NRCS soil scientist has completed interpretation of additional historic soil samples. Work is currently focused on integrating new data into the national soils database. As of December, 2010, BWSR has not received an invoice for work done on this contract.

Final Report Summary

M.L. 2008: Inventorying and cataloging the over 10,000 soil samples collected over a 30 year period beginning in the mid-1970's has began. Using many of these same sampling sites, contemporary samples will be taken to determine what, if any, trends exist regarding soil carbon and nitrogen. Data for 118 sites has been collected and is being interpreted. A paper detailing the results will be ready by January 2011. Initial results show land use and management influence soil organic carbon levels in Minnesota soils.

VII. Total Trust Fund Project Budget:

M.L. 2008

Staff or Contract Services: $ 400,000. $150,000 --$75,000 each for contracts with Crow Wing and Pine Counties—for ongoing soil survey activities. Due to their withdrawal, Pine County will receive a pro-rated final payment and may not earn the entire $75,000 [result 1]; $100,000 contract with USDA-NRCS to increase soil mapping and data availability [result 2] The balance—if any-- of the Pine County agreement will be awarded to USDA-NRCS; $150,000 contract with the UM to accelerate data collection, availability and interpretation [result 3].

Equipment: $ None anticipated to be procured with LCCMR funds.

Development: $ N/A

Restoration: $ N/A

Acquisition, including easements: $ N/A

TOTAL 2008 TRUST FUND PROJECT BUDGET: $ 400,000

M.L. 2009
Contracts: $400,000 USDA NRCS $140,000; Counties $235,000: Crow Wing County $75,000; Lake County $107,000; and Cook County, $53,000; Retired NRCS soil scientist, $25,000.

Equipment/Tools/Supplies: N/A
Acquisition, including Easements: N/A
Travel: N/A
Other: N/A
TOTAL 2009 TRUST FUND PROJECT BUDGET: $400,000

IIX. OTHER FUNDS & PARTNERS/ PROJECT STRATEGY:

A. Project Partners:
M.L. 2008
The project team includes Joe McCloskey, State Soil Scientist, USDA NRCS; Greg Larson, State Soil Specialist, BWSR, and Professor Ed Nater, UM Department of Soil, Water and Climate. The NRCS will receive $100,000 plus the balance of the terminated agreement with Pine County and the UM will receive $150,000.

M.L. 2009 **Amendment Approved: 5/7/2010**
The project team includes Caryl Radatz, State Soil Scientist, USDA NRCS; Megan Lennon, Soil Scientist, BWSR and Greg Larson, State Soil Specialist. The NRCS will receive $140,000.

B. Other Funds Proposed to be Spent during 2008 and 2009:
Each year, the Minnesota Office of the NRCS has or will commit(s) about $2.5 Million to their soils program, with about $2.0 Million spent on completing soil mapping and digitizing activities in the remaining project areas. The Board of Water and Soil Resources provides in-kind contributions of about $20,000 annually.

C. Spending History:
The LCMR contributed $500,000 funding for the biennium ending June 30, 2007. Crow Wing County has contributed about $30,000 annually. Pine County has contributed about $10,000 annually. Lake and Cook Counties will each contribute about $10,000 annually.

D. Time for 2008 and 2009 funds:
2008 funds are for the biennium beginning July 1, 2008.
2009 funds are for the biennium beginning July 1, 2009.

E. Project Impact and Long-term Strategy:
As stated previously, soils data are critical to the use and management of soils and other natural resources. Work remains in five survey areas (of 91) before WEB-

published soil survey is available statewide. A county by county assessment of the completion schedule is provided, followed by a table that summarizes which year(s) of LCCMR funding was used.
Koochiching: Field work is done. WEB-publication is complete.
Saint Louis County (Crane Lake subset): Field work is done. WEB-publication is complete.
Pine: Work is no longer on schedule. The termination of the project by the county creates an uncertain future. To meet federal mandates, USDA-NRCS will continue to work in the county but at a much slower pace. However, as reported earlier, the NRCS has made significant progress.
Crow Wing County: Work is on schedule to complete the entire county by late 2013. WEB-publication of the 83,000 acre Glacial Lake Brainerd geomorphic area is complete.
Lake County: As reported earlier, work is beginning to complete the entire county by late 2013. Much of the county is part of the Superior National Forest. Soils mapping therein has been completed by the US Forest Service.
Cook County: As reported earlier, work is beginning to complete the entire county by late 2013. Much of the county is part of the Superior National Forest. Soils mapping therein has been completed by the US Forest Service.

Survey Area	**LCCMR 07**	**LCCMR 08**	**LCCMR 09**
Koochiching	X	X	
Saint Louis (Crane Lake)	X	X	
Pine County		X	
Crow Wing County	X	X	X
Lake County			X
Cook County			X

IX. DISSEMINATION: As the projects described herein are developed and approved by the NRCS, they may be used without restriction.

IX. REPORTING REQUIREMENTS: Periodic work program progress reports will be submitted not later than January 2009; June 30, 2009; January 2010, June 30, 2010, and January 2011. A final work program report and associated products for the 2008 appropriation will be submitted between June 30 and August 1, 2010 as requested by the LCCMR and a final work program report and associated

products for the 2009 appropriation will be submitted no later than August 1, 2011.

X. RESEARCH PROJECTS: Not applicable.

Attachment A: Budget Detail for 2009 Projects July 11, 2010

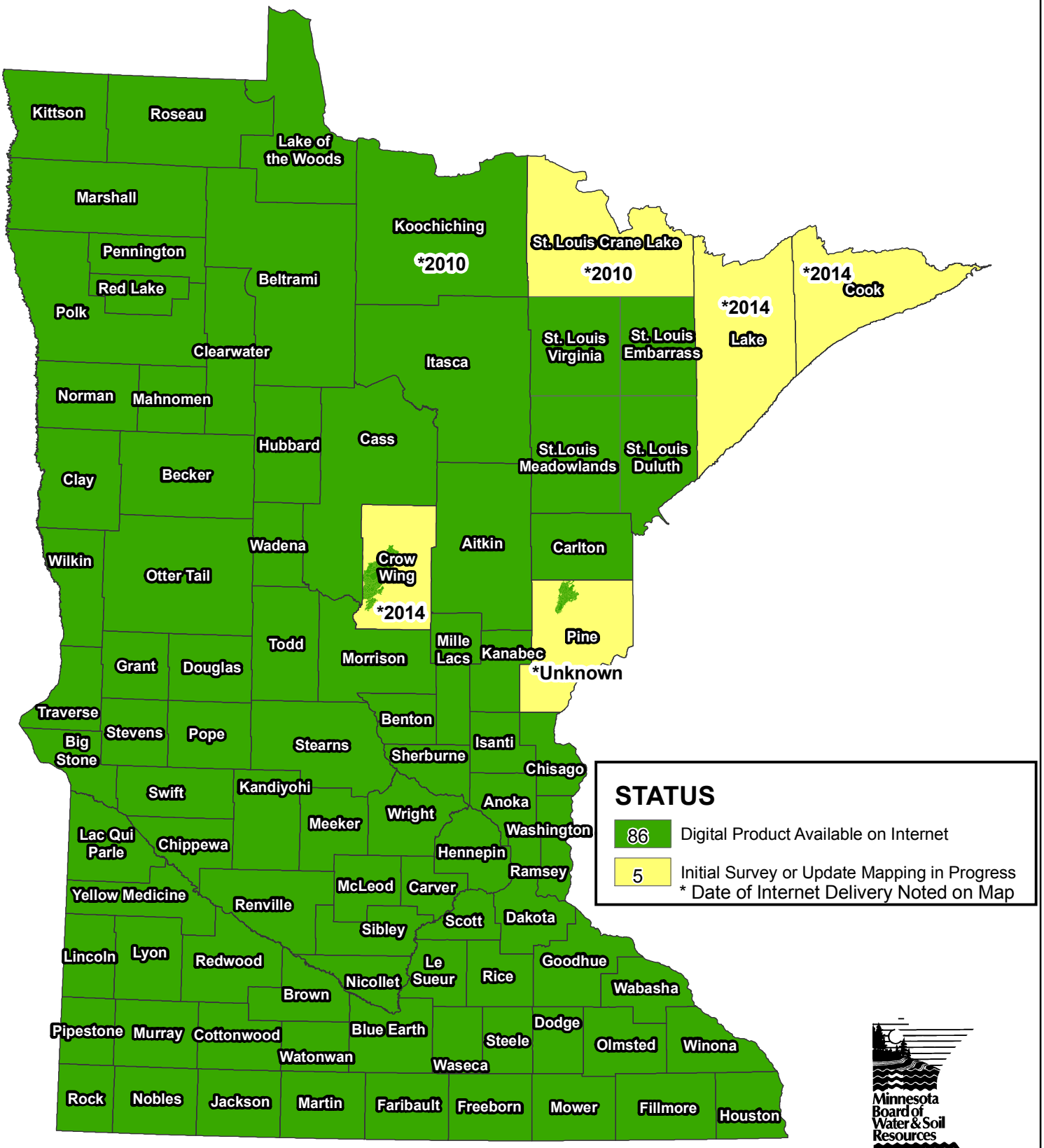
Project Title: Soil Survey

Project Manager Name: Greg Larson

Trust Fund Appropriation: $400,000

2009 Trust Fund Budget	**Results 1 Budget 4/15/2010 Amendment approved: 5/7/2010**	**Amount Spent** *(11/16/2010)*	**Balance** *(12/30/2010)*	**Revised Result 2 Budget July 11, 2010**	**Amount Spent** *(10/21/2010)*	**Balance** *(12/30/2010)*	**Revised Result 3 Budget 7/11/2010**	**Amount Spent** *(12/30/2010)*	**Balance** *(12/30/2010)*	**Revised TOTAL Budget BUDGET**	**Revised TOTAL BALANCE**
				Increase soil mapping							
BUDGET ITEM											
Contracts											
Cook County	53,000	53,000	0							53,000	0
Crow Wing County	75,000	0	75,000							75,000	75,000
Lake County	107,000	41,395	65,605							107,000	65,605
Retired Soil Scientist 6/24/2010 (Al Giencke, work is to interpet and make web available 1,000 soil samples)							25,000	0	25,000	25,000	25,000
USDA NRCS				140,000	50,000	90,000		0		140,000	90
COLUMN TOTAL	**$235,000**	**$94,395**	**$140,605**	**$140,000**	**$0**	**$140,000**	**$25,000**	**$0**	**$25,000**	**$400,000**	**$165,695**

Status of Minnesota Digital Soil Surveys and Their Internet Delivery



October, 2010

NRCS Web Soil Survey:
http://websoilsurvey.nrcs.usda.gov/app/

Source: NRCS

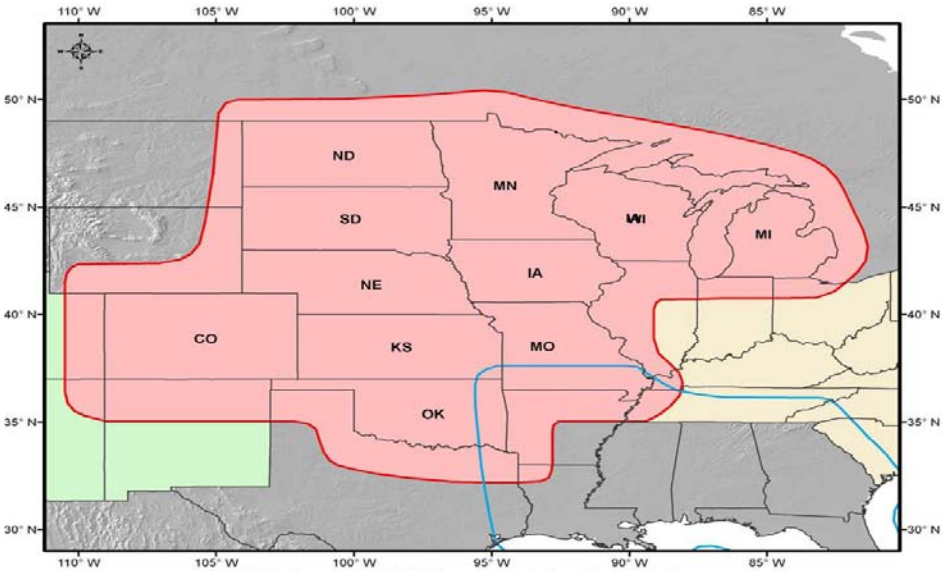
PROJECT TITLE: **Updating Precipitation Intensities for Runoff Estimation and Infrastructure Designs.**

PROJECT MANAGER:	C. Bruce Wilson
AFFILIATION :	Minnesota Pollution Control Agency
MAILING ADDRESS:	520 Lafayette Road North
CITY/STATE/ZIP:	St. Paul, MN 55155-4194
PHONE:	651-757-2828
E-MAIL :	Bruce.Wilson@State.MN.US
WEBSITES:	http://www.pca.state.mn.us/
	http://hdsc.nws.noaa.gov/hdsc/pfds/

FUNDING SOURCE:	Environment and Natural Resources Trust Fund
LEGAL CITATION:	M.L. 2008, Chp. 367, Sec 2, Subd. 5(c)
APPROPRIATION AMOUNT:	$100,000

Overall Project Outcome and Results

Checking the daily weather forecast for where and how bad the next storms will be has become a more important part of our daily routines. Recent variable climate (dry periods, intense storms and floods) have brought heightened awareness by farmers, engineers, cities and water managers of rainfall intensity (how fast) and duration (how long). Up to now, available summaries (done in the early 1960's) were based on relatively crude analyses of rainfall data collected through the 1950's. This project has updated precipitation intensities based on the compilation of hundreds of rainfall monitoring locations in and around Minnesota (including our neighboring Canadian and adjacent state partners) with continuous data collected through 2009 via a partnership with the National Oceanic and Atmospheric Administration, National Weather Service (NOAA/NWS). State-of-the-art computer-based statistical procedures have generated summary information and maps with a resolution of 4 km by 4 km (or about 2.5 miles by 2.5 miles). NOAA required one contract with all 11 Midwest states (Minnesota, North Dakota, South Dakota, Wisconsin, Michigan, Iowa, Missouri, Colorado, Nebraska, and Kansas) with pass-through funding via the Pooled Highway Fund. All Environment and Natural Resources Trust Fund dollars were expended by June 30, 2011 with additional funding provided by the Minnesota DOT being used to complete the final work components. This study has generated rainfall frequency estimates for durations from 15 minutes to 60 days and for average recurrence intervals from 1 to 1,000 years along with trend analyses. Final web-based products will be available in early 2012 due to delays associated with reducing huge amounts of data from about ½ of the contiguous United States. The results of this work are required for standard engineering practices associated with runoff routing, flood prevention and safe road & culvert designs - and will become part of our daily forecasts ('today's storm is called a hundred year event').

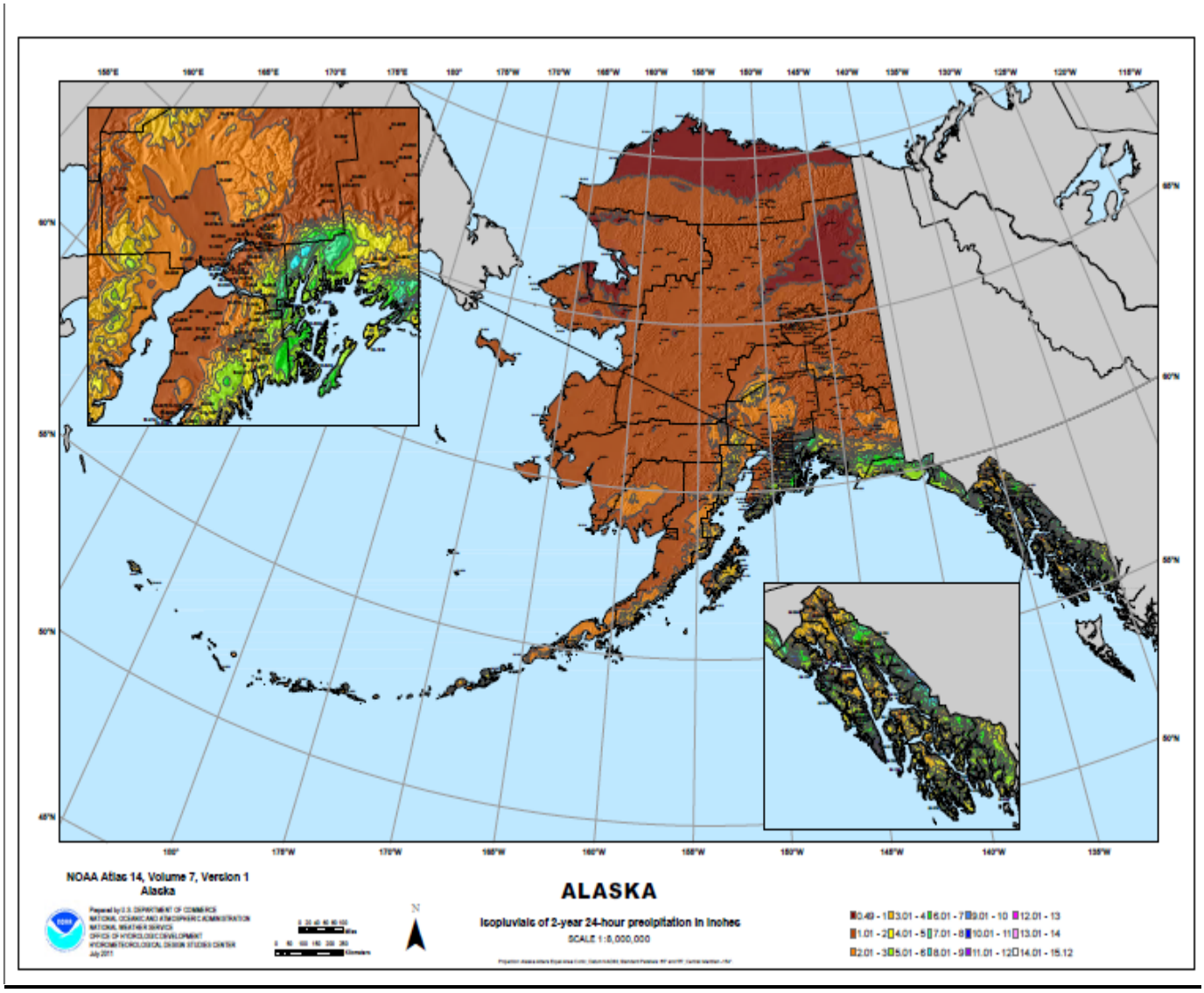


NOAA 14 Midwest Project Area

Project Results Use and Dissemination

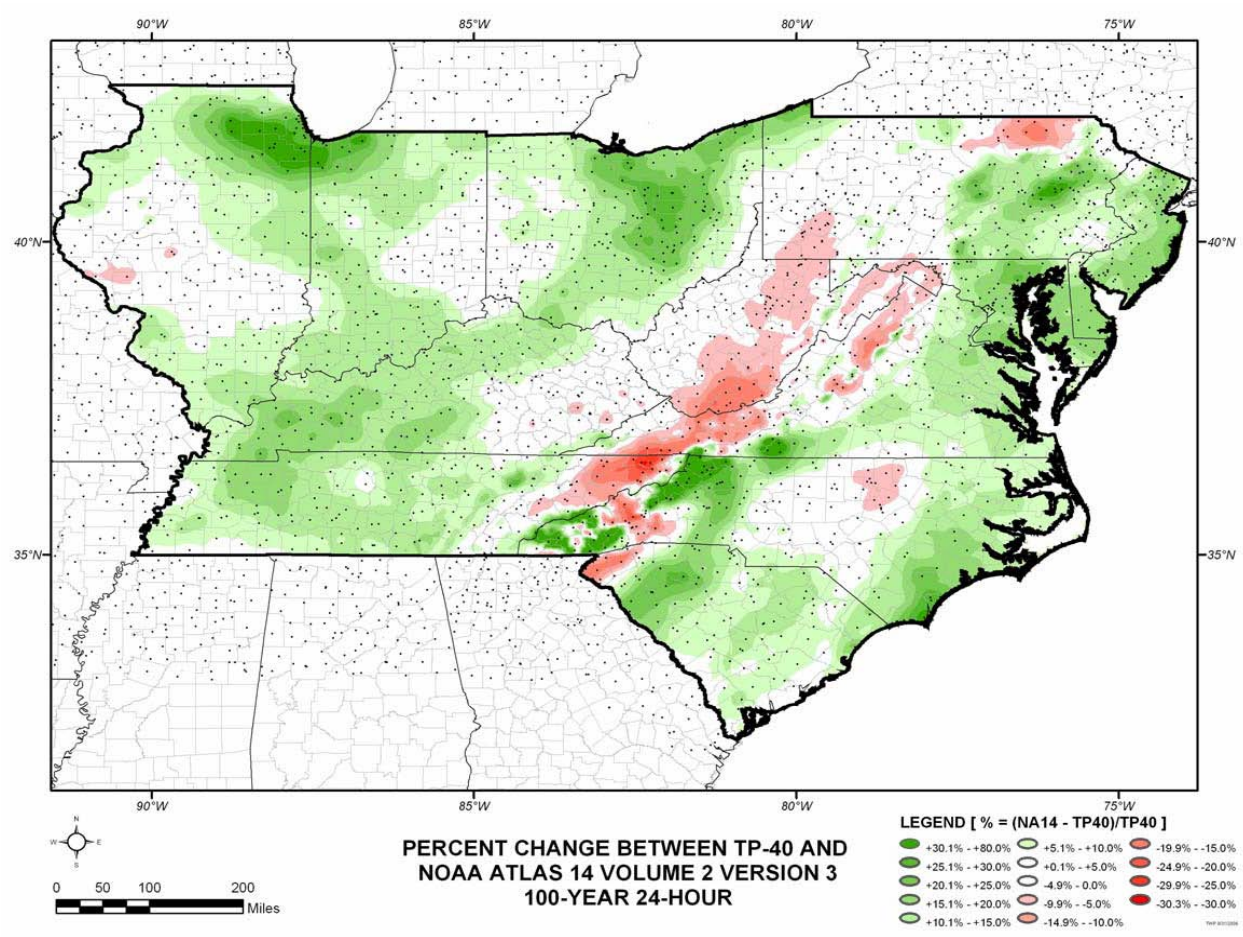
1. Precipitation frequency information is required for standard engineering practices for building new roads, highways, bridges, and developments so as to minimize flooding and for water quality treatment, agricultural and other watershed management purposes.
2. This study has resulted in rainfall frequency estimates from 15 minutes to 60 day durations and for average recurrence intervals from 1 to 1,000 years. Data has been summarized in NOAA's nationally recognized standard engineering tables. New products have been developed for inclusion in GIS formats for a wide variety of computer-based applications and website distribution for watershed management purposes. Regional patterns and comparisons to old TP-40 rainfall frequency data will also be available.
3. Project products will be freely available from the NOAA website http://hdsc.nws.noaa.gov/hdsc/pfds including reports, maps and spatial data with precipitation frequency estimates and downloads of digital files including:
    - point estimates (via a point-and-click interface)
    - ArcInfo© ASCII grids
    - ESRI shapefiles
    - color cartographic maps for each state
    - associated Federal Geographic Data Committee-compliant metadata
    - data series used in the analyses: annual maximum series and partial duration series
    - temporal distributions of heavy precipitation (6-hour, 12-hour, 24-hour and 96-hour)
    - seasonal exceedance graphs: counts of events that exceed the 1 in 2, 5, 10, 25, 50 and 100 annual exceedance probabilities for the 60-minute, 24-hour, 48-hour, and 10-day durations.

State and regional examples from completed NOAA/NWS work for other US areas are included below. State precipitation frequency products. The below graphic depicts considerable variation in intensity in the typical storm that occurs once every 2 years over a 24 hour period across Alaska. In this example, lesser amounts associated with brown colors (e.g. less than 3 inches) with greater amounts shown in green (~ 5 to 9 inches) and yet greater amounts in blue/pink (e.g. 9 to 15 inches).



Example Regional Products. The above product for east-central US depicts the percent change in rainfall between the old TP-40 rainfall intensity data to the new NOAA Atlas 14 for a 100 year, 24 hour storm event with green colors showing increased amounts (up to 30% to 80 % (pocket by Chicago) increase from TP-40 values) and red shades depicting declining amounts (up to ~ 30% declines in the mountain areas from old TP-40 values). Hence, using TP-40 data could result in the use of significantly different

rainfall amounts than current data would suggest, for the design of developments and associated infrastructure.



<u>Summary of Final Deliverables to be Freely Disseminated by Spring 2012:</u>

- Web-based Precipitation Frequency Data Server.
- Precipitation frequency estimates with 90% confidence intervals at rain gage locations for durations of 15, and 30 minutes,1, 2, 3, 6, 12 hours, and 1, 2, 4, 7, 10, 20, 30, 45, and 60 days and average recurrence intervals (return period)) of 1, 2, 5, 10, 25, 50, 100, 200, 500, and 1000 years.
- High resolution grids of average precipitation frequency estimates and 90% confidence intervals for each combination of duration and average recurrence intervals, as specified above. .
- Shapefiles of contours of the gridded estimates of average precipitation frequency estimates and 90% confidence intervals for each combination of durations and average recurrence intervals specified above.
- Meta information in Federal Geographic Data Transfer Standard format.
- Cartographic maps of the estimates with one map for each combination of frequency and duration for the expected value and upper and lower 90%

confidence intervals or equivalent information delivered through an Internet map server.

- Probabilistic temporal distributions for 6, 12, 24 and 48 hour durations in both chart and digital form.
- Peer reviews of initial gridded frequency estimates for 1 and 24 hour durations and for 2-year and 100-year average recurrence intervals.
- Charts of the seasonal distribution of annual maxima.
- Documentation.
- Status reports.
- Final products will be provided on the NOAA/NWS website **www.nws.noaa.gov/ohd/hdsc**

Environment and Natural Resources Trust Fund
2008 Work Program Final Report

Date of Report: August 5, 2011
Final Report
Date of Work program Approval: June 10, 2008
Project Completion Date: June 30, 2011

I. PROJECT TITLE: **Updating Precipitation Intensities for Runoff Estimation and Infrastructure Designs.**

Project Manager: C. Bruce Wilson
Affiliation: Minnesota Pollution Control Agency
Mailing Address: 520 Lafayette Road North
City / State/Zip: St. Paul, MN 55155-4194
Telephone Number: 651-757-2828
E-mail Address: bruce.wilson@state.mn.us
Fax Number: 651-297-8337
Web Page address: http://www.pca.state.mn.us/
http://hdsc.nws.noaa.gov/hdsc/pfds/
Location: Statewide

Total Trust Fund Project Budget:	**Trust Fund Appropriation:**	**$**	**100,000**
	Minus Amount Spent:	**$**	**100,000**
	Equal Balance:	**$**	**0**

Legal Citation: M.L. 2008, Chp. 367, Sec 2, Subd. 5(c)

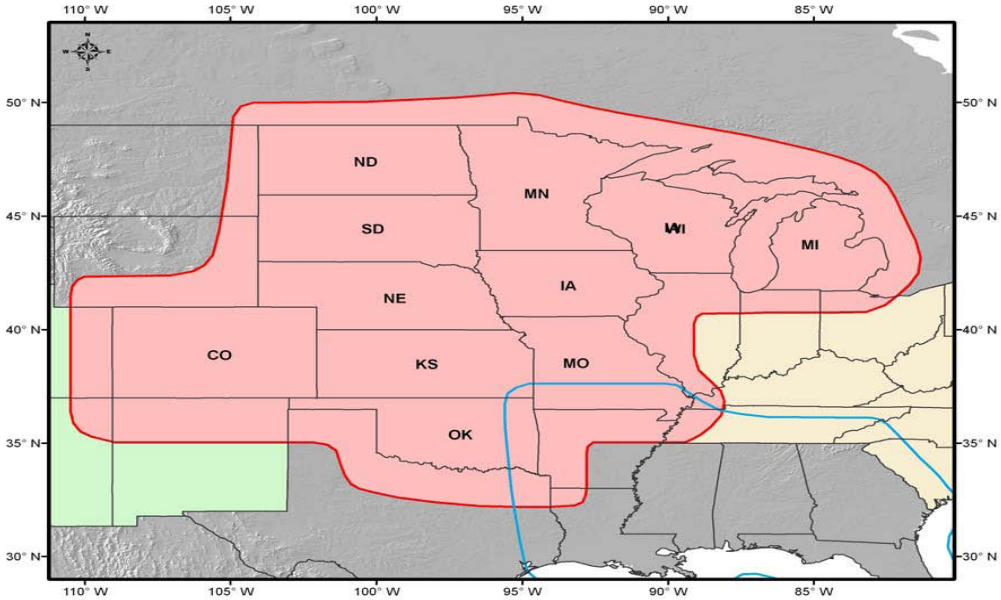
Appropriation Language:

$100,000 is from the trust fund to the Commissioner of the Minnesota Pollution Control Agency (MPCA) for a cooperative agreement with the National Oceanic and Atmospheric Administration (NOAA) to partially fund a multi-state effort to obtain updated climate change related rainfall frequencies to enhance engineering of stormwater conveyance and treatment systems and roads. The acquired data shall be distributed free of charge. This appropriation is available until June 30, 2011, at which time the project must be completed and final products delivered, unless an earlier date is specified in the work program.

II. and III. Final Project Summary and Results:
Checking the daily weather forecast for where and how bad the next storms will be has become a more important part of our daily routines. Recent variable climate (dry periods, intense storms and floods) have brought heightened awareness by farmers, engineers, cities and water managers of rainfall intensity (how fast) and duration (how long). Up to now, available summaries (done in the early 1960's) were based on relatively crude analyses of rainfall data collected through the 1950's. This project has updated precipitation intensities based on the compilation of hundreds of rainfall monitoring locations in and around Minnesota (including our neighboring Canadian and adjacent state partners) with continuous data collected to 2009 via a partnership with the National Oceanic and Atmospheric Administration, National Weather Service (NOAA/NWS). State-of-the-art computer-based statistical procedures have generated summary information and maps with a resolution of 4 km by 4 km (or about 2.5 miles by 2.5 miles). NOAA required one contract with all 11 Midwest states (Minnesota, North

Dakota, South Dakota, Wisconsin, Michigan, Iowa, Missouri, Colorado, Nebraska, and Kansas) with pass-through funding via the Pooled Highway Fund. All Environment and Natural Resources Trust Fund dollars were expended by June 30, 2011 with additional funding provided by the Minnesota Department of Transportation (Mn/DOT) being used to complete the final work components. This study has generated rainfall frequency estimates for durations from 15 minutes to 60 days and for average recurrence intervals from 1 to 1,000 years along with trend analyses. Final web-based products will be available in early 2012 due to delays associated with reducing huge amounts of data from about half of the contiguous United States. The results of this work are required for standard engineering practices associated with runoff routing, flood prevention and safe road and culvert designs and will become part of our daily forecasts (today's storm is called a 'hundred-year storm').

Progress Summary as of September 8, 2010:



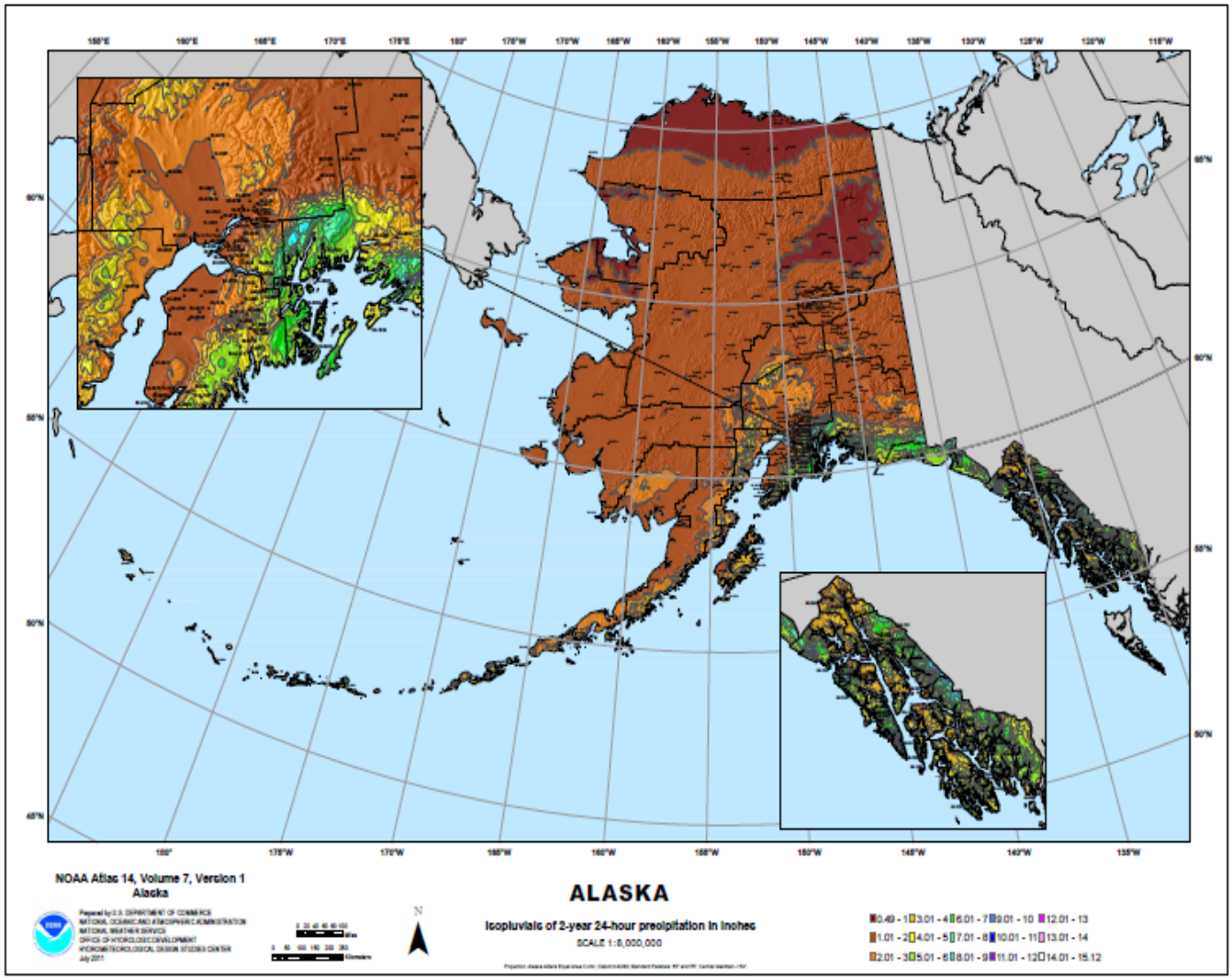
NOAA 14 Midwest Project Area

<u>Project Results Use and Dissemination</u>

1. Precipitation frequency information is required for standard engineering practices for building new roads, highways, bridges, and developments so as to minimize flooding and for water quality treatment, agricultural and other watershed management purposes.
2. This study has resulted in rainfall frequency estimates from 15 minutes to 60-day durations and for average recurrence intervals from 1 to 1,000 years. Data has been summarized in NOAA's nationally recognized standard engineering tables. New products have been developed for inclusion in GIS formats for a wide variety of computer-based applications and website distribution for watershed management purposes. Regional patterns and comparisons to old TP-40 rainfall frequency data will also be available.
3. Project products will be freely available from the NOAA website: http://hdsc.nws.noaa.gov/hdsc/pfds including reports, maps and spatial data with precipitation frequency estimates and downloads of digital files including:
    - Point estimates (via a point-and-click interface)
    - ArcInfo© ASCII grids
    - ESRI shapefiles
    - Color cartographic maps for each state

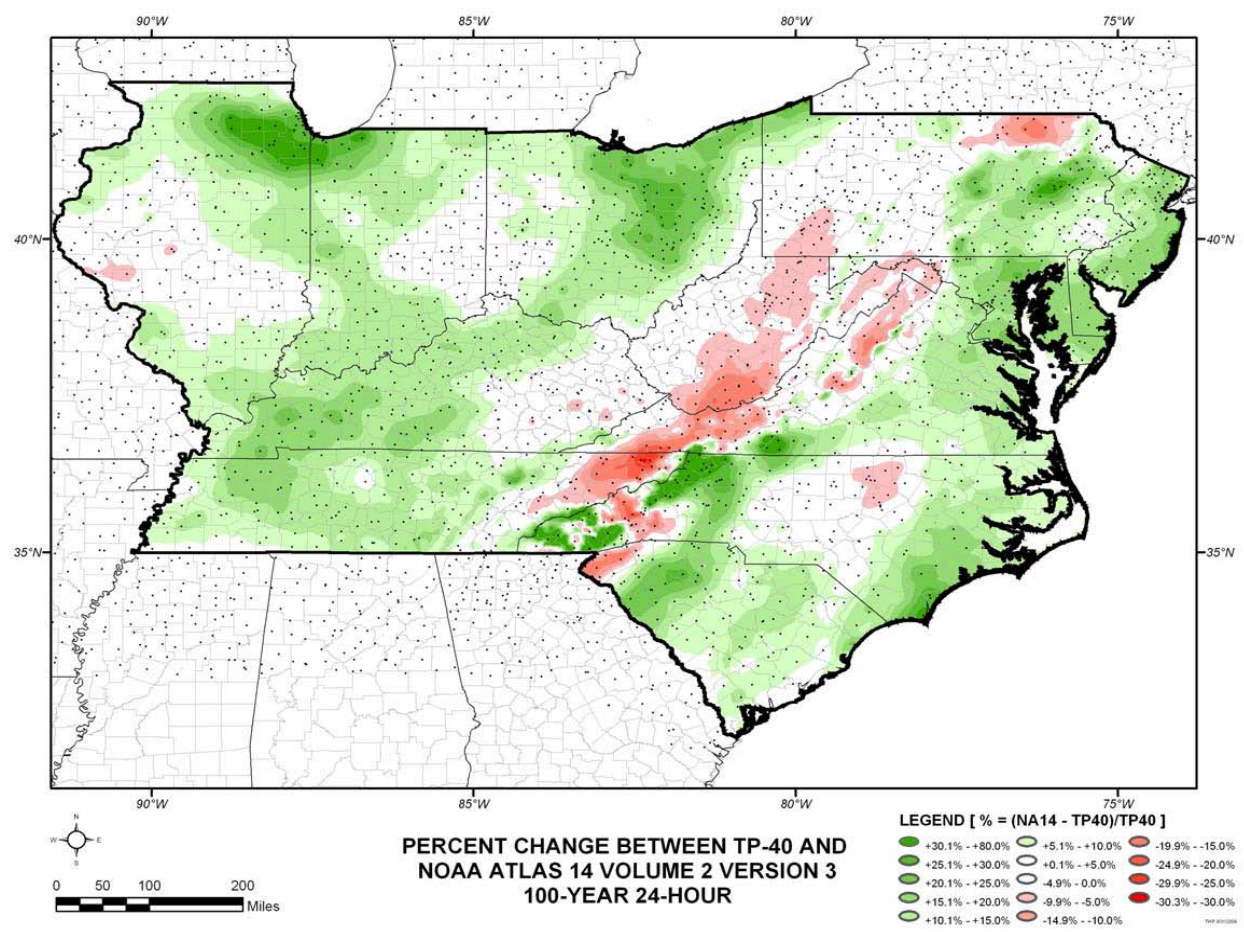
- Associated Federal Geographic Data Committee compliant metadata
- Data series used in the analyses: annual maximum series and partial duration series
- Temporal distributions of heavy precipitation (6-hour, 12-hour, 24-hour and 96-hour)
- Seasonal exceedance graphs: counts of events that exceed the 1 in 2, 5, 10, 25, 50 and 100 annual exceedance probabilities for the 60-minute, 24-hour, 48-hour, and 10-day durations.

State and regional examples from completed NOAA/NWS work for other US areas are included below. The below graphic depicts considerable variation in intensity in the typical storm that occurs once every 2 years over a 24-hour period across the state of Alaska. In this example, lesser amounts associated with brown colors (e.g. less than 3 inches) with greater amounts shown in green (~ 5 to 9 inches) and yet greater amounts in blue/pink (e.g. 9 to 15 inches).



Example: Regional Products. The below graphic for the east-central US depicts the percent change in rainfall between the old TP-40 rainfall intensity data to the new NOAA Atlas 14 for a 100-year, 24-hour storm event with green colors showing increased amounts (up to 30% to 80% (pocket by Chicago)

increase from TP-40 values) and red shades depicting declining amounts (up to ~ 30% declines in the mountain areas from old TP-40 values). Hence, using TP-40 data could result in the use of significantly different rainfall amounts than current data would suggest, for the design of developments and associated infrastructure.



<u>Summary of Final Deliverables to be freely Disseminated by Spring 2012:</u>

- NOAA Web-based Precipitation Frequency Data Server
- Precipitation frequency estimates with 90% confidence intervals at rain gage locations for durations of 15 and 30 minutes,1, 2, 3, 6, 12 hours, and 1, 2, 4, 7, 10, 20, 30, 45, and 60 days and average recurrence intervals (return period)) of 1, 2, 5, 10, 25, 50, 100, 200, 500, and 1000 years
- High resolution grids of average precipitation frequency estimates and 90% confidence intervals for each combination of duration and average recurrence intervals, as specified above.
- Shapefiles of contours of the gridded estimates of average precipitation frequency estimates and 90% confidence intervals for each combination of durations and average recurrence intervals specified above
- Meta information in Federal Geographic Data Transfer Standard format
- Cartographic maps of the estimates with one map for each combination of frequency and duration for the expected value and upper and lower 90% confidence intervals or equivalent information delivered through an Internet map server

- Probabilistic temporal distributions for 6, 12, 24 and 48 hour durations in both chart and digital form
- Peer reviews of initial gridded frequency estimates for 1 and 24 hour durations and for 2-year and 100-year average recurrence intervals
- Charts of the seasonal distribution of annual maxima
- Documentation
- Status reports
- Final products will be provided on the NOAA/NWS website **www.nws.noaa.gov/ohd/hdsc**

IV. Outline of Project Results:

Total Budget: $200,000; Environmental Trust Fund Contribution: $100,000

Deliverable Sequence	Grand Completion Date: June 30, 2011

Result 1: Data collection and quality control.

Description: Daily and hourly rain gauge data are the primary sources of information for this project. There were 344 daily Minnesota precipitation stations chosen from the MNDNR Climatology office (including three from just across the border in Wisconsin). Each of these stations had at least 10 years of data. The data period was from 1970 to January, 2009. The longest record in the file was 43 years beginning in 1966. In addition, 22 stations were used from the Metropolitan Council Environmental Services, Minnesota: Metering and Alarm Rainfall Database providing 15 minute data. Our Canadian partners (Environment Canada) contributed 284 daily stations that were included in the Midwest study. In addition, 35 stations provided hourly data, a significant amount of data, to help better define border patterns.

Rainfall data for other durations (5-min, 15-min) were collected and used to develop short-duration frequency estimates. The data has been assembled in digital form in a manner that is amenable to manipulation and collation in variety of different ways. The specific form of the storage will follow the techniques and formats refined during the development of NOAA Atlas 14 Volumes 1-3.

Data which may contribute to estimation of annual maximum series, partial duration series, or temporal distributions has been quality controlled. Data whose quality is not satisfactory was removed from the database and will not be used in subsequent analyses. In cases where data were changed, the change will be maintained in a log for future reference.

The data were analyzed to determine the seasonality of heavy rainfall. Seasonality was used as additional quality control measure by excluding years in which there are insufficient observations during the heavy rainfall months. The data records were also examined to ensure a minimum number of data years at each station. Stations with an insufficient number of data years will be excluded. The minimum number of data years is a tradeoff between a sufficient number of data years and a sufficient density of stations included in the analysis. Stations with large gaps in the period of record have been examined to ensure that there is no change in statistics across the gap. Nearby stations with complementary periods of record that would otherwise have an insufficient number of data years were examined as candidates for merging.

The data will be used to create annual maximum series (AMS) and partial duration series (PDS). Those series was examined for potential outliers and for trends in time series that may be caused by

urbanization, climate change, etc. It was found that there was insufficient data in Minnesota to evaluate the very short term duration events less than 15 minutes.

Summary Budget Information for Result 1: Trust Fund Budget: $50,000
Amount Spent: $50,000
Balance: $ 0

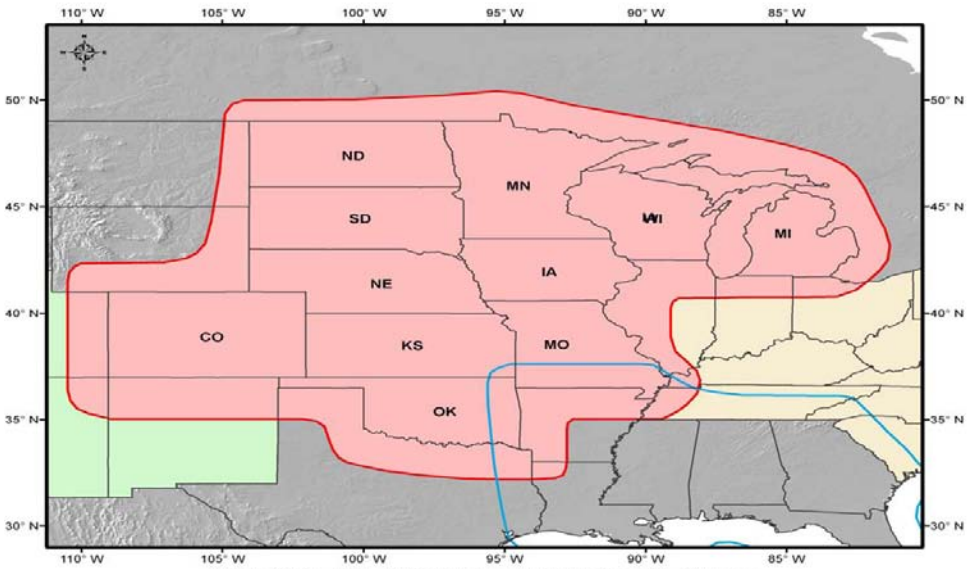
Deliverable	Completion Date	Budget	Status
1. This task resulted in development of a data base of observations and extracted time series that is the basis for subsequent analyses.	September 30, 2009.	$50,000	Spent

Final Report Summary

The last of 11 Midwest states entered into contracts with NOAA/NWS and submitted funds via the Federal Highway Administration Pooled Fund Program by April, 2009. The project, while more cost efficient with 11 states, got off to a slower start due to the extent of administrative details and sheer volume of data from about ½ of the contiguous United States.

The Hydrometeorological Design Studies Center of the National Weather Service Headquarters (Silver Spring, MD) began data transfer inquiries and distributing protocols in August, 2008. Preliminary data uploading from the Minnesota State Climatology Office (Greg Spoden) was initiated at that time.

Primary activities in this period focused on data reformatting, initial data quality control, and extraction of annual maximum series. The Minnesota Department of Natural Resources Office of Climatology submitted our Minnesota data which has been formatted. Minnesota contributed 344 stations having at least 10 years of daily data but NOAA rejected volunteer monitoring data that did not have at least 10 years of observations.



NOAA 14 Midwest Project Area

Data collection, formatting and initial quality control reviews were completed and reported by NOAA in their quarterly report through April, 2010. This work element was completed in November, 2010.

Result 2. Regionalization
Description: NWS's rainfall frequency analysis approach relies on the development of homogeneous climatological geographic areas. This step will result in the definition of regions that may be considered homogenous based on climatological characteristics and selected statistical criteria.

Summary Budget Information for Result 2: Trust Fund Budget: $25,000
Amount Spent: $25,000
Balance: $ 0

Deliverable	Completion Date	Budget	Status
1. Develop precipitation regions.	December 31, 2009	$25,000	Spent

Final Report Summary
The addition of the Southeast states (Arkansas, Louisiana, Mississippi, Alabama, Georgia and Florida to the effort slowed completion of the regionalization, but has improved the quality of the final products. NOAA reported that work was completed at this time for the Midwest state, subject to peer review of products.

Result 3. Frequency distribution selection and fitting studies
Description: A suite of probability distribution functions have been evaluated for best fit to data. The outcome of this task is the selection of the best frequency distribution for each region and each storm duration for both annual maximum and partial duration series. The parameters of the selected distributions were computed as were the ratios of average partial duration to annual maximum estimates for different exceedance probabilities.

Summary Budget Information for Result 3: Trust Fund Budget: $25,000
Amount Spent: $25,000
Balance: $ 0

Deliverable	Completion Date	Budget	Status
1. Statistical frequency distributions for each region	March 31, 2010	$25,000	Spent

Final Report Summary.
Work began in late 2009 looking at wet season frequency analyses. NOAA reports that this work has been completed for Minnesota with publication pending completion of review of the entire Midwest and Southeast US data (for outliers, trends and refining spatial patterns).

Other Related Results to be Completed Using Other Funds

- **Frequency calculations:** NWS has used the above determined best-fit probability distributions for each region and duration to compute the precipitation frequency estimates at each rain gage location. The product of this task is a set of precipitation frequency estimates for durations from 60 minutes to 60 days at each observation location.
- **Short Duration Estimates:** Due to the scarcity of data with duration of less than 1 hour, precipitation frequency estimates for sub-hourly durations was computed as a ratio of hourly duration estimates, for sites with adequate data. The final products of this task will be sub-hourly precipitation frequency estimates at each hourly station in the project area.

- **Internal Consistency at Observing Locations:** An extensive quality control continues to be performed on all frequency estimates. For example, for each average recurrence interval and location precipitation frequency estimates will be compared with longer-duration estimates to ensure that estimates are not higher for shorter durations than for longer durations. The product from this task will be a set of precipitation frequency values, for each duration, at each observing location that satisfy at-site internal consistency.
- **Spatial Interpolation and Consistency:** Precipitation frequency estimates computed at observing locations have been spatially interpolated to grids with a spacing of approximately 1 to 4 miles. The spatial interpolation process will account for variation in terrain and will produce grids which are consistent from one grid to the next. This task has produced spatially interpolated high resolution grid of precipitation frequency estimates for each combination of average recurrence interval and duration across the project area domain.
- **Mapping Products:** A variety of mapping products has been produced to assist users in interpreting and using the precipitation frequency estimates including: digital versions of spatially interpolated grids, vector representations of the contoured grids, and high quality cartographic maps in 'pdf' format. This availability will allow users to incorporate digital versions of the estimates directly in their applications without having to go through expensive and error prone digitizing steps as in past publications.
- **Temporal Distributions:** NWS has developed precipitation temporal distribution curves for 6-, 12-, 24-, and 96 hour durations and make data available in ASCII files through their website.
- **Peer Reviews:** The development of precipitation frequency estimates will be distributed to an invited list of local climate experts for peer review from our State Climatology Office and University of Minnesota. NOAA will analyze final comments, make appropriate actions and publish the results.
- **Documentation:** All aspects of the development has been documented in sufficient depth to allow the knowledgeable user to understand the basis of the estimates and their scope and applicability. The documentation developed for NOAA Atlas 14 Volumes 1-3 was approximately 250-300 pages for each volume, significantly more than provided in the past.
- **Status Reporting:** NOAA will continue to provide quarterly status reports as this part of the national effort winds down. Reports will document progress in the preceding quarter, status of the entire project, issues, activities expected in the coming quarter and expected completion schedule.

V. TOTAL TRUST FUND BUDGET

Staff or Contract Services: $100,000
$100,000 for contract with NOAA/NWS to accumulate updated precipitation intensities data.
TOTAL TRUST FUND PROJECT BUDGET: $100,000

VI. OTHER FUNDS and PARTNERS:

A. Project Partners: Minnesota Department of Transportation, Local Road Research Board

B. Other Funds Proposed to be spent during the Project Period: $100,000 from the Minnesota Department of Transportation, Local Road Research Board.

C. Past Spending: *Not applicable*

D. Time: Three years duration beginning July 1, 2008 and ending June 30, 2011

VII. DISSEMINATION:
This study will result in more reliable rainfall frequency estimates for rainfall durations from 15 minutes to 60 days and for average recurrence intervals from 1 to 1,000 years. All reasonably available rainfall data has been quality controlled and used in the analysis. State-of-the-art geographic-based statistical techniques have been used to produce maps, tables and graphics to nationally accepted standard protocols. Discrete data has been spatially interpolated to a resolution of 4 km by 4 km (or about 2.5 miles by 2.5 miles). Project products will be freely available from the NOAA website: http://hdsc.nws.noaa.gov/hdsc/pfds including reports, maps and spatial data with precipitation frequency estimates.

Summary of Final Deliverables to be Disseminated:
Summary listing of all reportables:

- Web-based Precipitation Frequency Data Server
- Precipitation frequency estimates with upper and lower 95% confidence limits (i.e., 90% confidence intervals) at rain gage locations for durations of 15, and 30 minutes, 1, 2, 3, 6, 12 hours, and 1, 2, 4, 7, 10, 20, 30, 45, and 60 days and average recurrence intervals (return period)) of 1, 2, 5, 10, 25, 50, 100, 200, 500, and 1000 years.
- High resolution grids of average precipitation frequency estimates and 90% confidence intervals for each combination of durations and average recurrence intervals, as specified above
- Shapefiles of contours of the gridded estimates of average precipitation frequency estimates and 90% confidence intervals for each combination of durations and average recurrence intervals specified above
- Meta information in Federal Geographic Data Transfer Standard format
- Either cartographic maps of the estimates with one map for each combination of frequency and duration for the expected value and upper and lower 90% confidence intervals or equivalent information delivered through an Internet map server
- Probabilistic temporal distributions for 6, 12, 24 and 48 hour durations in both chart and digital form
- Peer reviews of initial gridded frequency estimates for 1 and 24 hour durations and for 2-year and 100-year average recurrence intervals
- Charts of the seasonal distribution of annual maxima
- Documentation
- Status reports

Delivery of all final products on the NOAA/NWS website: **www.nws.noaa.gov/ohd/hdsc**

VIII. REPORTING REQUIREMENTS:
Periodic work program progress reports will be submitted beginning June 30, 2008 in this sequence:
Interstate Participation Summary and Project Status as of *June 30, 2008;*
Initial Work Effort Status as of *December 31, 2008;*
Status as of *June 30*, 2009;
Status as of *December 31,* 2009;
Status as of *June 30*, 2010;
Status as of *December 31, 2010; and*
Status as of *June 30, 2011.*

A final work program report and associated products will be submitted between June 30 and August 1, 2011 as requested by the LCCMR. *Quarterly update reports from NOAA/NWS shall be provided to the LCCMR in addition to the formal reporting sequence defined in this work plan. .*

IX. RESEARCH PROJECTS:

This is an applied research project using NOAA/NWS established protocols to develop standard precipitation duration and frequency estimates.

2008 Project Abstract
For the period ending June 30, 2011

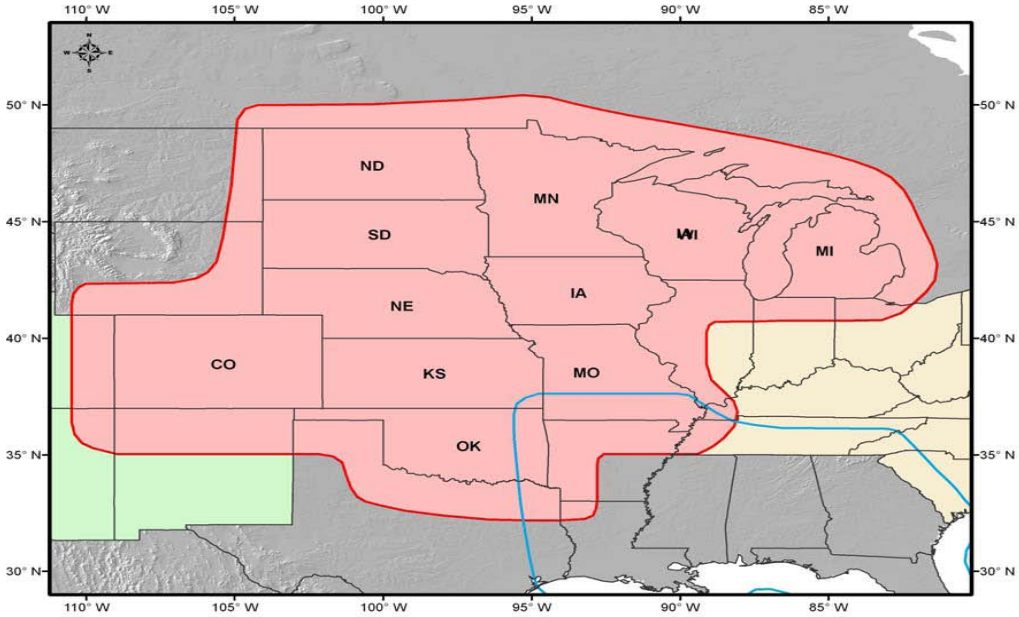
PROJECT TITLE: **Updating Precipitation Intensities for Runoff Estimation and Infrastructure Designs**

PROJECT MANAGER:	C. Bruce Wilson
AFFILIATION :	Minnesota Pollution Control Agency
MAILING ADDRESS:	520 Lafayette Road North
CITY/STATE/ZIP:	St. Paul, MN 55155-4194
PHONE:	651-757-2828
E-MAIL :	Bruce.Wilson@State.MN.US
WEBSITES:	http://www.pca.state.mn.us/
	http://hdsc.nws.noaa.gov/hdsc/pfds/

FUNDING SOURCE:	Environment and Natural Resources Trust Fund
LEGAL CITATION:	M.L. 2008, Chp. 367, Sec 2, Subd. 5(c)
APPROPRIATION AMOUNT:	$100,000

Overall Project Outcome and Results

Checking the daily weather forecast for where and how bad the next storms will be has become a more important part of our daily routines. Recent variable climate (dry periods, intense storms and floods) have brought heightened awareness by farmers, engineers, cities and water managers of rainfall intensity (how fast) and duration (how long). Up to now, available summaries (done in the early 1960's) were based on relatively crude analyses of rainfall data collected through the 1950's. This project has updated precipitation intensities based on the compilation of hundreds of rainfall monitoring locations in and around Minnesota (including our neighboring Canadian and adjacent state partners) with continuous data collected through 2009 via a partnership with the National Oceanic and Atmospheric Administration, National Weather Service (NOAA/NWS). State-of-the-art computer-based statistical procedures have generated summary information and maps with a resolution of 4 km by 4 km (or about 2.5 miles by 2.5 miles). NOAA required one contract with all 11 Midwest states (Minnesota, North Dakota, South Dakota, Wisconsin, Michigan, Iowa, Missouri, Colorado, Nebraska, and Kansas) with pass-through funding via the Pooled Highway Fund. All Environment and Natural Resources Trust Fund dollars were expended by June 30, 2011 with additional funding provided by the Minnesota DOT being used to complete the final work components. This study has generated rainfall frequency estimates for durations from 15 minutes to 60 days and for average recurrence intervals from 1 to 1,000 years along with trend analyses. Final web-based products will be available in early 2012 due to delays associated with reducing huge amounts of data from about ½ of the contiguous United States. The results of this work are required for standard engineering practices associated with runoff routing, flood prevention and safe road and culvert designs and will become part of our daily forecasts (today's storm is called a 'hundred year storm').



NOAA 14 Midwest Project Area

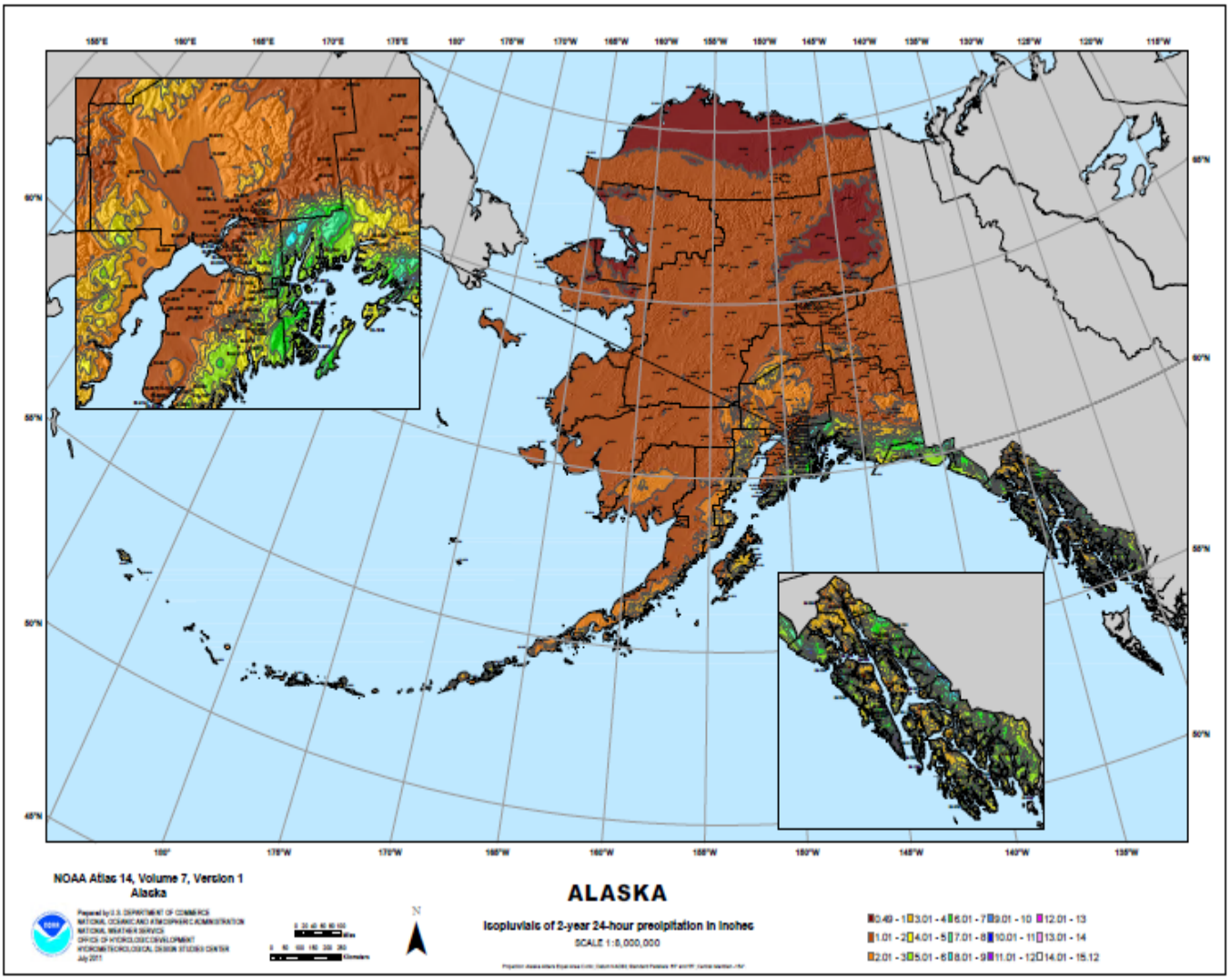
Project Results Use and Dissemination

1. Precipitation frequency information is required for standard engineering practices for building new roads, highways, bridges, and developments so as to minimize flooding and for water quality treatment, agricultural and other watershed management purposes.
2. This study has resulted in rainfall frequency estimates from 15 minutes to 60-day durations and for average recurrence intervals from 1 to 1,000 years. Data has been summarized in NOAA's nationally recognized standard engineering tables. New products have been developed for inclusion in GIS formats for a wide variety of computer-based applications and website distribution for watershed management purposes. Regional patterns and comparisons to old TP-40 rainfall frequency data will also be available.
3. Project products will be freely available from the NOAA website: http://hdsc.nws.noaa.gov/hdsc/pfds including reports, maps and spatial data with precipitation frequency estimates and downloads of digital files including:

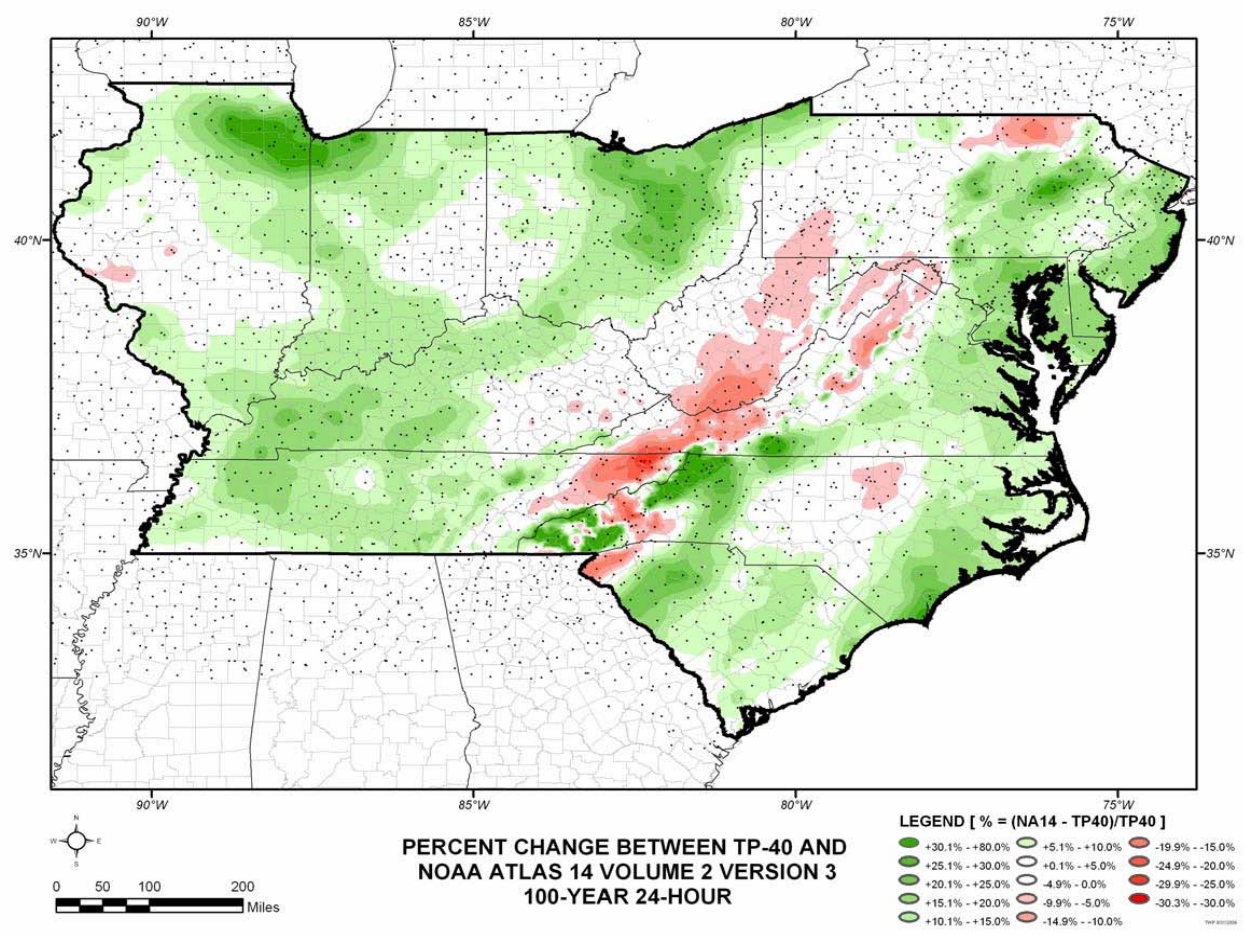
- point estimates (via a point-and-click interface)
- ArcInfo© ASCII grids
- ESRI shapefiles
- color cartographic maps for each state
- associated Federal Geographic Data Committee-compliant metadata
- data series used in the analyses: annual maximum series and partial duration series
- temporal distributions of heavy precipitation (6-hour, 12-hour, 24-hour and 96-hour)
- seasonal exceedance graphs: counts of events that exceed the 1 in 2, 5, 10, 25, 50 and 100 annual exceedance probabilities for the 60-minute, 24-hour, 48-hour, and 10-day durations

State and regional examples from completed NOAA/NWS work for other US areas are included below. State precipitation frequency products. The below graphic depicts considerable variation in intensity in the typical storm that occurs once every 2 years over a 24-hour period across Alaska. In this example,

lesser amounts associated with brown colors (e.g. less than 3 inches) with greater amounts shown in green (~ 5 to 9 inches) and yet greater amounts in blue/pink (e.g. 9 to 15 inches).



Example: Regional Products. The below product for east-central US depicts the percent change in rainfall between the old TP-40 rainfall intensity data to the new NOAA Atlas 14 for a 100-year, 24-hour storm event with green colors showing increased amounts (up to 30% to 80% (pocket by Chicago) increase from TP-40 values) and red shades depicting declining amounts (up to ~ 30% declines in the mountain areas from old TP-40 values). Hence, using TP-40 data could result in the use of significantly different rainfall amounts than current data would suggest, for the design of developments and associated infrastructure.



Summary of Final Deliverables to be Freely Disseminated by Spring 2012:

- NOAA web-based Precipitation Frequency Data Server
- Precipitation frequency estimates with 90% confidence intervals at rain gage locations for durations of 15, and 30 minutes,1, 2, 3, 6, 12 hours, and 1, 2, 4, 7, 10, 20, 30, 45, and 60 days and average recurrence intervals (return period)) of 1, 2, 5, 10, 25, 50, 100, 200, 500, and 1000 years
- High resolution grids of average precipitation frequency estimates and 90% confidence intervals for each combination of duration and average recurrence intervals, as specified above .
- Shapefiles of contours of the gridded estimates of average precipitation frequency estimates and 90% confidence intervals for each combination of durations and average recurrence intervals specified above
- Meta information in Federal Geographic Data Transfer Standard format
- Cartographic maps of the estimates with one map for each combination of frequency and duration for the expected value and upper and lower 90% confidence intervals or equivalent information delivered through an Internet map server
- Probabilistic temporal distributions for 6, 12, 24 and 48 hour durations in both chart and digital form
- Peer reviews of initial gridded frequency estimates for 1 and 24 hour durations and for 2-year and 100-year average recurrence intervals
- Charts of the seasonal distribution of annual maxima

- Documentation
- Status reports
- Final products will be provided on the NOAA/NWS website **www.nws.noaa.gov/ohd/hdsc**

Attachment A: Budget Detail for 2008 Projects - Summary and a Budget page for each partner (if applicable)

Project Title: Updating Precipitation Intensities for Runoff Estimation and Infrastructure Designs

Project Manager Name: C. Bruce Wilson (651-757-2828)

Trust Fund Appropriation: $ *100,000*

1) See list of non-eligible expenses, do not include any of these items in your budget sheet

2) Remove any budget item lines not applicable

2008 Trust Fund Budget	**Result 1 Budget:**	**Amount Spent** *(date)*	**Balance** *(date)*	**Result 2 Budget:**	**Amount Spent** *(date)*	**Balance** *(date)*	**Result 3 Budget:**	**Amount Spent** *(date)*	**Balance** *(date)*	**TOTAL BUDGET**	**TOTAL BALANCE**
	Data Collection and Quality Control			*Regionalization*			*Frequency Distribution and Fitting Studies*				
BUDGET ITEM			0			0			0	0	0
PERSONNEL: wages and benefits			0			0			0	0	0
Contracts	50,000		50,000	25,000		25,000	25,000		25,000	100,000	100,000
Professional/technical *(NOAA, via FHWA Interstate Lockbox)*		50,000	-50,000		25,000	-25,000		25,000	-25,000	0	-100,000
Other contracts *(with whom?, for what?) list out: personnel, equipment, etc.*			0			0			0	0	0
Other direct operating costs *(for what? – be specific)*			0			0			0	0	0
Equipment / Tools *(what equipment? Give a general description and cost)*			0			0			0	0	0
Office equipment & computers - NOT ALLOWED unless unique to the project			0			0			0	0	0
Other Capital equipment *(list specific items)*			0			0			0	0	0
Land acquisition			0			0			0	0	0
Land rights acquisition *(less than fee)*			0			0			0	0	0
Professional Services for Acq.			0			0			0	0	0
Printing			0			0			0	0	0
Other Supplies *(list specific categories)*			0			0			0	0	0
Travel expenses in Minnesota			0			0			0	0	0
Travel outside Minnesota *(where?)*			0			0			0	0	0
Construction *(for what?)*			0			0			0	0	0
Other land improvement *(for what?)*			0			0			0	0	0
Other *(Describe the activity and cost) be specific*			0			0			0	0	0
COLUMN TOTAL	**$50,000**	**$50,000**	**$0**	**$25,000**	**$25,000**	**$0**	**$25,000**	**$25,000**	**$0**	**$100,000**	**$0**

2008 Project Abstract
For the Period Ending June 30, 2010

PROJECT TITLE: Minnesota Breeding Bird Atlas
PROJECT MANAGER: Mark Martell
AFFILIATION: Audubon Minnesota
MAILING ADDRESS: 2357 Ventura Drive, Suite 106
CITY/STATE/ZIP: St. Paul, MN 55113
PHONE: 651-739-9332
E-MAIL: mmartell@audubon.org
WEBSITE: http://mn.audubon.org/
FUNDING SOURCE: Environment and Natural Resources Trust Fund
LEGAL CITATION: ML 2008, Chap. 367, Sec. 2, Subd. 5(d).

APPROPRIATION AMOUNT: $169.000

Overall Project Outcome and Results

These were the first 2-years of an anticipated six-year effort which will result in a comprehensive, statewide survey documenting the breeding distribution of all species of birds in Minnesota. After six years the final atlas products will include the publication of a book and an interactive on-line atlas, both with detailed distribution maps, data on species breeding status, and a summary of data from other surveys. Full access to the information will be provided to the public as well as conservation agencies and organizations.

The first two years of the project, focused on project development, volunteer recruitment, establishment of a data management system, and 2 seasons of data collection. This is a statewide multi-partner project overseen and advised by steering and technical committees. One full-time and one part-time temporary project staff were hired during this period and were assisted by 30 volunteer coordinators overseeing 638 volunteer surveyors. Written materials, workshops, and field sessions were used to recruit and train participants in the project. A data access and information website was established (www.mnbba.org) and we contracted with Cornell University to adapt their web-based data entry, management, and reporting system (the e-bird database) to our project (http://bird.atlasing.org/Atlas/MN/Main?cmd=Start). The MNBBA website and the Cornell database are linked and complement each other.

Each Township in the state is divided into 4 “blocks” with one block (usually the NE) designated as the “priority block”. Data collection began in spring of 2009 and by the end of the six-year project will include every one of the approximately 2,120 Township in Minnesota. An all-species, volunteer driven survey, and a separate specialized “point count” survey (overseen by NRRI) will be conducted in each of townships across the state. By June 30, 2010 data had been entered into our database from 2,076 survey blocks. The 638 volunteers reported spending 6,939 hours doing surveys. A total of 48,425 individual sightings were submitted on 238 species.

Project Results Use and Dissemination
***This section NOT intended to count toward recommended 300 word length for Abstract**

Results from the Breeding Bird Survey are updated daily and available on our website at www.mnbba.org. Further analysis and dissemination of the data will be available at the conclusion of the project at the end of year 6 or 7.

To date the Minnesota Breeding Bird Atlas has received coverage in a number of newspapers statewide and various organizational publications and newsletters.

Trust Fund 2008 Work Program Final Report

Date of Report: July 30, 2010
Final Report
Date of Work program Approval: June 10, 2008
Amendment Approved: July 8, 2009
Project Completion Date: June 30, 2010

I. PROJECT TITLE: Minnesota Breeding Bird Atlas

Project Manager: Mark Martell
Affiliation: Audubon Minnesota
Mailing Address: 2357 Ventura Dr.
City / State / Zip: St. Paul, MN, 55125
Telephone Number: 651-739-9332
E-mail Address: mmartell@audubon.org
FAX Number: 651-731-1330
Web Page address: http://mn.audubon.org/

Location: Statewide

Total Trust Fund Project Budget: $270,000

The total appropriation for this project will be split between Audubon Minnesota and the Natural Resources Research Institute at the University of Minnesota-Duluth as outlined below. NRRI will submit a separate work plan for their part of the project.

To Audubon Minnesota	**Trust Fund Appropriation:**	$ 169,000.00
	Minus Amount Spent:	$ 159,725.96
	Equal Balance:	$ 9,274.04
To NRRI – U of Minnesota Duluth	Trust Fund Appropriation:	$ 101,000
	Minus Amount Spent:	$
	Equal Balance:	$

Legal Citation: ML 2008, Chap. 367, Sec. 2, Subd. 5(d).

Appropriation Language:
$270,000 is from the trust fund to develop a statewide survey of Minnesota breeding bird distribution and create related publications, including a book and online atlas with distribution maps and breeding status. Of this appropriation, $169,000 is to the commissioner of natural resources for an agreement with Audubon Minnesota and $101,000 is to the Board of Regents of the University of Minnesota for the Natural Resources Research Institute. The atlas must be available for downloading on the Internet free of charge.

II. and III. FINAL PROJECT SUMMARY

These were the first 2-years of an anticipated six-year effort which will result in a comprehensive, statewide survey documenting the breeding distribution of all species of birds in Minnesota. After six years the final atlas products will include the publication of a book and an interactive on-line atlas, both with detailed distribution maps, data on species breeding status, and a summary of data from other surveys. Full access to the information will be provided to the public as well as conservation agencies and organizations.

The first two years of the project, focused on project development, volunteer recruitment, establishment of a data management system, and 2 seasons of data collection. This is a statewide multi-partner project overseen and advised by steering and technical committees. One full-time and one part-time temporary project staff were hired during this period and were assisted by 30 volunteer coordinators overseeing 638 volunteer surveyors. Written materials, workshops, and field sessions were used to recruit and train participants in the project. A data access and information website was established (www.mnbba.org) and we contracted with Cornell University to adapt their web-based data entry, management, and reporting system (the e-bird database) to our project (http://bird.atlasing.org/Atlas/MN/Main?cmd=Start). The MNBBA website and the Cornell database are linked and complement each other.

Each Township in the state is divided into 4 “blocks” with one block (usually the NE) designated as the “priority block”. Data collection began in spring of 2009 and by the end of the six-year project will include every one of the approximately 2,120 Township in Minnesota. An all-species, volunteer driven survey, and a separate specialized “point count” survey (overseen by NRRI) will be conducted in each of townships across the state. By June 30, 2010 data had been entered into our database from 2,076 survey blocks. The 638 volunteers reported spending 6,939 hours doing surveys. A total of 48,425 individual sightings were submitted on 238 species.

IV. OUTLINE OF PROJECT RESULTS*:*

Result 1: Project Development
Description:
This project will require multi-year, statewide coordination among partners, volunteers and technical experts. To oversee and manage this effort a Steering Committee made up of partner representatives will be established to provide project coordination and oversight. A Technical Committee will be established to oversee data methodology, quality and management. Day to day operations will be handled by a full-time, paid coordinator to be hired after July 1, 2008. Audubon Minnesota staff will provide project management and administration. Breeding bird data will be collected by a large number of volunteers working around the state and overseen by 31 regional volunteer coordinators. These volunteers and coordinators will need to be identified and recruited from around the state and provided with initial and ongoing training and feedback. Handbooks, field data forms, protocols, maps and GPS units will be developed or purchased and provided to field personnel as needed.

Summary Budget Information for Result 1: **Trust Fund Budget** **$ 35,557.00**
Amount Spent: **$ 31,103.28**
Balance: **$ 4,453.72**

Deliverable	Completion Date	Budget	Status
1. Establish steering and tech. committees and hire project Coordinator	August 30, 2008	$2,000	Completed
2. Produce survey materials	December 30, 2008	$10,000	Completed
3. Recruit and train first season volunteers	February 30, 2009	$7,548	Completed
4. Recruit and train second season volunteers	February 30, 2010	$16,008	Completed

Completion Date: June 30, 2010

Final Report Summary:
A project steering committee was established and includes representatives from Audubon Minnesota, the University of Minnesota, Minnesota DNR Division of Ecological Resources, Minnesota DNR Division of Fisheries and Wildlife, the U. S. Fish and Wildlife Service, the Minnesota Ornithologists' Union, Ramsey County Parks, Wolf Ridge Environmental Center, and Eagle Bluff Environmental Learning Center. The Steering Committed meets every 2-3 months and an Executive Committee consisting of Mark Martell – Audubon Minnesota, Dr. Scott Lanyon – Univ. of Minnesota, Dr. Gerald Niemi – NRRI, Univ. of MN Duluth; oversee the operation of the BBA. The staff and Steering Committee relied heavily on a number of individuals with specialized knowledge of birds, databases, GIS, Citizen Science recruitment and other areas. Because of the wide array of needs we found it was easier to have the Technical Committee serves as a sub-committee of the Steering Committee along with forming other sub-committees to deal with budget and funding, volunteer recruitment, data quality control, and public outreach and education. After a national search that resulted in over 70 applications Bonnie Sample, a recent graduate from the Wildlife Conservation Masters Degree program at the University of Minnesota, was chosen as the project coordinator.

For administrative purposes we divided the state into 32 regions and recruited volunteer coordinators to help coordinate volunteer surveyor recruitment and training, data collection, and local outreach. They also do initial data quality control on bird sightings submitted to the database. We currently have coordinators for 22 regions. Most of the regions for which do not have coordinators are in the relatively unpopulated areas of the state and are overseen by the project Coordinator. At the end of this 2 year period we had registered 638 volunteers who put in 6,939 hours of time.

Supporting materials to assist volunteers in collecting data were produced and distributed as both printed hard copy and on the BBA website. The materials produced were;

The MNBBA Handbook
Breeding Evidence Codes and Tips
Single Visit Field Form
Incidental Reporting Form
Verification Form
Special Species and Habitat Codes
Permission Letter to Survey Private Property
Vehicle Placard
Master Species List
Special Species and Habitat Codes
Suggestions for Surveying an Atlas Block
Nocturnal Survey Guidelines
Marsh Bird Survey Guidelines
Species Reference Guide
Field Reminder Checklist
County Checklist
Easy Guide to Finding Blocks and Entering Data
Surveyor Data Entry Instructions.

These materials were modified and updated during the project to reflect volunteer comments and experience. All of the materials are available on the MNBBA website.

Result 2: Data Management System

Description:
We will develop and maintain a website with information about the atlas, and which will provide volunteers with survey protocols, identification aids, and updated results and maps. We will contract with Cornell University to custom modify their Breeding Bird Atlas management and storage system for Minnesota. The system was developed by the Laboratory of Ornithology at Cornell University in conjunction with the National Audubon Society and other partners. The system is used in a number of bird monitoring and research programs and Breeding Bird Atlas programs in Ohio and Pennsylvania are currently using it. This system will be used during the six-year life of the program and provides data storage, on-line data entry, quality control, and editing capabilities. It will allow us to have the ability to print aerial photos and topographic maps of survey sites and view BBA results by species or geographic region.

Summary Budget Information for Result 2:	**Trust Fund Budget:**	**$** $68,420
	Amount Spent:	$ 65,220
	Balance:	$ 3,200

Deliverable	Completion Date	Budget	Status
1. Contract for a web-based data entry and management system.	December 30, 2008	$21,292	Completed
2. Create informational website through Audubon or partner staff.	March 30, 2009	$9,992	Completed
3. Maintain and update website and database.	March 30, 2010	$20,636	Completed

Completion Date: June 30, 2010

Final Report Summary:

The Minnesota Breeding Bird Atlas utilizes the Cornell Laboratory of Ornithology ebird database which was modified for our use. This database is web accessible allows for data entry, updated results viewing by species or geographic block and has a number of built-in error checks. The database is available online at (http://bird.atlasing.org/Atlas/MN/Main?cmd=Start)

A website for the Minnesota Breeding Bird Atlas designed and is online at: www.mnbba.org. This website has two primary functions; first to be a source of information for volunteers and others associated with the MNBBA. This site is where volunteer information and materials related to data collection can be found. The site also can be used as a portal to the Cornell site. Second, mnbba.org is where the general public can find information and results on the Minnesota Breeding Bird Atlas.

Result 3: Volunteer Data Collection

Description:
Data collection will begin in spring of 2009 and by the end of the six-year project will include every Township in Minnesota. Over the six years of the BBA one “priority block” (3 x 3 miles) in each of Minnesota’s approximately 2,250 Townships will be surveyed. An all-species, volunteer driven survey will be conducted in each of approximately 2,120 townships across the state (the remaining Townships will be surveyed under Result 4 below). Volunteers will be trained by staff and/or birding experts provided by project partners including; Audubon Minnesota, Minnesota DNR, the U.S. Fish and Wildlife Service, the University of Minnesota, and the Minnesota Ornithologists’ Union. We expect to complete 675 of these surveys by June 30, 2010.

Summary Budget Information for Result 3:	**Trust Fund Budget:**	**$65,023.00**
	Amount Spent:	**$63,402.68**
	Balance:	**$ 1,620.32**

Deliverable	Completion Date	Budget	Status
1. 300 Townships surveyed in Yr 1.	June 30, 2009	$45,927	Accomplished
2. 375 Townships surveyed in Yr 2.	June 30, 2010	$35,596	Accomplished

Completion Date: June 30, 2010

Final Report Summary:
To support the field data collection we spent the first months of the project identifying, mapping, and creating Geographic Information System (GIS) layers of the priority blocks. We began training volunteers in late winter of 2009 and data collection began in the spring of 2009.

We recruited volunteers through various list serves, newspaper and newsletter articles, phone, radio, and TV interviews, workshops conducted by staff and regional coordinators, presentations at bird club meetings, bird festivals, ornithology classes, professional staff meetings, and numerous 1:1 contacts. Efforts reported to-date by volunteers include: 610 blocks "owned" by volunteers who have committed to doing a complete survey of that block, breeding bird observations reported in 2,076 blocks, and 6,939 volunteer survey hours. We have 48,425 breeding bird observations submitted to our database. These observations reported on 238 species; of these, 203 species have confirmed breeding evidence. This response far exceeds our earlier expectations.

Result 4: Point Count Surveys
NRRI – University of Minnesota-Duluth will oversee this Result using their portion of the appropriation. A separate work plan submitted by NRRI details this part of the effort.

Description:
Over the six years of the BBA, point count surveys by specially trained seasonal staff will be conducted in every township throughout the state (in addition to the volunteer surveys done in Result 3 above). This will provide important population density information on Minnesota's breeding birds. Additionally in approximately 120 "hard-to-access" Townships in the BWCAW and northern peatlands NRRI will combine the general and point count surveys. These surveys will be done by the seasonal staff and access to these areas is will be provided by canoe or helicopter. During the first 2-years of the project, that period covered by this appropriation NRRI expects to complete 675 point counts and 40 "hard-to-access" area surveys by June 30, 2010.

TOTAL TRUST FUND PROJECT BUDGET:

Total Appropriation to the Minnesota Breeding Bird Atlas: $270,000

Audubon Minnesota as detailed in this work plan: $169,000
NRRI – U of MN Duluth as detailed in their separate work plan: $101,000

Audubon Minnesota
Staff Salary and Benefits: **$106,252**
Program Coordinator:
Administrative Support:
Administrative support will be provided by Audubon staff and will be responsible for reimbursement reports, billing, tracking finances associated with project, paying project related bills, processing Audubon related contracts associated with project and handling project personnel hiring and time sheets.
Project Manager:
Contract Services: $ **38,174**
Website Development:
Data Management System:
Workshop Expenses:
Supplies and Equipment: **$9,575**
Mailings:
Printing:
GPS Units:
GPS units will be used for the full life of the project which is expected to be six years. Units will be assigned to field personnel to aid in navigation and assist in data collection. If the use changes the Environment and Natural Resources Trust Fund will be paid an amount equal to the cash value received or a residual value approved by the LCCMR director if sold.
Maps: $1,500
Travel: **$5,725**

Explanation of Capital Expenditures Greater Than $3,500: None

V. OTHER FUNDS & PARTNERS:

A. Project Partners: No other project partners are to receive project funds.

B. Other Funds spent during the Project Period:

U.S. Fish and Wildlife Service – Region 3 - $2,347

Minnesota DNR - $9,250

Minnesota Ornithologist's Union - $20,000

C. Past Spending: $61,500 to cover planning, method development, and researching and writing a scoping document.

D. Time: The described work in this plan is two years in duration. The overall project completion is expected to be six years with a total (six year) budget of $1,500,000

VII. DISSEMINATION:

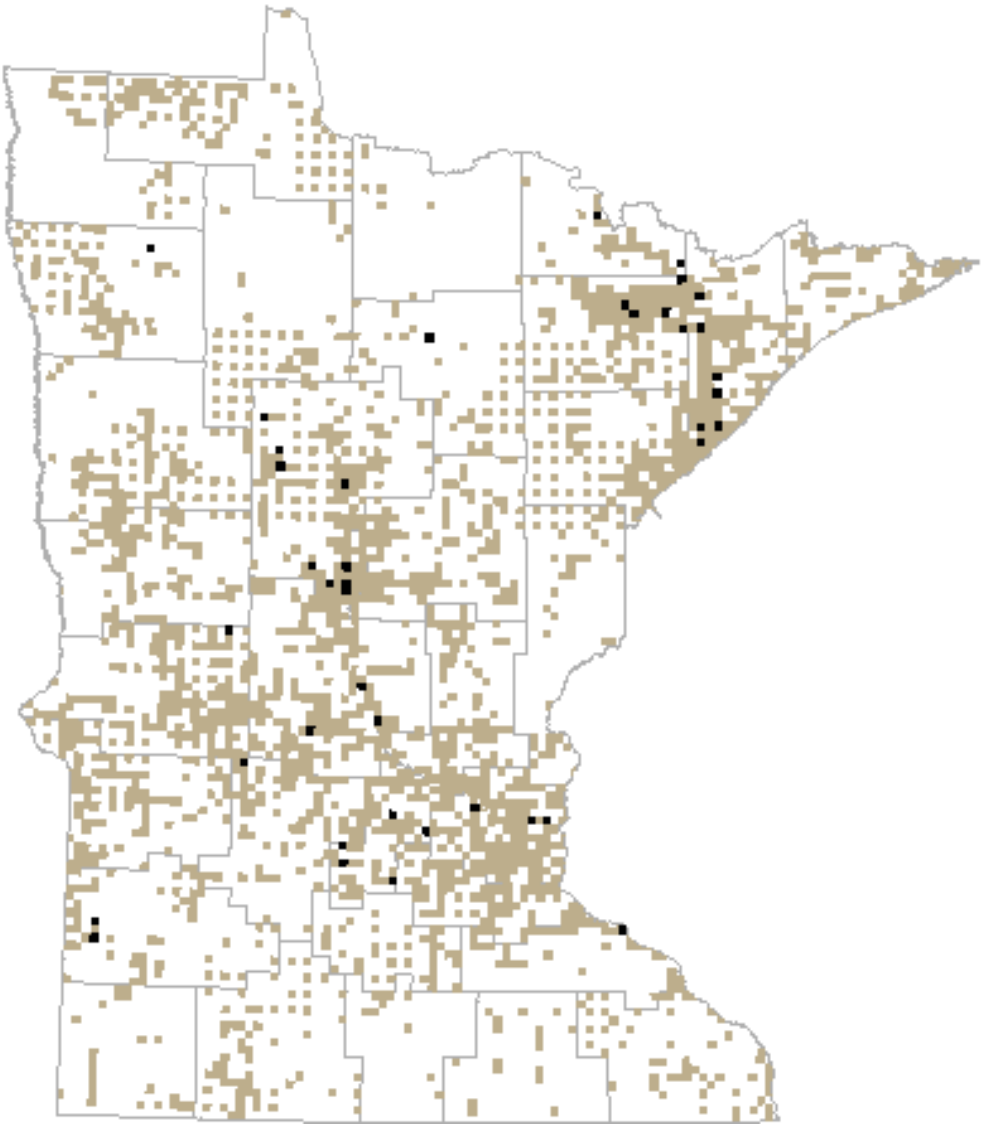
The project will establish a web site that will provide access to information and results during and after the project period. A book may be published at the end of the six-year project.

VIII. REPORTING REQUIREMENTS:

Periodic work program progress reports will be submitted not later than December 30, 2008, August 30, 2009, and January 31, 2010. A final work program report and associated products will be submitted between June 30 and August 1, 2009 or 2010 as requested by the LCCMR

IX. RESEARCH PROJECTS:

Areas of Minnesota with MNBBA data entered.



Attachment A: Budget Detail for 2008 Projects

Project Title: Breeding Bird Atlas
LCCMR Master Budget Document- Audubon Minnesota

Project Manager Name: *Mark Martell*
This Billing Period 3/27/10 to 6/30/10
Trust Fund Appropriation: $ *169,000*

1) See list of non-eligible expenses, do not include any of these items in your budget sheet

2) Remove any budget item lines not applicable

2008 Trust Fund Budget

BUDGET ITEM
PERSONNEL: wages and benefits $101,549
Project Coordinator ($74,518 est.)
Administrative Support ($25,031 est.)
Project Manager ($2000 est.)
Contracts $42,600
Website Development and Maintenance ($5700 est)
Data Management System ($35,000 est.)
Workshop expenses ($1900 est.)
Equipment / Tools $14,300
GPS Units ($2800 est.)

Maps ($1500 est.)
Mailings ($6000 est.)
Printing ($4000 est.)
Other Supplies (list specific categories)
Travel expenses in Minnesota $10,551
Other *(Describe the activity and cost) be specific*
COLUMN TOTAL

Result 1 Budget Detail:		
Result 1 Budget Detail:	**Result 1 billed previously**	**This Billing** *(3/27/10 to 6/30/10)*
Project Development		
24,409.00	**24,409.00**	**-**
1,900.00	**624.27**	**50.00**
7,000.00	**2,316.57**	**1,455.44**

2,248.00	2,248.00	
35,557.00	29,597.84	1,505.44

	Result 2 Budget Detail:			
Balance *(6/30/10)*	**Result 2 Budget Details:**	**Result 2 billed previously**	**This Billing** *(3/27/10 to 6/30/10)*	**Balance** *(6/30/10)*
	Data Management			
-	**27,392.00**	**25,789.58**	**1,602.42**	**(0.00)**
1,225.73	**40,700.00**	**35,000.00**	**2,500.00**	**3,200.00**
3,227.99	**-**	**-**	**-**	**-**

-	328.00	328.00		-
4,453.72	68,420.00	61,117.58	4,102.42	3,200.00

Result 3 Budget Detail:				
Result 3 Budget Details:	**Result 3 billed previously**	**This Billing** *(3/27/10 to 6/30/10)*	**Balance** *(6/30/10)*	**Total This billing**
Data Collection				
54,451.17	**30,755.54**	**23,695.63**	**-**	**25,298.05**
		-	**-**	**2,550.00**
2,596.83	**5,181.45**	**621.15**	**(3,205.77)**	**2,076.59**

7,975.00	738.04	2,400.87	4,836.09	2,400.87
65,023.00	36,675.03	26,717.65	1,630.32	32,325.51

Summary	
TOTAL BUDGET	TOTAL REMAINING BALANCE
106,252.17	(0.00)
42,600.00	4,425.73
9,596.83	22.22

10,551.00	**4,836.09**
169,000.00	**9,284.04**

Legislative-Citizen Commission on Minnesota Resources
2008 Project Abstract
For the period ending June 30, 2010

PROJECT MANAGER: Gerald J. Niemi
AFFILIATION: Natural Resources Research Institute, University of Minnesota-Duluth
MAILING ADDRESS: 5013 Miller Trunk Highway
CITY/STATE/ZIP: Duluth/MN/55811
PHONE: 218-720-4270
EMAIL: gniemi@d.umn.edu
FUNDING SOURCE: Environmental and Natural Resources Trust Fund
LEGAL CITATION: M.L. 2008, Chap. 367, Sec. 2, Subd. 5(d)

APPROPRIATION AMOUNT: $101,000.

Overall Project Outcome and Results

This project is the first two-years of an anticipated six-year effort in the development of the Minnesota Breeding Bird Atlas – the first-ever comprehensive survey of Minnesota's breeding birds. The overall project is divided into two parts – 1) volunteer observations organized by Audubon Minnesota and 2) systematic surveys of Minnesota's breeding birds organized by the University of Minnesota (summarized here). Because of the vastness of Minnesota, both of these efforts are necessary and complementary. Objectives of this portion of the project were to gain uniform statewide coverage for all of Minnesota's birds, estimate breeding bird populations by habitat type, and contribute to a nationwide network of bird atlases in the United States. The first two years of this project focused on the experimental design to sample all townships in Minnesota over a five-year period, an interactive data entry system, data gathering using standard 10-minute point counts, and a brief data summary. Data gathering was primarily completed by graduate and undergraduate students at the University of Minnesota, Duluth and Twin Cities campuses. All were required to pass a test of 80 bird songs, verify their hearing ability, and participated in field standardization exercises.

Over the two breeding seasons (2009 and 2010) covered by this project, the target of 40 % of Minnesota townships (>920) was sampled. We observed over 200 species of birds and counted over 78,000 individual birds during the first two years of these efforts in over 950 townships and in over 2800 individual point counts. In addition, all bird censusers contributed thousands of observations to the volunteer data base in the complementary study organized by Audubon Minnesota, including over 4,000 probable or confirmed breeding records for Minnesota birds. Over 98 % of the data gathered in 2009 and 2010 have been entered and error checked.

Project Results Use and Dissemination

These data will be downloaded to the Minnesota breeding bird atlas during the fall of 2010 through the Cornell University interface. All of these data will be incorporated into a comprehensive atlas of Minnesota's breeding birds that will be used as 1) a first-ever baseline on the current population status of this important Minnesota resource, 2) critical information for future conservation planning, and 3) as a guide for such activities as identifying important bird areas or for nature-based tourism activities.

Supplementary Materials

The Minnesota Breeding Bird Atlas has received considerable publicity over the past two years. Included below are several examples of these public relations materials such as 1) an article in the U of Minnesota-NRRI NOW publication, and 2) example article by John Myers a reporter for the Duluth News Tribune in the Enterprise, a publication by Park Rapids, MN.

Trust Fund 2008 Work Program Final Report

Date of Report: August 16, 2010
Final Report: June 30, 2010
Contact Information: Gerald Niemi

I. PROJECT TITLE: **Minnesota Breeding Bird Atlas –Joint Project – Natural Resources Research Institute, University of Minnesota, Duluth and Audubon MN**

Project Manager: Gerald J Niemi
Affiliation: Natural Resources Research Institute, University of Minnesota Duluth
Mailing Address: 5013 Miller Trunk Hwy
City / State / Zip: Duluth MN 55811
Telephone Number: 218/720-4270
E-mail Address: gniemi@nrri.umn.edu
Fax Number: 218/720-4328
Web Page address: http://www.nrri.umn.edu/staff/gniemi.asp

Location: Statewide

Total Trust Fund Project Budget: $270,000

The total appropriation for this project will be split between Audubon Minnesota and the Natural Resources Research Institute at the University of Minnesota Duluth as outlined below. Audubon Minnesota will submit a separate workplan for their part of the project.

To NRRI – U of Minnesota Duluth	**Trust Fund Appropriation:**	$	101,000
	Minus Amount Spent:	$	101,000
	Equal Balance:	$	0
To Audubon Minnesota	Trust Fund Appropriation:	$	169,000
	Minus Amount Spent:	$	159,726
	Equal Balance	$	9,274

Legal Citation: M.L. 2008, Chap. 367, Sec. 2, Subd. 5(d)

Appropriation Language:
$270,000 is from the trust fund to develop a statewide survey of Minnesota breeding bird distribution and create related publications, including a book and online atlas with distribution maps and breeding status. Of this appropriation, $169,000 is to the commissioner of natural resources for an agreement with Audubon Minnesota and $101,000 is to the Board of Regents of the University of Minnesota for the Natural Resources Research Institute. The atlas must be available for downloading on the Internet free of charge.

II and III. FINAL PROJECT SUMMARY

Result 1: Project Development

Audubon Minnesota will oversee this Result using their portion of the appropriation. A separate workplan submitted by Audubon details this part of the effort. Project Manager, Gerald Niemi, serves on the Executive Committee of the MN Breeding Bird Atlas project and participates on the Steering Committee to insure coordination between Result 4 and Result 2 and 3 (below).

Result 2: Data Management System

Audubon Minnesota will oversee this Result using their portion of the appropriation. A separate workplan submitted by Audubon details this part of the effort. NRRI personnel with expertise in geographic information systems have provided expertise and cooperation with Audubon and interaction with the Cornell Laboratory of Ornithology in the initiation of the data management system. NRRI from Result 4 below are working with Cornell University for an automatic download of the data to their system and incorporation into the MN Breeding Bird Atlas data base.

Result 3: Volunteer Data Collection

Audubon Minnesota will oversee this Result using their portion of the appropriation. A separate workplan submitted by Audubon details this part of the effort. NRRI personnel gathering point count data on Result 4 have also served as volunteers. All personnel have entered their data into the MN breeding bird atlas data base during their gathering of data on point counts..

Result 4: Point Count Surveys

Result 4 is focused on the breeding season in Minnesota (approximately mid-May to mid-July). We designed an efficient means to sample the townships. We used 2-person teams gathering point count data – one group in southern Minnesota, one in western Minnesota, and one in northern Minnesota, plus individual expert observers in selected regions of the state. Individuals were able to sample about 3 townships per morning, but in some cases where there is good road access they were able to sample 4 townships per morning. The townships sampled were selected in a restricted, random fashion to insure the townships censused are evenly-distributed across the state. It was “restricted” to also insure logistical (transportation) efficiency, primarily so that townships to be sampled on a daily and weekly basis were relatively close together. The protocol was peer-reviewed by seven professional and amateur ornithologists in the state of MN and WI and their comments incorporated.

The censusing protocol calls for censusers to pass a test of their bird identification skills by sound and pass a hearing test to insure their hearing is within normal ranges. Censusers also go through a 3-4 day training session to improve the standardization of data gathering. These censusers are paid as temporary university employees because the 1) field work is physically demanding, 2) work time include difficult hours (e.g., approximately 4:00 am to noon), and 3) it is a fulltime job.

We designed an input program in which data are transferred from field sheets to digital files via an Internet interface. Data are double-entered and error checked for any mistakes in data entry. Besides the systematic point counts, the field crews have been recording all observations of bird species within the townships they are sampling. These data, along with the appropriate breeding category, will be recorded directly into the Cornell MN Breeding Bird Atlas data base.

Over the two years of censusing during the 2009 and 2010 breeding seasons, we have recorded over 78,000 individual birds in over 920 townships sampled in Minnesota (Figure 1). This is over 40 % of the townships in the state of Minnesota and meets our target of 40 % covered in two years of effort. Hence we are on target to complete sampling in the over 2300 townships in the state of Minnesota. These samples include over 40 townships sampled in inaccessible or remote areas such as the Boundary Waters Canoe Area Wilderness and the Red Lake Peatland/Pine Island State Forest region of northern Minnesota. We have recorded over 200 species for 2,850 individual point counts completed throughout Minnesota. We have averaged 27.6 individual birds recorded per point and an average of 85.3 individual birds within 3 point counts of a priority block per township. The most common species recorded were the following (frequency = number of points observed/number of points sampled): American Robin (58.2%), Common Yellowthroat (51.8%), Red-winged Blackbird (51.1%), Song Sparrow (49.8%), Mourning Dove (38.8%), American Crow (37.7%), American Goldfinch (37.7%), Red-eyed Vireo (33.4%), Chipping Sparrow (29.8%), Common Grackle (28.1%), House Wren (28.0%), and Blue Jay (25.5%).

At the time of this report, about 98% of the data have been entered and error checked. Over the coming years, these data will be analyzed and presented in more detail. We anticipate that these data will be downloaded to the Cornell website during the fall-winter period of 2010-2011.

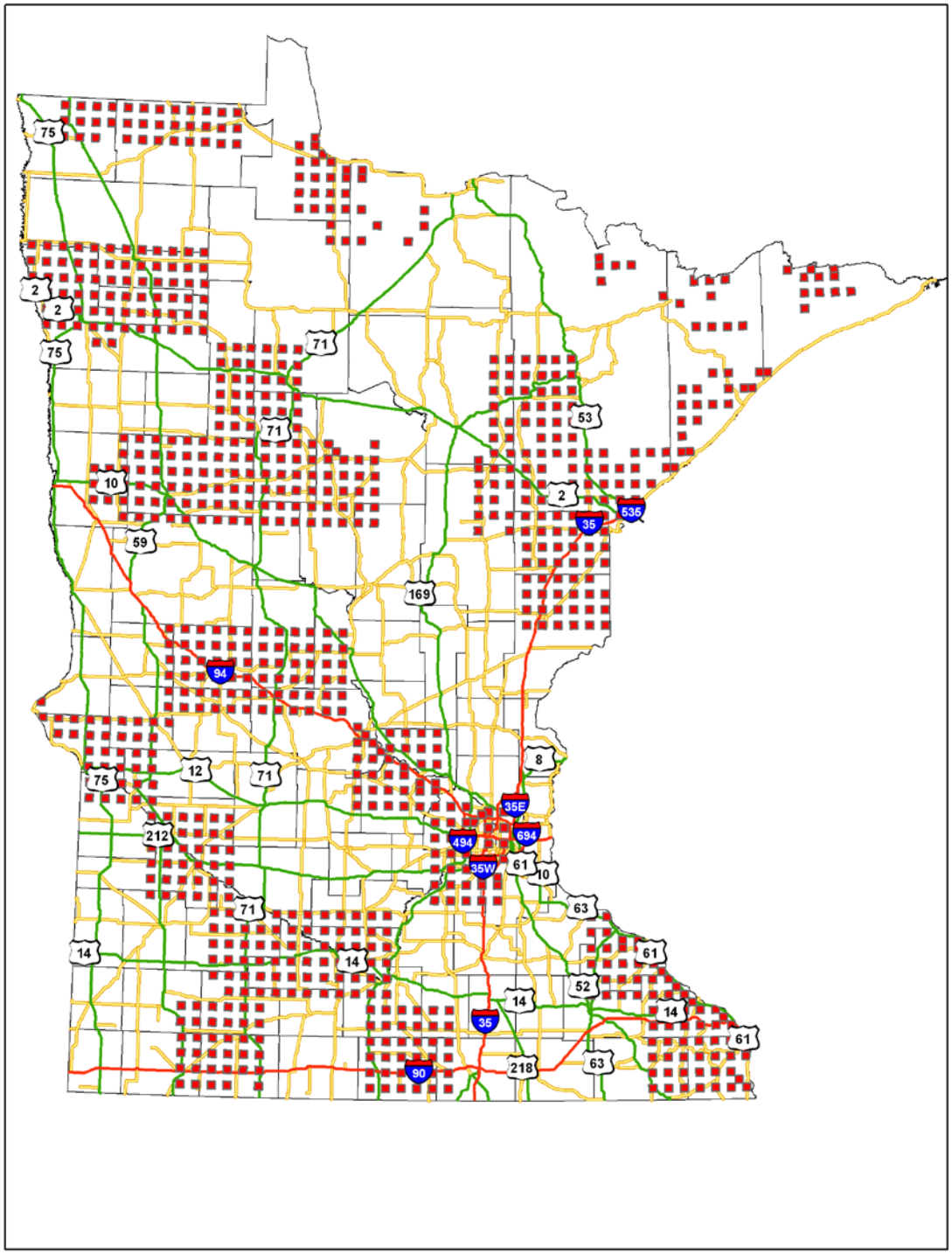


Figure 1. Townships sampled with point counts (red squares) during the 2009 and 2010 breeding seasons in the state of Minnesota. A subset of 10% of the townships sampled in 2009 were re-sampled in 2010.

Summary Budget Information for Result 4:	**Trust Fund Budget:**	**$** 101,000
	Amount Spent:	**$** 101,000
	Balance:	**$ 0**

Deliverable	Completion Date	Budget	Status
1. Over 500 townships have been sampled during the May-June 2009 breeding bird period – this exceeds the number of points we had anticipated sampling in year 1	June 30, 2009	$38,240	Completed.
2 An additional 400 townships were sampled in May-June 2010 for a total of over 900 townships sampled in Minnnesota. This meets our target for the first two years of this study.	June 30, 2010	$22,880	Completed
3. Over 40 hard-to-access townships were sampled in northern Minnesota during the past year (summer 2010). We believe that we will be able to sample all or nearly all of these townships during the five years of data gathering.	June 30, 2010	$39,880	Completed

Completion Date: *June 30, 2010*

V. TOTAL TRUST FUND PROJECT BUDGET:

Total Appropriation to the Minnesota Breeding Bird Atlas: $270,000

NRRI – U of MN Duluth as detailed in this workplan: $101,000
Audubon Minnesota as detailed in their separate workplan: $169,000

NRRI – U of MN Duluth

Seasonal Field Staff: **50,200**

Other Direct Operating Costs: **1,000**

GIS survey, site analysis work

Seasonal Field Staff Travel: **$40,800**

Costs for 6-12 field staff to travel by car to field sites throughout Minnesota over a two-year period. Costs include transportation by car, lodging, and meals.

Supplies: **$ 9,000**

Three GPS units and six digital cameras (Amendment approved 4/21/09)

Explanation of Capital Expenditures Greater Than $3,500: None

VI. OTHER FUNDS & PARTNERS:

A. Project Partners: No other project partners are to receive project funds.

B. Other Funds Proposed to be spent during the Project Period:

Potential: National Fish and Wildlife Foundation - $26,900 (grant requests submitted)

C. Past Spending:

D. Time: The described work in this plan is two years in duration. The overall project completion is expected to be six years with a total (six year) budget of $1,500,000

VII. DISSEMINATION:

The project will establish a web site that will provide access to information and results during and after the project period. A book may be published at the end of the six-year project.

Attachment A: see attached

For the birds

New York has two. Pennsylvania is working on its second. Wisconsin just finished their first.

And finally, Minnesota—with its major continental flyway along the Mississippi—will join the other 47 states that have a comprehensive Breeding Bird Atlas. The six-year project gets underway this spring to assess how many breeding bird species there are, and where, across the entire state. It will also provide baseline data to monitor changes in their populations.

NRRI is leading the scientific data-gathering and analysis portion of the project. And it's familiar work for NRRI ornithologist and scientist Jerry Niemi. For many years, Niemi provided leadership for the institute's long-term bird monitoring program in the Chippewa, Superior and Chequamegon national forests.

"This atlas project is consistent with the methodology we've used on the national forests," said Niemi. "We're taking our scientific approach and going statewide."

Over the next five years, NRRI's newly hired and highly trained birding team will listen and watch for breeding birds in every township in Minnesota—some 2,300—for three 10-minute counts. This summer is the trial run to figure out how long the process actually takes.

By 2016, Minnesota will have scientifically observed and documented data on the estimated 225 to 250 bird species that breed here each spring, along with maps, charts and graphs.

A second part of this extensive study will incorporate the findings of almost 1,000 volunteer birders across the state. Minnesota Audubon is seeking bird enthusiasts across the state and will coordinate the data collected from them. Because of the inconsistencies in volunteer skill levels, time, and numbers, Niemi said NRRI will use a limited amount of the volunteer information in their study.

"No state that I know of has used the scientific point count approach that we use, but the ones I've talked with said they wished they had," Niemi said.

NRRI's funding will also allow Niemi to send observers to areas that are very remote, like the Boundary Waters Canoe Area Wilderness and the Red Lake Peatland.

Baseline data on breeding bird populations is critical for measuring the health of bird populations, ecosystems, and understanding how people affect the landscape. NRRI's project is funded by the Legislative-Citizens Commission on Minnesota Resources.

Count begins for Minnesota Bird Atlas

HOW POINT COUNTS ARE DONE

As the sun rises during bird breeding season (June 1 to July 10), observers trained and tested to identify the songs of over 80 different bird species go into the woods and listen. Listen carefully. They make notations on a clipboard to indicate bird species they hear inside and outside a 100 meter radius.

Observers also record the minute they heard the bird and information about its behavior—singing, calling, carrying nesting material, or whether it's a sight observation.

Enterprise

Date: Saturday, September 05, 2009
Location: PARK RAPIDS, MN
Circulation (DMA): 6,270 (15)
Type (Frequency): Newspaper (2WK)
Page: 12A
Keyword: NRRI

Bird Atlas project will see what's up in the air

BY JOHN MYERS
DULUTH NEWS TRIBUNE

It's the most comprehensive study of bird species ever conducted in Minnesota, with researchers stopping three times in every township across the state to see what's flying around. Volunteers will contribute their findings as well.

The first-ever Minnesota Breeding Bird Atlas is long overdue, bird enthusiasts say, and will help document which species are where across the state.

About a dozen trained researchers will do the study's heavy lifting, stopping for 10 minutes at 2,352 different locations – generally the northwest quadrant of every township – from downtown Minneapolis, across southern Minnesota's farms, through the desolate Red Lake peatlands and even the Boundary Waters Canoe Area Wilderness.

Meanwhile, more than 1,000 volunteers, most of them avid birders, will fan out across assigned areas to help confirm what the scientists find, and maybe add findings of their own. Even the general public is being asked to report their findings, be it a back yard robin's nest or a hawk nesting on their office building.

"We're going to put it all together and get the most comprehensive dataset anyone has ever compiled [on Minnesota birds]," said Jerry Niemi, ornithologist at the University of Minnesota Duluth's Natural Resources Research Institute.

The study won't count actual numbers of birds but how many species are identified and where. Surveyors will pay attention to the birds' habitats at nesting season, generally late May to early July, when the count will take place.

The three locations in each township include a random point, a point within the dominant habitat (farms, forest, swamps, etc.) and one in the second most common habitat.

It's estimated the state has between 225 and 250 bird species that nest here each summer.

Researchers started work this year and finished about 600 townships, Niemi said. Organizers hope to finish by 2013, with the atlas published in 2014. Most researchers are graduate students who must pass a test identifying 75 bird songs, as well as a hearing test.

"I can't do it because I can't pass the hearing test," Niemi noted.

While avid birders have a good handle on which native birds are most often seen here, there will likely be some surprises, said Anna Peterson, an NRRI bird researcher. Much of the existing data on the range of Minnesota birds is dated.

"Most of the older birding books show turkey vultures range only in southern Minnesota. But we all know they have spread across the northern part of the state now," she said.

Another species, boreal chickadees, were once common across Minnesota and are listed as such in most books. But boreal chickadees now may have a much smaller range, Niemi said, while once common evening grosbeaks have nearly disappeared from the Northland.

Other birds thought to be extinct or rare may show up more often than anyone expected. And birds thought to be common may end up being scarcer than thought.

NRRI is leading the scientific data-gathering and analysis portion of the project, which is being compiled by the Cornell Laboratory of Ornithology. The Audubon Society is coordinating volunteers. The project is funded by the state's lottery and cigarette tax profits through the Legislative Citizen's Commission on Minnesota Resources.

Minnesota is one of only a few states that doesn't have a comprehensive breeding bird atlas. Wisconsin published its atlas in 2006.

More volunteers are needed to cover every survey section in the state, said Bonnie Sample, atlas coordinator for Minnesota Audubon.

In addition to volunteer surveyors and professional researchers, the general public is being asked to submit their bird sightings next summer. To find out how to report birds, or to volunteer to go into the field in a specific region to survey them, go to mnbba.org, e-mail bsample@audubon.org or call

© 2009 PARK RAPIDS ENTERPRISE
All Rights Reserved.

Account: 19615 (372)
MN-274
For reprints or rights, please contact the publisher

Attachment A: Budget Detail for 2008 Projects - Summary and a Budget page for each partner (if applicable)

Breeding Bird Atlas

Project Manager Name: NRRI - Dr. Gerald Niemi

Trust Fund Appropriation: $101,000

1) See list of non-eligible expenses, do not include any of these items in your budget sheet

2) Remove any budget item lines not applicable

2008 Trust Fund Budget	Amount Budgeted	Amount Spent June 30, 2010	FINAL BALANCE
BUDGET ITEM			
PERSONNEL: Seasonal Research Assistants	50,200	50,200	0
Direct operating expenses			
GIS-site analysis; print shop	1,000	1,000	0
Travel expenses in Minnesota	40,800	40,800	0
Lab/field supplies	9,000	9,000	0
COLUMN TOTAL	**$101,000**	**$101,000**	0

2008 Project Abstract
For the Period Ending June 30, 2010

PROJECT TITLE:	**Restorable Wetlands Inventory**
PROJECT MANAGER:	Darin R. Blunck
AFFILIATION:	Ducks Unlimited, Inc.
MAILING ADDRESS:	1 Waterfowl Way
CITY/STATE/ZIP:	Memphis, TN 38103
PHONE:	(901) 758-3788
E-MAIL:	dblunck@ducks.org
WEBSITE:	www.ducks.org
FUNDING SOURCE:	Environment and Natural Resources Trust Fund
LEGAL CITATION:	

M.L. 2008, Chp. 367, Sec. 2, Subd. 5(e)
2008 Appropriation Language:
$245,000 is from the trust fund to the commissioner of natural resources for an agreement with Ducks Unlimited, Inc., to continue the inventory, mapping, and digitizing of drained restorable wetlands in the southwest prairie region of Minnesota. This appropriation is available until June 30, 2011, at which time the project must be completed and final products delivered, unless an earlier date is specified in the work program.

APPROPRIATION AMOUNT: $245,000

Overall Project Outcome and Results

The Restorable Wetlands Inventory (RWI) is a complement to the National Wetlands Inventory (NWI) completed in late-1980s by the U.S. Fish & Wildlife Service. An administrative decision was made developing the original NWI not to map wetland basins in Minnesota identified as completely drained. The number and acreage of completely drained wetlands that were not mapped by the NWI process is significant

RWI project identifies and digitizes the completely-drained depressional wetlands that were not mapped by the NWI process. Restorable wetlands mapping is based upon protocols established for NWI allowing seamless integration of the two datasets.

In the Southwest Prairie Complex, over 300,000 individual restorable wetland basins were identified and mapped. Upon completing the Southwest Prairie Complex mapping, townships in 42 western and south-central counties in the prairie and transition zone eco-regions of Minnesota have been mapped, adding an important component to the State's spatial data infrastructure that informs environmental planning and research. Through this investment in RWI – combined with the National Wetlands Inventory, landcover classifications, and a growing catalogue of high-resolution elevation data – our capacity to understand (and importantly, restore and manage) Minnesota's wetland resources is continuing to improve.

Project Partners were the LCCMR, Ducks Unlimited, Inc., and the U.S. Fish and Wildlife Service. The photo-interpretation and digitization work was contracted to the GIS Lab at South Dakota State University.

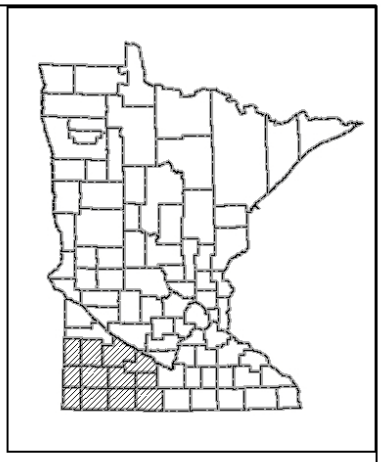
Project Results Use and Dissemination

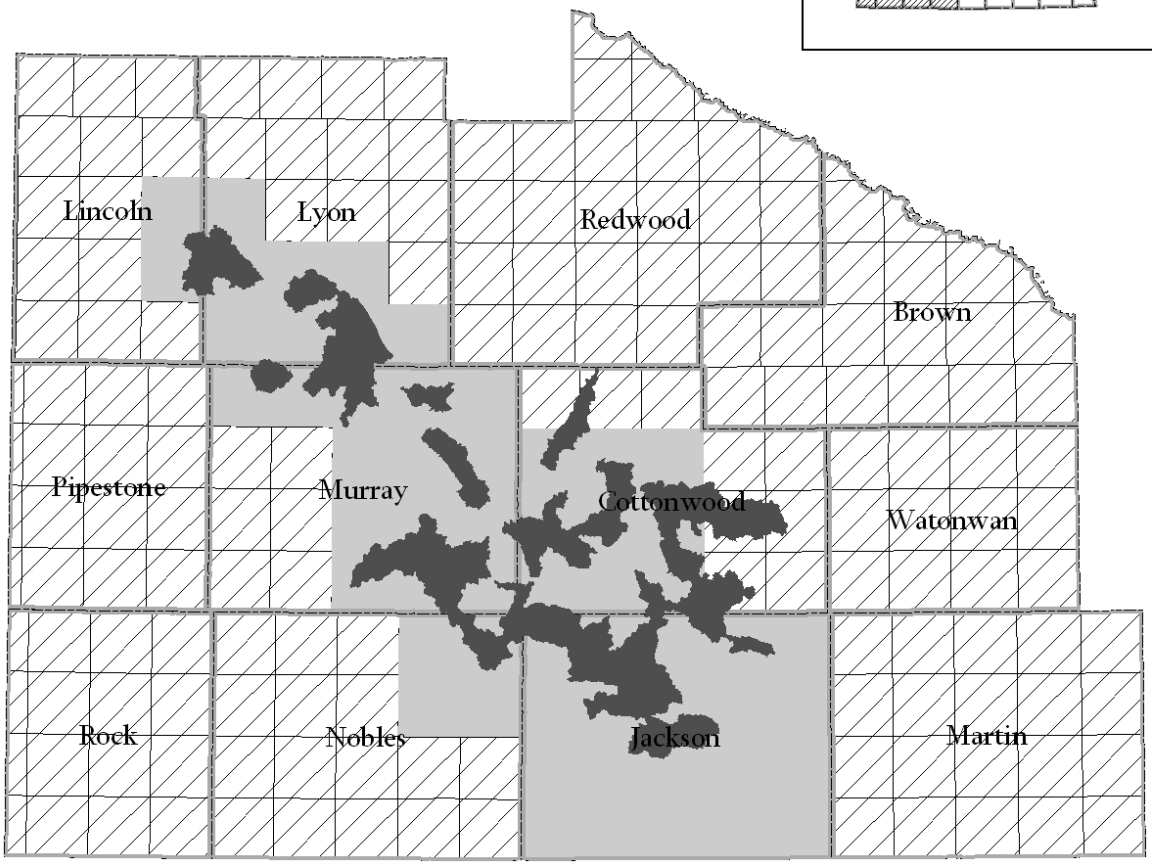
The Restorable Wetlands Inventory mapping product for the Southwest Prairie Complex is complete and will be distributed on the Minnesota Data Deli and Ducks Unlimited, Inc. websites by the end of August 2010 in GIS-compatible formats.

Attached are maps showing mapping extent of the current M.L. 2008 appropriation and the cumulative RWI mapping effort.

Minnesota Restorable Wetland Inventory

Southwest Prairie Complex Mapping





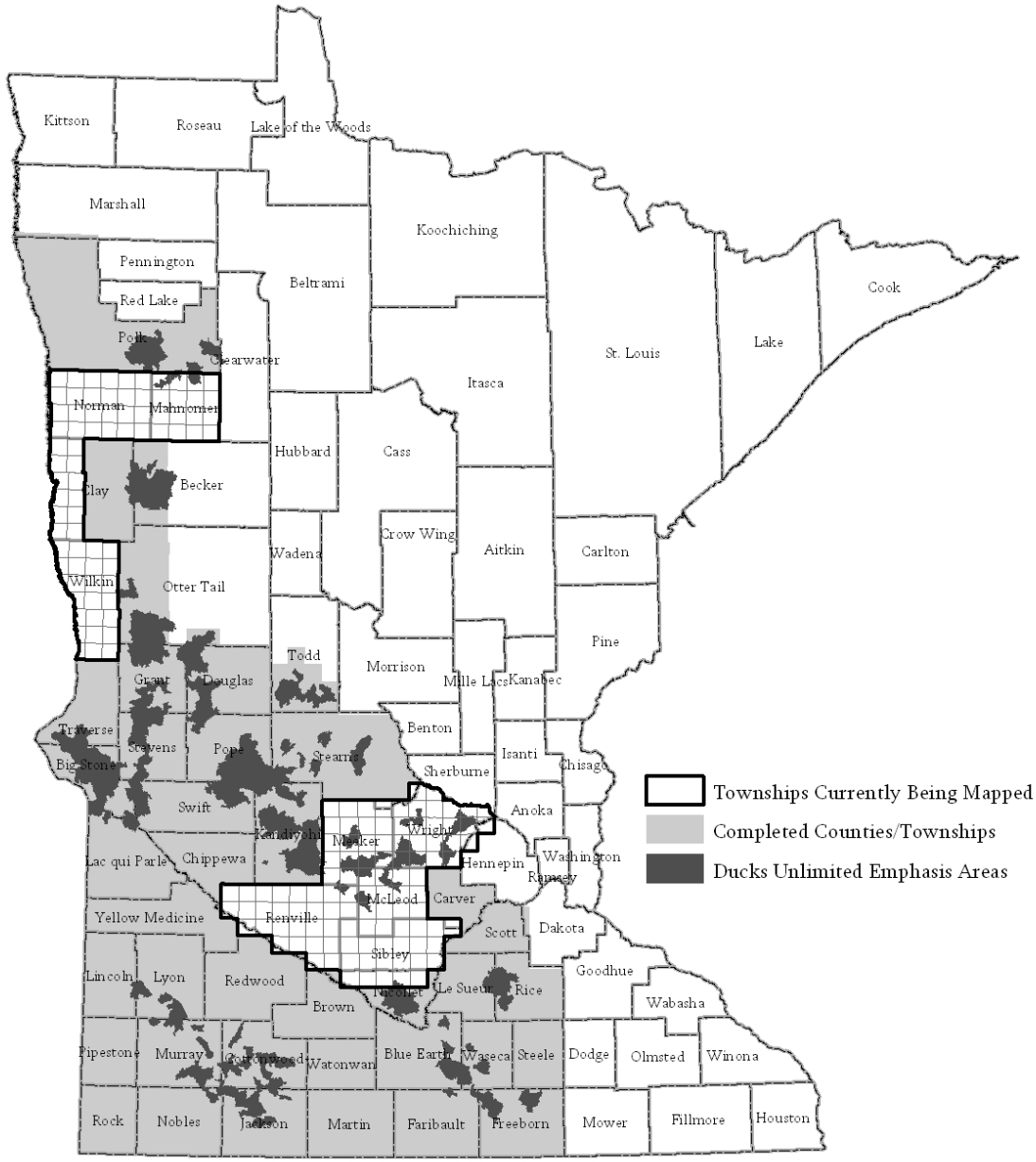
Southwest Prairie Complex Mapping (M.L. 2008 Appropriation)

Completed Counties/Townships

Ducks Unlimited Emphasis Areas

Restorable Wetland Inventory - LCCMR

Minnesota Mapping Status 2010



Trust Fund 2008 Work Program and
Trust Fund 2009 Work Program

Date of Report:	August 15, 2010	
Date of Next Status Report:	December 31, 2010	
	M.L. 2008	**M.L. 2009**
Date of Work program Approval:	June 10, 2008	June 16, 2009
Project Completion Date:	June, 30 2010	June 30, 2012

I. PROJECT TITLE: **Restorable Wetlands Inventory**

Project Manager: Darin R. Blunck
Affiliation: Ducks Unlimited, Inc.
Mailing Address: 1 Waterfowl Way
City / State / Zip : Memphis, TN 38103
Telephone Number: (901) 758-3788
E-mail Address: dblunck@ducks.org
Fax Number:
Web Page address: http://www.ducks.org

Location: Under the 2008 Appropriation, mapping will occur in 154 townships in Brown, Cottonwood, Lincoln, Lyon, Martin, Murray, Nobles, Pipestone, Redwood, Rock, and Watonwan Counties (See Status Map).

Under the 2009 Appropriation, mapping will occur in 170 townships in Clay, Mahnomen, McLeod, Meeker, Nicollet, Norman, Renville, Sibley, Wilkin, and Wright Counties (See Status Map).

Total Trust Fund Project Budget:	**M.L. 2008**	**M.L. 2009**	**Total**
Trust Fund Appropriation:	**$245,000.00**	**$300,000**	**$545,000**
Minus Amount Spent:	**$243,870.50**	**$0**	**$245,000**
Equal Balance:	**$1129.50***	**$300,000**	**$300,000**

*M.L. 2008 not used will cancel.

Legal Citation:
M.L. 2008, Chp. 367, Sec. 2, Subd. 5(e)
2008 Appropriation Language:
$245,000 is from the trust fund to the commissioner of natural resources for an agreement with Ducks Unlimited, Inc., to continue the inventory, mapping, and digitizing of drained restorable wetlands in the southwest prairie region of Minnesota. This appropriation is available until June 30, 2011, at which time the project must be completed and final products delivered, unless an earlier date is specified in the work program.

M.L. 2009, Chp. 143, Sec. 2, Subd. 3(e)
2009 Appropriation Language:
$300,000 is from the trust fund to the commissioner of natural resources for an agreement with Ducks Unlimited, Inc., to complete the inventory, mapping, and digitizing of drained restorable wetlands in Minnesota. This appropriation is available until June 30, 2012, at which time the project must be completed and final products delivered, unless an earlier date is specified in the work program.

II. PROJECT SUMMARY AND RESULTS:

The Restorable Wetlands Inventory (RWI) is a complement to the National Wetlands Inventory (NWI) completed in late-1980s by the U.S. Fish & Wildlife Service. An administrative decision was made developing the original NWI not to map wetland basins in Minnesota identified as completely drained. The number and acreage of completely drained wetlands that were not mapped by the NWI process is significant. In Pope County alone, 25,000 acres of completely drained wetland acres were missed in the NWI mapping process—nearly 19% of the total wetland resources in that county. RWI project identifies and digitizes the completely-drained depressional wetlands that were not mapped by the NWI process. Restorable wetlands mapping is based upon protocols established for NWI allowing seamless integration of the two datasets.

<u>M.L. 2008 FINAL PROJECT SUMMARY</u>

The Restorable Wetlands Inventory (RWI) is a complement to the National Wetlands Inventory (NWI) completed in late-1980s by the U.S. Fish & Wildlife Service. An administrative decision was made developing the original NWI not to map wetland basins in Minnesota identified as completely drained. The number and acreage of completely drained wetlands that were not mapped by the NWI process is significant

RWI project identifies and digitizes the completely-drained depressional wetlands that were not mapped by the NWI process. Restorable wetlands mapping is based upon protocols established for NWI allowing seamless integration of the two datasets.

In the Southwest Prairie Complex, over 300,000 individual restorable wetland basins were identified and mapped. Upon completing the Southwest Prairie Complex mapping, townships in 42 western and south-central counties in the prairie and transition zone eco-regions of Minnesota have been mapped, adding an important component to the State's spatial data infrastructure that informs environmental planning and research. Through this investment in RWI – combined with the National Wetlands Inventory, landcover classifications, and a growing catalogue of high-resolution elevation data – our capacity to understand (and importantly, restore and manage) Minnesota's wetland resources is continuing to improve.

Project Partners were the LCCMR, Ducks Unlimited, Inc., and the U.S. Fish and Wildlife Service. The photo-interpretation and digitization work was contracted to the GIS Lab at South Dakota State University.

M.L. 2009
The 2009 LCCMR appropriation of will provide the last project funding needed to complete, remaining RWI mapping for the glaciated, tallgrass prairie region of Minnesota – an additional 6,120 mi^2. The mapping will occur in approximately 170 townships in Clay, Mahnomen, McLeod, Meeker, Nicollet, Norman, Renville, Sibley, Wilkin, and Wright Counties.

III. PROGRESS SUMMARY AS OF:

M.L. 2008
Completed (see "M.L. 2008 Final Project Summary" in Section II above)

December 31, 2008
M.L. 2009
N/A

June 30, 2009:
M.L. 2009
N/A

December 31, 2009:
M.L. 2009
Agreement has been signed with GIS lab at South Dakota State University to continue working on the project through the final phase of counties.

June 30, 2010:
M.L. 2009
NAPP imagery has been acquired and prepared for the Red River Valley Complex and Farm Service Agency compliance slides have been obtained for Clay and Wilkin Counties. Deviating from the schedule outlined in the workplan, Clay and Wilkin Counties will be completed prior to Mahnomen and Norman Counties due to the timing of the compliance slide acquisitions.

IV. OUTLINE OF PROJECT RESULTS*:*

Result 1: Southwest Prairie Complex Mapping
Description:
In **Brown, Cottonwood, Lincoln, Lyon, Martin, Murray, Nobles, Pipestone, Redwood, Rock, and Watonwan Counties**, RWI product will be mapped for **154 Townships**. National Aerial Photography Program (NAPP) (1:40,000 scale) color infrared (CIR) photographs will be viewed in stereo pairs at 5x magnification using a cartographic engineering stereoscope. Drained depressional wetlands will be delineated on a Mylar overlay using a 6X0 (0.13mm diameter) rapidograph pen and indelible ink. Collateral data will be consulted during the digitization process consisting of published county soil surveys and descriptions of hydric soils, USDA Farm Service Agency compliance slides (aerial 35-mm slides) acquired in 1993

(immediately after a period of intense precipitation), USGS 7.5-minute topographic maps, and National Wetlands Inventory (NWI) maps. Mylar overlays will be scanned to create draft digital data. The final deliverable consists of distributing the final GIS products on the Minnesota DNR Data Deli and Ducks Unlimited websites.

Summary Budget Information for Result 1:

	M.L. 2008	M.L. 2009	Total
Trust Fund Budget:	**$245,000.00**	**$0**	**$245,000.00**
Amount Spent:	**$243,870.50**	**$0**	**$243,870.50**
Balance:	**$1129.50**	**$0**	**$1129.50**

Deliverable	Completion Date	Budget	Status
1. Acquisition of Imagery	July 2008	$2,500	n/a
2. SDSU Photointerpretation/Digitization • Brown County (~17 townships) • Cottonwood (9 townships) • Lincoln County (13 townships) • Lyon County (12 townships) • Martin County (20 townships) • Murray County (6 townships) • Nobles County (16 townships) • Pipestone County (~12 townships) • Redwood County ~(24 townships) • Rock County (~13 townships) • Watonwan County (12 townships)	n/a September 2008 December 2008 February 2008 April 2009 July 2009 September 2009 December 2009 February 2010 April 2010 May 2010 June 2010	$242,500	n/a
3. Product Distribution	July 2010	$0	n/a

[a] SDSU GIS Lab will receive a one-time payment upon delivery of product for all Counties. Ducks Unlimited, Inc. will request LCCMR reimbursement after product has been delivered by SDSU and Ducks Unlimited, Inc. has paid SDSU for their work. Completion dates reflect anticipated digitization timeframes for each county.

Completion Date: M.L. 2008 = July 31, 2010

Final Report Summary (July 2010):

The Restorable Wetlands Inventory (RWI) is a complement to the National Wetlands Inventory (NWI) completed in late-1980s by the U.S. Fish & Wildlife Service. An administrative decision was made developing the original NWI not to map wetland basins in Minnesota identified as completely drained. The number and acreage of completely drained wetlands that were not mapped by the NWI process is significant

RWI project identifies and digitizes the completely-drained depressional wetlands that were not mapped by the NWI process. Restorable wetlands mapping is based upon protocols established for NWI allowing seamless integration of the two datasets.

In the Southwest Prairie Complex, over 300,000 individual restorable wetland basins were identified and mapped. Upon completing the Southwest Prairie Complex mapping, townships in 42 western and south-central counties in the prairie and transition zone eco-regions of Minnesota have been mapped, adding an important component to the State's spatial data infrastructure that informs environmental planning and research. Through this investment in RWI – combined with the National Wetlands Inventory, landcover classifications, and a growing catalogue of high-resolution elevation data – our capacity to understand (and importantly, restore and manage) Minnesota's wetland resources is continuing to improve.

The Restorable Wetlands Inventory mapping product for the Southwest Prairie Complex is complete and will be distributed on the Minnesota Data Deli and Ducks Unlimited, Inc. websites by the end of August 2010 in GIS-compatible formats.

Result 2: Red River Valley Complex Mapping
Description:
Within **Clay, Mahnomen, Norman, and Wilkin Counties**, RWI product will be mapped for **72 Townships** (see Work Plan Map #1). The protocols, procedures, and deliverables will be the same as described under Result 1, but for the different geographic extent.

Summary Budget Information for Result 2:

	M.L. 2008	M.L. 2009	Total
Trust Fund Budget:	**$0**	**$125,000**	**$125,000**
Amount Spent:	**$0**	**$5,000**	**$5,000**
Balance:	**$0**	**$120,000**	**$120,000**

Deliverable	Completion Date	Budget	Status
1. Acquisition of Imagery	January 2010	$2,500	n/a
2. SDSU Photointerpretation/Digitization • Mahnomen County (16 townships) • Norman County (24 townships) • Clay County (12 townships) • Wilkin County (~21 townships)	n/a June 2010 September 2010 December 2010 April 2011	$122,500	n/a
3. Product Distribution	April 2011	$0	n/a

[a] SDSU GIS Lab will receive a one-time payment upon delivery of product for all Counties. Ducks Unlimited, Inc. will request LCCMR reimbursement after product has been delivered by SDSU and Ducks Unlimited, Inc. has paid SDSU for their work. Completion dates reflect anticipated digitization timeframes for each county.

Completion Date: M.L. 2009 = April 30, 2011

Result Status as of December 31, 2009:
M.L. 2009

Agreement has been signed with the GIS lab at South Dakota State University to continue photo-interpretation and digitization work on the final, remaining counties in the RWI project.

Result Status as of June 30, 2010:
M.L. 2009
NAPP imagery has been acquired and prepared for the Red River Valley Complex and Farm Service Agency compliance slides have been obtained for Clay and Wilkin Counties. Deviating from the schedule outlined in the workplan, Clay and Wilkin Counties will be completed prior to Mahnomen and Norman Counties due to the timing of the compliance slide acquisitions.

Result Status as of December 31, 2010:

Result Status as of June 30, 2011:

Final Report Summary (July 2012):

Result 3: Prairie-Hardwood Complex Mapping
Description:
In **Meeker, McLeod, Wright, Renville, Sibley, and Nicollet Counties**, RWI product will be mapped for **106 Townships**. The protocols, procedures, and deliverables will be the same as described under Result 1, but for the different geographic extent.

Summary Budget Information for Result 3:

	M.L. 2008	M.L. 2009	Total
Trust Fund Budget:	**$0**	**$175,000**	**$175,000**
Amount Spent:	**$0**	**$0**	**$0**
Balance:	**$0**	**$175,000**	**$175,000**

Deliverable	Completion Date	Budget	Status
1. Acquisition of Imagery	June 2011	$2,500	n/a
2. SDSU Photointerpretation/Digitization • Meeker County (18 townships) • Wright County (~22 townships) • McLeod County (14 townships) • Sibley County (16 townships) • Nicollet County (~5 townships) • Renville County (~27 townships)	n/a August 2011 October 2011 December 2011 February 2012 February 2012 June 2012	$172,500	n/a
3. Product Distribution	June 2012	$0	n/a

[a] SDSU GIS Lab will receive a one-time payment upon delivery of product for all Counties. Ducks Unlimited, Inc. will request LCCMR reimbursement after product has been delivered by SDSU and Ducks Unlimited, Inc. has paid SDSU for their work. Completion dates reflect anticipated digitization timeframes for each county.

Completion Date: M.L. 2009: June 30, 2012

Result Status as of December 31, 2009:
M.L. 2009
Agreement has been signed with the GIS lab at South Dakota State University to continue photo-interpretation and digitization work on the final, remaining counties in the RWI project.

Result Status as of June 30, 2010:
M.L. 2009
N/A

Result Status as of December 31, 2010:

Result Status as of June 30, 2011:

Result Status as of December 31, 2011:

Result Status as of June 30, 2012:

Final Report Summary (July 2012):

V. TOTAL TRUST FUND PROJECT BUDGET:

M.L. 2008
Staff or Contract Services: $ 245,000

• Contract - South Dakota State University, NWI Laboratory	$ 242,500
• 2.5% FTE - Project Manager Ducks Unlimited, Inc.	$ 2,500
TOTAL 2008 TRUST FUND PROJECT BUDGET:	**$ 245,000**

M.L. 2009
Staff or Contract Services: $ 300,000

• Contract - South Dakota State University, NWI Laboratory	$ 296,000
• 5% FTE - Project Manager Ducks Unlimited, Inc.	$ 4,000
TOTAL 2009 TRUST FUND PROJECT BUDGET:	**$ 300,000**

VI. OTHER FUNDS AND PARTNERS

A. Project Partners

M.L. 2008 and M.L. 2009
Dr. Rex Johnson, HAPET Team Leader, U.S. Fish & Wildlife Service – Region 3
Darin R. Blunck, Director of Conservation Programs, Ducks Unlimited, Inc.
Brian Huberty, Regional NWI Coordinator, U.S. Fish & Wildlife Service – Region 3

B. Other Funds Proposed to be Spent during the Project Period

M.L. 2008

U.S. Fish & Wildlife Service	$45,000 Cash/In-kind	Imagery Acquisition and QA/QC
Ducks Unlimited, Inc.	$4,500 In-kind	Project Management

M.L. 2009

U.S. Fish & Wildlife Service	$50,000 Cash/In-kind	Imagery Acquisition and QA/QC
Ducks Unlimited, Inc.	$6,000 In-kind	Project Management

C. Spending History

U.S. Fish & Wildlife Service	$ 10,000 Cash/In-kind
Ducks Unlimited, Inc.	$ 6,000 In-kind
Habitat Corridors Partnership (LCCMR)	$ 98,000 Cash

D. Time:

M.L. 2008

Grant funds will be used predominantly for contract services with timeframes established for deliverables based on approximations of when the contractor estimates feasible delivery of products. Reimbursement for the Southwest Prairie Complex Result will be requested from LCCMR in July 2010 upon completion and delivery of the mapping product.

M.L. 2009

Reimbursement for the Red River Valley mapping result will be requested from LCCMR in April 2011 upon completion and delivery of the mapping product. Reimbursement will be requested in June 2012 upon completion and delivery of the mapping product for the Prairie-Hardwood Complex.

E. Project Impact and Long-term Strategy

The completion of the Restorable Wetlands Inventory is an important component of the State's spatial data infrastructure. Once completed, the dataset will provide seamless data on wetland restoration potential in the glaciated regions of Minnesota. The dataset is a baseline dataset that requires no periodic updates.

VII. DISSEMINATION:

Data will be distributed on the web via the Minnesota GIS Data Deli (http://deli.dnr.state.mn.us) and the Ducks Unlimited, Inc. (http://www.ducks.org) websites.

VIII. REPORTING REQUIREMENTS:

M.L. 2008

Periodic work program progress reports will be submitted not later than December 2008, June 2009, and December 2009 for the 2008 appropriation. A final work program report and associated products for the 2008 appropriation will be submitted between June 2010 and July 2010.

M.L. 2009

Periodic work program progress reports will be submitted not later than December 2009, June 2010, December 2010, June 2011, December 2011, and June 2012. A

final work program report and associated products for the 2009 appropriation will be submitted no later than August 1, 2012.

IX. RESEARCH PROJECTS:

Attachment A: Budget Detail for 2008 Projects - Summary and a Budget page for each partner (if applicable)

Project Title: *Restorable Wetland Inventory*

Project Manager Name: *Darin R. Blunck - Ducks Unlimited, Inc.*

Trust Fund Appropriation: $ **245,000**

1) See list of non-eligible expenses, do not include any of these items in your budget sheet

2) Remove any budget item lines not applicable

2008 Trust Fund Budget	**Result 1 Budget:**	**Amount Spent 12/31/2009**	**Balance 12/31/2009**	**TOTAL BUDGET**	**TOTAL BALANCE**
	Southwest Prairie Complex Mapping				
BUDGET ITEM					
Contracts					
Professional/technical: Ducks Unlimited, Inc., Project Management	2,500	1,371	1,130	2,500	1,130
Professional/technical: GIS Laboratory, Department of Fish and Wildlife Sciences, South Dakota State University	242,500	242,500	0	242,500	0
COLUMN TOTAL	**$245,000**	**$243,871**	**$1,130**	**$245,000**	**$1,130**

2008 Project Abstract
For the Period Ending June 30, 2010

PROJECT TITLE: Wildlife Disease Data Surveillance and Analysis
PROJECT MANAGER: Patrick T Redig, DVM, PhD
AFFILIATION: The Raptor Center, University of Minnesota
MAILING ADDRESS: 1920 Fitch Avenue
CITY/STATE/ZIP: St. Paul, MN 55108
PHONE: 612-624-4969
E-MAIL: redig001@umn.edu
WEBSITE: www.TheRaptorCenter.org
FUNDING SOURCE: Environment and Natural Resources Trust Fund
LEGAL CITATION: M.L. 2008, Chap. [367], Sec. [2], Subd. 5(f)

APPROPRIATION AMOUNT: $ 100,000

Overall Project Outcome and Results

Wildlife is an integral part of the complex interrelationship between human, animal and environmental health, yet there is no centralized system for collection of wildlife health data. The study of wildlife health is limited by the logistics and expenses involved with sample acquisition. Wildlife rehabilitation centers represent an untapped resource as they admit a larger number of wild animals with a greater variety of species than any other resource.

This project developed a centralized database for tracking morbidity and mortality of wildlife seen in wildlife rehabilitation centers in Minnesota. A central goal was the development of standardized terminology,, a critical step in the ability to integrate data from multiple rehabilitation centers. Initially, a survey was designed and distributed to ascertain current practices for clinical wildlife health data management. Next, a series of workshops was held with experts in the field of wildlife health to define data sets for signalment, animal recovery information, cause of admission and initial clinical signs. The animal recovery and signalment descriptors were used to integrate 10 years of historical data from Minnesota's two largest wildlife rehabilitation facilities. This established baseline data for normal patterns of wildlife admissions and created a preliminary GIS and web-based information system. A pilot project involving six wildlife hospitals focusing on avian species susceptible to lead poisoning, was begun to evaluate the functionality of the circumstances of admission, clinical signs and pathophysiological diagnosis terminology. This project is ongoing.

The results of this project were instrumental in the creation of a template for wildlife health data reporting and the development of a system for surveillance of wildlife health issues. This information will be important for wildlife conservation projects, wildlife management, disease surveillance, and as an indicator of ecosystem health. The data can be accessed through the new web site, http://wildlifedisease.nbii.gov/cwhi/, or by contacting The Raptor Center.

Project Results Use and Dissemination
***This section NOT intended to count toward recommended 300 word length for Abstract**

The information resulting from this project has already been used to inform the development of a wildlife health reporting system being developed by the Wildlife Center of Virginia and to be distributed to wildlife rehabilitation centers around the country. A secondary outcome of this project, the development of a collaborative group called the Clinical Wildlife Health Initiative, has resulted in the expansion of this work to a national level. Discussions are underway on the potential use of this information in the United States Fish and Wildlife Service permitting process for rehabilitation center reporting, as well as the use of the

new system for long-term monitoring at rehabilitation centers along the Gulf Coast as a result of the Deepwater Horizon Oil Spill.

Trust Fund 2008 Work Program Final Report

Date of Report: 15 August 2010
Final Report:
Date of Work program Approval:
Project Completion Date: 30 June 2010

I. PROJECT TITLE: Wildlife Disease Data Surveillance and Analysis

Project Manager: Patrick T. Redig, DVM, Ph. D.
Affiliation: The Raptor Center, University of Minnesota
Mailing Address: 1920 Fitch Avenue
City / State / Zip : St. Paul, MN 55108
Telephone Number: 612-624-4969
E-mail Address: redig001@umn.edu
FAX Number: 612-624-8740
Web Page address: www.TheRaptorCenter.org

Location: St. Paul, MN

Total Trust Fund Project Budget:	**Trust Fund Appropriation:**	**$**	**100,000**
	Minus Amount Spent:	**$**	**99,973**
	Equal Balance:	**$**	**27**

Legal Citation: M.L. 2008, Chap. [367], Sec. [2], Subd. 5(f)

Appropriation Language:
$100,000 is from the trust fund to the Board of Regents of the University of Minnesota for the Raptor Center to develop a GIS-based database that catalogs symptoms and conditions observed in injured wildlife.

II. and III. FINAL PROJECT SUMMARY:
The long-term project goal was to develop a centralized database for tracking of morbidity and mortality of wildlife seen in wildlife rehabilitation centers. Wildlife is an integral part of the complex interrelationship between human, animal and environmental health, yet there is no centralized system for collection of wildlife health data. The study of wildlife health is limited by the logistics and expenses involved with sample acquisition. Wildlife rehabilitation centers represent an untapped resource as they admit a larger number of wild animals and a greater variety of species than any other resource.

A central aim of this project was the development of standardized terminology for reporting of morbidity and mortality, a critical step in the ability to integrate data from multiple rehabilitation centers. In order to develop the standardized terminology, a survey was designed and distributed to ascertain current practices for wildlife health

data management. A series of workshops was held with experts in the field of wildlife health. Defined lists of data were developed for signalment, animal recovery information, cause of admission and initial clinical signs. These descriptors were used to integrate 10 years of historical data (animal recovery and signalment) from Minnesota's two largest wildlife rehabilitation facilities to establish baseline data for normal patterns of wildlife admissions, creating a preliminary GIS and web-based information system. A second pilot project involving six wildlife hospitals and focusing on avian species susceptible to lead poisoning was begun to evaluate the functionality of the terminology related to circumstances of admission, clinical signs and pathophysiological diagnosis.

The results of this project will be instrumental in the creation of a template for wildlife health data reporting and the development of a system for surveillance of wildlife health issues. This information is important for wildlife conservation projects, wildlife management, disease surveillance and as an indicator of ecosystem health. The data can be accessed through the web site or by contacting The Raptor Center.

IV. OUTLINE OF PROJECT RESULTS*:*
Amendment approved 3/10/2010

Result 1: Standardized dataset

Description: Currently available health data will be characterized, and needs for future health data collection from birds seen in wildlife hospitals will be identified. A defined list of data to be collected for use in the database will be developed. To do this, ~~two~~ workshops will be held to review current data collection and categorization, identify gaps in data collection, evaluate needs for a health monitoring system and formulate a process for development of a health monitoring system. After the initial workshop, a series of comprehensive meetings will be virtual workshops using teleconference technology. Wildlife experts recruited for these workshops will include wildlife veterinarians, professionals in wildlife health monitoring systems and epidemiology, MN DNR, wildlife services, Minnesota state veterinarian, USGS, National Wildlife Health Center, and wildlife rehabilitators. Between virtual workshops, each hospital involved will use the most recent iteration of the standardized dataset definitions in their facility to evaluate their functionality; these experiences will be shared in the next workshop and used to inform future iterations of the datasets. The participation of informatics and terminology specialists in the virtual workshop process will provide expert external input to this process. Once standard terminology is developed for circumstances of admission, clinical signs and pathophysiological diagnosis, the functionality of these definitions will be evaluated through use in a pilot project involving six wildlife hospitals. Capacity of current electronic medical records systems will be increased through acquisition or development to encompass reporting needs for use with the wildlife health monitoring system.

Summary Budget Information for Result 1:	**Trust Fund Budget:**	**$ 49,500**
	Amount Spent:	**$ 44,385**
	Balance:	**$ 5,115**

Deliverable	Completion Date	Budget	Status
Characterization of available health data	12.15.2008	14,500	100%
Workshops ~~(two)~~	06.30. 2010	12,000	100%
Defined list of data to be collected	06.30. 2010	7,000	100%
Evaluation of database functionality	06.30.2010	16,000	100%

Completion Date:

Final Report Summary:

A survey to ascertain current practices for collecting health data on animals seen in wildlife hospitals was distributed. This was followed by a series of workshops involving experts such as wildlife veterinarians, ecosystem health experts, public health officials, epidemiologists, informatics, GIS and statistics; through these workshops, a defined list of standardized terminology was developed for animal recovery information, causes of admission, initial clinical signs and pathophysiological diagnosis. This process was more labor-intensive than originally projected and a series of virtual workshops was used to complete the process. The results of these workshops were used to develop the concept of a web-based, centralized database for health information from wildlife clinical care facilities. Once developed, the standardized terminology was trialed at six wildlife rehabilitation hospitals around the country in a project focusing on lead exposure in avian wildlife. Based on a survey of institutions, ten species were reported to be affected by lead and commonly admitted. Using the new terminology and recording systems developed, admissions of these ten species are being tracked and evaluated for lead exposure. This pilot project is on-going and will be used to inform adjustments to the terminology work.

A significant challenge was realized in the lack of adequate electronic medical records systems at most facilities. As a result, a partnership was developed with the Wildlife Center of Virginia (WCV). Over the past eight years, WCV has been developing a wildlife incident/intake database with a medical records component. The development of standardized terminology was the critical component to finishing the development of their system, which eventually will be distributed to wildlife clinical care facilities around the country.

Result 2: Database for health information

Description: A user-friendly, publically accessible, searchable, GIS and web-based database will be developed in conjunction with Wildlife Disease Information Node (USGS) to be used for monitoring trends in health of birds seen in wildlife hospitals. The components of this database will initially include data fields for animal recovery information and related environmental data such as land use, climate, water, soil types and vegetation. This will be expanded to include standardized datasets. A 10 year historic dataset of admission information from birds seen at 2 wildlife hospitals will be developed to evaluate functionality of the database.

Summary Budget Information for Result 2: **Trust Fund Budget: $ 50,500**
Amount Spent: $ 55,588
Balance: $ (5,088)

Deliverable	Completion Date	Budget	Status
Database for animal recovery information	12.15.2008	15,000	100%
Expanded database – health datasets	06.30.2009	15,500	100%
Historic dataset of admission information	06.30.2010	13,500	100%
Evaluation of functionality of database	06.30.2010	6,500	100%

Final Report Summary:

An on-line GIS-linked database has been developed through the Wildlife Disease Information Node web site (http://wildlifedisease.nbii.gov/cwhi/). The data in this database currently encompasses all clinical wildlife cases involving 11 avian species seen in the past 10 years at The Raptor Center and the Wildlife Rehabilitation Center. The data can be sorted based on species, age, sex, state/county of recovery and wildlife facility case where case admitted. Informatics specialists worked with the staff of these two organizations to create a clean dataset of basic admission information and develop a preliminary data baseline. With the development of standardized datasets from Result 1, the database functionality is being expanded for future use and will be piloted with the lead exposure in avian wildlife study results; due to the lack of common terminology in clinical records up to this point, it was not possible to build in causes of admission, clinical signs and diagnosis for the historic datasets. Another significant challenge is in the available GIS information; past clinical records could only provide animal recovery information at a county level. This limits the ability to associate specific environmental data such as land use, water and vegetation with animal recovery location. The prospective pilot project currently being run with the expanded datasets is also using more detailed animal recovery location, which will be included in future versions of the web site and used to evaluate the utility of the environmental overlay maps.

V. TOTAL TRUST FUND PROJECT BUDGET:

Staff or Contract Services: $80,000

TRC Clinic Manager, 10% effort for 2 years: $15,000

Responsible for inventory of databases and information available, coordinating clean-up of data and data verification for future database consolidation, consolidation of data, refining of medical records and coordination of communication across institutions involved with database efforts. Also responsible for coordination of first workshop~~s~~.

TRC Staff Veterinarian, 5% effort for 1st year: $9,000; 10% effort for 2nd year

Responsible for data verification and consultation, evaluation of data collection methods and characterization of data, and analysis of data. Responsible for coordination, preparation, running and follow-up for virtual

workshop series, as well as development of standardized datasets with common terminology to be used for pilot project.

TRC Research Scientist, 5% effort for 1year: $14,000

Scientific resource and data analysis.

TRC technical staff and clerical support, 750 hours (250 hours year one, 500 hours year two): $15,000

Data clean-up and entry from electronic and paper databases; Workshop arrangements and communications.

Contract: Wildlife Rehabilitation Center: $7,000

Data clean-up and entry, data

Contract: USGS Wildlife Disease Information Node: $20,000

Creation of web-based database/data management system and integration with GIS overlays.

Professional Services: $8,500

Virtual Workshop Budget
16 participants, 10 weeks @ $55/session:
Note: We are following the amount provided to peer reviewers of trust programs by LCCMR. Not everyone would be able to participate each week and some will not take the offered payments as they are not eligible due to employment stipulations,

Equipment: $3,000

Four computer workstations will be purchased for The Raptor Center's medical and surgical clinic to provide real-time entry capacity of electronic medical records/health data. Embedded reporting software will be developed for data transmission to new centralized database.

Other: $ 10,000 – costs associated with bringing in experts for two workshops, including travel, per diems, honorariums, printed materials, communications and location rental.

$ 7,000 – software development: refinement and expansion of electronic medical records system to web-based system with GIS capacity. University of Minnesota Information Technology department.

TOTAL TRUST FUND PROJECT BUDGET: $ 100,000

Explanation of Capital Expenditures Greater Than $3,500: *A computer system for electronic medical records for collection, consolidation and integration of health data.*

VI. OTHER FUNDS & PARTNERS:

A. Project Partners:

Wildlife Disease Information Node (USGS)

– Josh Dein, Wildlife Disease Information Node

Wildlife Rehabilitation Center

Wildlife Center of Virginia

B. Other Funds Proposed to be Spent during the Project Period:

We have requested $20,000 from USGS; no commitment has been received to date

We have $65,000 committed from Katherine B. Andersen Fund of the St. Paul Foundation toward equipment upgrade for electronic medical records system (digital radiology)

During the project period, additional staff time will be donated for oversight of this project, as well as scientific resource of the Executive Director (5% - 2 years: $13,000).

C. Past Spending:

During the two years prior to July 1, 2008, The Raptor Center staff has spent 5% of clinic staff time (in-kind) on preparing the Center's medical records system for use in this project.

D. Time:

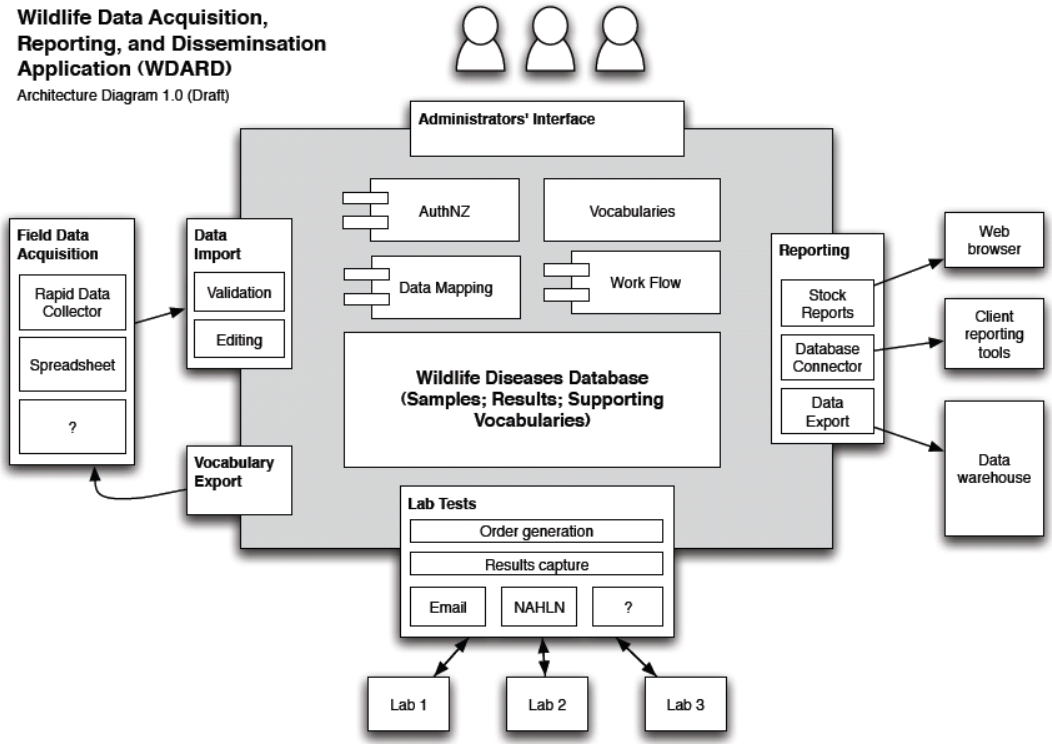
VII. DISSEMINATION: Sharing of data will be through the publically accessible database associated with the Wildlife Disease Information Node (http://wildlifedisease.nbii.gov/). In addition, the information resulting from this project will be used to inform the development of a wildlife health reporting system being developed by the Wildlife Center of Virginia and to be distributed to wildlife rehabilitation centers around the country.

VIII. REPORTING REQUIREMENTS:
Periodic work program progress reports will be submitted not later than 12/15/08, 6/30/09, and 12/15/09. A final work program report and associated products will be submitted between June 30 and August 1, 2010 as requested by the LCCMR

IX. RESEARCH PROJECTS:

Figures:

1. Data Architecture



J:\SHARE\WORKFILE\ML2008\Work Program Information\2008WPTemplateblank.doc

Appendix I: Workshop Participants

Lori Arent, MS	The Raptor Center, University of Minnesota	St. Paul, MN
Keely Bargnesi	Avian Conservation Center/Center for Birds of Prey	Charleston, SC
Ed Clark	Wildlife Center of Virginia	Waynesboro, VA
F. Josh Dein, BA, VMD, MS	Wildlife Disease Information Node	Madison, WI
Nate Flesness	International Species Information System (ISIS)	Eagan, MN
Cheryl Hoggard, DVM	National Wildlife Rehabilitators Association	
John Huckabee, DVM	PAWS Wildlife Center	Lynnwood, WA
Stacy Hughes	Avian Conservation Center/Center for Birds of Prey	Charleston, SC
Dave McRuer, MSc, DVM, Dipl ACVPM	Wildlife Center of Virginia	Waynesboro, VA
Mark Pokras, DVM	Tufts Cummings School of Veterinary Medicine	North Grafton, MA
Julia Ponder, DVM	The Raptor Center, University of Minnesota	St. Paul, MN
Leslie Reed, DVM	Wildlife Rehabilitation Center of MN	Roseville, MN
Lorisa Ricketts	The Center for Wildlife	Cape Neddick, ME
Karen Shenoy, DVM	NWRA	MN
Rachel Thompson	International Species Information System (ISIS)	Eagan, MN
Flo Tseng, DVM	Wildlife Clinic, Tufts	North Grafton, MA
Sallie Welte, VMD	Tri-State Bird Rescue and Research, Inc	Newark, DE
Jeff Wilcke, DVM, MS, DACVCP	VA-MD Regional College of Veterinary Medicine	Blacksburg, VA
Michelle Willette	The Raptor Center, University Of Minnesota	St. Paul, MN

Clinical Wildlife Health Initiative: Pilot Project Definitions

Circumstances of Admission

1) **Animal Interaction** – Contact with another animal leads directly or indirectly to the wildlife patient being admitted to a rehabilitation facility.

   a) Domestic animal – A form of animal interaction where wildlife had either direct or indirect contact with one or more of a variety of animals that have been tamed and made fit for a human environment. This term includes animals that were domesticated as a species but may now be feral.

      i) *Dog* – Wildlife injury caused by a domesticated dog. May be feral.

      ii) *Cat* – Wildlife injury caused by a domesticated cat. May be feral.

   b) Non-domestic animal – A form of animal interaction where wildlife had either direct or indirect contact with an animal not made tame or fit for a human environment.

      i) *Same species* – Wildlife injury caused by a non-domesticated animal of the same species.

      ii) *Different species* – Wildlife injury caused by a non-domesticated animal of a different species. This may also include wild yet non-native animals kept as pets (ex. escaped boa constrictors, roaming Serval cats, etc)

2) **Collision** – Injury resulting from an impact with either a stationary or a moving object.

   a) Moving object – Collision with an object that is in motion such as a vehicle or an object being swung purposefully or accidentally at the animal.

      i) *Car/Truck/Motorcycle* – Impact with any part of a moving car, truck, motorcycle, all terrain vehicle, snow-machine, etc.

      ii) *Train* – Impact with any part of a moving train.

      iii) *Plane* – Impact with any part of a moving plane.

      iv) *Watercraft* – Impact with a type of watercraft such as a boat, jet ski, ferry, etc.

      v) *Bicycle* – Impact with self-propelled vehicles including bicycles, scooters, etc.

      vi) *Motorized Farm Equipment* – Impact with a variety of farm equipment including tractors, mowers, ploughs, harrows, balers, etc.

vii) *Motorized Yard Equipment* – Impact with a variety of yard equipment including weed-eaters, lawnmowers, rototillers, etc.

viii) *Human Swung Object* – Collision with a moving object handled by a human either accidentally or with the intent of impact. The colliding object must not be thrown or it becomes a projectile. Examples: shovel used to hit a snake, tennis racket used to strike a bat, etc.

b) Stationary object – Collision with an object that is stationary that may be either manmade or a natural feature. The stationary object may have moving parts such as a windmill or hydro dam.

i) *Walls/Windows* – Injury resulting from an impact with a building, wall, window, etc.

ii) *Wind Turbines* – Injury resulting from an impact with the stationary pole or the moving blades of a wind turbine. Also includes damage caused by the negative pressure associated with the blades as is often found in wind turbine/bat interactions.

iii) *Powerlines/Wires* – Collision with any form of electrical or communication line or permanent wire fence structure that results in physical damage but NOT entrapment.

iv) *Natural Features* – Injury resulting from an impact with a natural feature such as a tree, rock-face, or the ground such as when an animal injures itself falling from a nest.

3) **Electrocution** – Injuries resulting from contact with more than one wire or a wire and a grounding object resulting in clinical signs associated with electrocution.

4) **Gas Flare –** Exposure to a gas flare associated with methane burners, refineries, oil and gas rig, etc.

5) **Entrapment** – A confining circumstance from which escape is difficult. Entrapment may occur from devices meant to capture animals, from devices or objects whose primary function is something other than to capture animals, or from spaces where the animal's body is free to move yet full escape to a natural setting is being impaired. When questioning which subcategory to use, the user should first define the intended purpose of the entrapping object or circumstance.

a) Trap – A confining object, device or circumstance whose primary function is to capture animals. Traps capturing animals other than the intended species of interest are included (by-catch).

i) *Fishing Tackle* – Traps intended to capture fish include fishing hooks, fishing line, fishing nets, crab pots, etc.

ii) *Leghold Trap/Snare* – Devices often used by wild game trappers that are intended for the harvest of fur-bearing animals. These devices include leghold traps, conibear traps, pitfall traps, deadfall traps, snares, etc.

iii) *Humane/Cage Trap* – Cages that are designed to capture live animals.

iv) *Glue Trap* – Traps made using a natural or synthetic adhesive applied to cardboard or similar material and used for the intended capture of rodents. The capture of unintentional species is common.

b) Non-trap – A confining object, device or circumstance whose primary function is something other than the capture/restraint of animals.

i) *Sporting/Landscaping Netting* – Any net or mesh-like material used in a variety of day-to-day functions but NOT intended to capture animals. Examples include garden/landscape netting, netting found in sports activities such as soccer and basketball, etc.

ii) *Fence* – Entrapment in any material used to prevent the movement of animals or humans either into or out of an area. Common examples include barbed wire, snow fencing, chain-linked fence, etc.

iii) *Litter/Garbage* – Entrapment in any waste material that has been carelessly left in the environment. Common examples include plastic wrappers or packaging, cans, bottles, string or rope (NOT INCLUDING fishing line or nets)

iv) *Oil/Grease Contamination* – Exposure to oil, grease, paint, or other petrochemical products leading to the penetration or covering of the fur, feathers, or external surface of the animal.

c) Spaces – Entrapment in a defined area where the body is free to move clear of restrictions however, escape away from the enclosed area is difficult.

i) *Chimney* – Entrapment within or through a chimney.

ii) *Building* – Entrapment within a building or room within a building. Common examples include houses, outdoor stair or window wells, warehouses, tents, barns, etc.

iii) *Vehicle* – Entrapment within or on a vehicle meant for human transportation. Examples include animals trapped within the wheel well of a plane, nests with young animals built under car bumpers, animals trapped within bilge water on boats, etc.

iv) *Pool* – Entrapment within any kind of swimming pool.

6) **Environment** – Conditions caused by environmental factors that lead directly or indirectly

to the animal being found and admitted for rehabilitation.

a) Harmful algal blooms – Animals admitted from an area affected by a known algal bloom and have clinical signs consistent with such an event. This circumstance requires an already determined diagnosis to select.

b) Weather – Inclement changes in the physical environment leading directly or indirectly to an animal being injured or displaced.

i) *Temperature* – Extreme hot or cold temperatures leading to an animal being injured or displaced.

ii) *Precipitation* – Any event associated with precipitation leading to an animal being injured or displaced. These factors may include: flooding, rain, hail, sleet, snow, avalanche, or draught conditions.

iii) *Wind* – Any event associated with wind leading to an animal being injured or displaced. These factors may include: hurricane, tornado, high winds, etc.

iv) *Lightning* – Direct or indirect exposure to lightning resulting in injury.

c) Seismic Event – Any event associated with a seismic event leading to an animal being injured or displaced. These factors may include: earthquake, tidal wave, volcano, etc.

d) Fire – Direct exposure to flames resulting from fire in the environment. Examples include: forest fires and grass fires.

e) Smoke – Direct exposure to smoke resulting from a fire in the environment.

7) **Nest/Habitat Destruction –** The destruction or disturbance of a nest, burrow, or essential habitat resulting in the animal being injured or displaced.

8) **Behavioral Stranding –** Referring to events other than weather leading to single or multiple animals cut off from their natural habitat and cannot be returned unassisted. Often caused by altered behavior such as marine mammal stranding.

9) **Orphan** – Any circumstance in which displaced healthy or injured young animals, still dependant on parental care for survival, are found and there is a high probability that the parents are dead or not available.

a) Parents Not Available – a single or group of young animals admitted for rehabilitation where it is known that the parents are deceased or appropriate attempts to unite the young animals with the parents have failed.

b) Parents Rejected – a single or group of young animals admitted for rehabilitation where it is known, or it is highly likely, that parental rejection has occurred.

10) **Inappropriate Human Possession** – A circumstance where an animal of any age is

inappropriately removed from its natural habitat and is in human possession due to either i) perceived risk by the rescuer, ii) to be kept as a pet, or iii) to be treated for injuries by a person lacking appropriate training, authorization, or assistance.

a) Abduction With Intent of Rescue – Any animal that is brought for rehabilitation with the intent of rescue, that has been removed from its natural habitat without warrant due to either i) perceived risk to the animal by the rescuer, ii) disregard or ignorance of the animal's natural history, or iii) when no attempt or an inappropriate attempt has been made to reunite a young animal with its parents. This term replaces the traditional "kidnapped".

b) Pet – Any animal inappropriately removed from its natural habitat and kept and cared for by a human as a "pet".

c) Unauthorized or Untrained Rehabilitation – Any injured animal removed from its natural habitat and kept and treated by a person lacking appropriate training, authorization, or assistance without seeking formal rehabilitation aid and with the intent of release.

11) **Projectile** – Any object propelled by a force through the air or water that eventually comes to rest.

a) Weapon – Any projectile discharged from an instrument whose primary design or intention is as a weapon.

i) *Gunshot* – A wound or injury caused by any projectile discharged from a firearm or similar device.

(1) *Rifle/Handgun* – An injury typically caused by a single metallic projectile propelled by gunpowder and discharged from a firearm having a rifled or helical groove pattern on the inner surface of the barrel. This also includes rifled slugs from shotguns and bullets or balls from smoothbore (non-rifled barrel) muskets/pistols.

(2) *Shotgun* – An injury typically caused by multiple metallic projectiles propelled by gunpowder and discharged from a firearm having a barrel with a smooth inner surface (smooth bore). Ex. birdshot, buckshot, etc.

(3) *Air Gun/BB Gun* – An injury typically caused by a single metallic projectile propelled by pressurized gas (air, CO2) or compressed spring, from a firearm with either a rifled or smooth inner surface to the barrel. These typically include pellet guns and BB guns.

ii) *Bow/Arrow* – An injury caused by a sharp-pointed shaft (arrow or bolt) that is projected by the elastic force from a bow or the spring-loaded force from a crossbow.

b) Non-weapon – Any projectile causing injury to an animal that originates from an instrument, structure, environment or being whose original design or intention is not

weapons related. Examples may include rockslides, falling branches, baseballs, objects falling from buildings, etc.

12) **Failure to Thrive/Maladaption** – Pertaining to any animal that has not acquired the necessary skills in order to function within the environment in a species appropriate manner. This term typically applies to animals that have not learned the necessary skills to hunt or forage (first year juvenile raptors), build or seek appropriate shelter, or interact with their environment in a manner that considered "normal" for that species.

13) **Undetermined** – Any unknown event whose origin is not specifically known or has not yet been decided. Also includes indeterminate causes where the circumstances may never be known.

14) **Dead on Arrival** – Any patient no longer living when admitted to the rehabilitation facility.

15) **Referral** – Any patient being transferred from one rehabilitation facility to another for the purpose of further rehabilitation or medical work-up.

    a) Permit holding facility – Any patient being transferred from a State or Federally permitted rehabilitation facility for the purpose of further rehabilitation or medical work-up.

    b) Non-permit holding facility – Any patient being transferred for the purpose of further rehabilitation or medical work-up from a facility lacking a State or Federal rehabilitation permit.

16) **Confiscation** – A patient admitted for rehabilitation that has been legally seized by an authorized person, organization or agency.

Anatomical System or Site of Physical Exam Findings/Clinical Signs on Admission

1) **Auditory** – Pertaining to the ears and associated structures including external ear structures (pinnae) and internal structures such as the eardrum and middle and inner ear components.

2) **Cardiovascular System – P**ertaining to the heart and blood vessels. This category may be selected in addition to localized damage to another anatomical structure resulting in hemorrhage.

3) **Cavity** –
   a) Thoracic – Pertaining to the body cavity/potential space between the neck and the diaphragm in mammals. Does not include organs housed within this space.

   b) Abdominal – Pertaining to the body cavity between the diaphragm and pelvis in mammals. Does not include organs housed within this space.

   c) Coelomic – Pertaining to the combined thoracic and abdominal spaces in animals lacking a diaphragm (birds, reptiles, and amphibians). Does not include organs housed within this space.

4) **Digestive System** – Pertaining to all structures of the gastrointestinal tract and all accessory organs of digestion. Structures within the gastrointestinal system include the mouth, teeth, tongue, esophagus, crop, stomach(s), intestines, and anus. The accessory digestive organs include the salivary glands, pancreas, liver, and gall bladder. The cloaca is also included in this category but is shared with the urogenital system as well.

5) **Integumentary System** – Pertaining to the skin and associated structures such as the fur, hooves, horns, pads, scutes, feathers, beak, leg scales, wattles, spurs, glands, and all underlying subcutaneous tissue.

6) **Generalized** – Conditions impacting multiple body systems causing whole body effects.

   a) Hypothermia – Decrease in body temperature below reference values published for that species

   b) Hyperthermia/Fever – Elevation of body temperature above reference values published for that species.

   c) Dehydration – Any condition consistent with a negative fluid balance. Clinical signs may include (but are not limited to) wrinkled skin, poor skin-tenting reaction, sunken eyes, increased mucous viscosity, and tacky mucous membranes.

   d) Depression/lethargy – Lowering of or decrease in functional activity due to known or unknown cause.

   e) Loss of body condition – Loss of body mass resulting in a reduced body condition score (BCS) below values considered "normal" in that species. Patients with a loss of body condition may either be thin or emaciated.

      i) *Thin* – The body state where the animal's weight and body condition score are below "normal" values for that species but the animal is otherwise physiologically and clinically normal.

      ii) *Emaciation* – Excessive leanness caused by disease or lack of nutrition characterized by extreme loss of subcutaneous fat and muscle that results in an abnormally lean body. Emaciated patients have significantly decreased total serum protein values

(often below 2.0 g/dl) and will often be given the lowest score available on standard body condition scoring systems. Other systemic health problems are usually present and the condition is usually not reversible with nutrition alone.

7) **Hematopoeitic System** – Pertaining to organs and tissues involved in the production of blood cells including lymph nodes, thymus, bursa of Fabricius, bone marrow and spleen.

8) **Musculoskeletal System** – Pertaining to a group of connective tissue components including bones, muscles, tendons, joints and ligaments.

a) Muscles/Tendon – Pertaining to muscles and associated tendons.

b) Joints/Ligament Tissue – Pertaining to any joint space or joint capsule and associated ligaments. Examples may include infected joints, swelling within the ligament or bursa, inflammation of the joint etc.

c) Skeleton – Pertaining to the stiff, hardened tissues forming the supporting framework of a vertebrate's body including bones and cartilage.

i) *Fracture* – A break in the continuity of a bone.

ii) *Non-fracture* – Pathology relating to the bone but not including fractures. These include luxations, subluxations, metabolic conditions of the bone, etc.

(1) Location – to be linked with an injury to the musculoskeletal system.

(a) *Skull*

(i) Facial bones – Pertaining to the mandible (lower jaw) and maxillae (upper jaw).

(ii) Cranium – All the bones of the skull excluding the facial bones.

(b) *Forelimb/Wing/Shoulder Girdle* – Pertaining to all single or fused bones of the forelimb/wing including phalanges, carpal bones, carpometacarpus, radius, ulna, and humerus; and all bones of the shoulder girdle included the scapula, clavicle/furcula, and coracoid bones.

(c) *Ribs/Sternum* – Pertaining to the ribs, sternum, and keel.

(d) *Hindlimb/Pelvis* – Pertaining to all single or fused bones of the hindlimb including phalanges, tarsal bones, tibia, fibula, tarsometatarsus, tibiotarsus, patella, femur, and all bones of the pelvis or synsacrum.

(e) *Spine/Tail* – Pertaining to all cervical, thoracic, lumbar, sacral and caudal vertebrae that make up the spine and tail.

(f) *Shell* – Pertaining to the fused boney plates that constitute the hard outer surface that protects turtles and tortoises. The superficial outer covering of the shell is made of keratin and is included under the integumentary system.

(i) Carapace - The dorsal (upper) shell of the turtle or tortoise.

(ii) Plastron - The ventral (lower) shell of the turtle of tortoise.

9) **Nervous System** – Pertaining to both the central and peripheral nervous system.

a) CNS Central/Brain – Relating to neurological deficits of the brain.

b) CNS Central/Spine – Relating to neurological deficits of the spinal cord.

c) CNS Peripheral Nerve – Relating to neurological deficits of the peripheral nervous system.

10) **Ocular** – Pertaining to the eyes and associated structures such as the eyelids, conjunctiva, ocular muscles, and lacrimal glands.

11) **Respiratory System** – Pertaining to the upper or lower respiratory tracts involved in respiration and gas exchange.

a) Upper Respiratory Tract – Pertaining to the nasal cavities, pharynx, larynx, trachea, and bronchi.

b) Lower Respiratory Tract – Pertaining to the lungs (including bronchioles, alveoli) and the air sacs in relevant species.

12) **Urogenital System** – Pertaining to all organs associated with the reproductive and urinary tracts.

a) Reproductive Tract – Pertaining to the organs associated with reproduction. In the female, they include the ovaries, uterine tubes, uterus, vagina, and vulva. In the male, they include testes, penis, scrotum, all accessory glands such as the prostate and all ducts essential for transporting sperm out of the body. Although the urethra plays an essential role in sperm transportation, this terminology scheme includes it with the urinary tract.

b) Urinary Tract – Pertaining to the organs concerned with the production and excretion of urine including the kidneys, ureters, urinary bladder, and urethra.

13) **Clinically Healthy** – No abnormal findings or signs of illness.

14) **Died Before Exam** – Died before a physical examination could be completed.

Categorization of Pathophysiology of Clinical Signs

1) **Degenerative** – Pertaining to the deterioration of a healthy tissue to an unhealthy state without the influence of other factors such as an inflammatory agent, infection, traumatic injury, etc. This pathology is most often caused by repetitive use, aging, or genetic predisposition. Disease examples may include degenerative joint disease and arthritis.

2) **Developmental/Congenital/Inherited** – Pertaining to the absence, deformity or excess of body parts as a result of faulty development of the embryo (developmental), abnormalities in structure or function which are present at birth and may or may not be inherited (congenital), or conditions caused by genes which condition the structure or function of an organ or tissue (inherited). Developmental and congenital diseases may or may not be associated with inherited defects.

3) **Autoimmune/Allergy/Immune-mediated** – A disease state that is characterized by an immune response (either antibody or cell-mediated) against the body's own tissues (autoimmune) or a reaction following second or subsequent exposure to a substance (allergen) causing an allergic reaction (allergy or immune-mediated response). Examples may include bee stings, pollen reactions, molds, certain drugs, etc.

4) **Metabolic** – A disease in which normal metabolic processes are disturbed and a resulting absence or shortfall or a normal metabolite (substance produced during metabolism) causes disease. Examples may include diabetes, hormone imbalance, enzyme deficiency, etc.

5) **Physical Injury** – An injury caused by i) trauma from an external force, ii) pressure or rubbing, iii) any kind of burn, or iv) exposure to a foreign substance.

a) Trauma – Pertaining to a wound or injury, usually caused by an external force that may occur anywhere on the body.

i) *External* – Pertaining to a wound or injury on the outer surface including limbs or superficial organs including eyes, ears, nose, etc of an animal.

ii) *Internal* – Pertaining to a wound or injury to an organ normally found within a body cavity.

b) Burns – Damage to tissues caused by contact with dry heat (fire), moist heat (steam or liquid), chemicals, electricity, or lightning.

c) Radiation – An injury caused by high-energy radiation such as x-rays and gamma-rays.

d) Foreign Substance – External contamination with a chemical or material that may or may not be irritating but usually results in diminished or loss of function. This may include glue traps, oil on the fur or feathers, non-water proofed feathers, etc.

i) *Oil/Grease* - Exposure to oil, grease, paint, or other petrochemical products leading to the penetration or covering of the fur, feathers, or external surface of the animal.

e) Ischemia – A deficiency of blood supply to some part of the body due to a constriction or an obstruction of the blood vessel(s).

i) *Frostbite* – A condition in which blood vessels constrict due to exposure to cold temperatures resulting in limited or no blood supply to the extremities. This usually results in non-inflammatory tissue death.

6) **Mental** – Pertaining to injuries or conditions causing an altered mental state that may include alterations in behavior, aimless wandering, headpressing, aggression, etc.

a) Abnormal behavior – Any behavior considered uncharacteristic for that species with consideration to internal factors (health status, normal physiology, etc.) and external factors (season, environmental conditions, etc.)

i) *Imprint* – A condition in very young animals when parental attachment and learned basic behavioral patterns are incorrectly established on a human, other life form, or object rather than a member of its own species.

7) **Neoplastic (Tumor-related)** – Any new and abnormal growth where the cell multiplication is uncontrolled and progressive.

a) Benign – Any tumor whose typical presentation includes slow growth, rare or no metastasis, and is usually non-reoccurring after removal.

b) Malignant – Any tumor whose typical presentation includes irreversible loss of differentiation in adult cell types and a fast and invasive growth rate with the potential to spread to other tissue types in the body.

i) *Metastatic* – A malignant tumor with the ability to transfer from one tissue type or part to another not directly connected with it.

ii) *Non-metastatic* – A malignant tumor without the ability to transfer from one tissue type or part to another not directly connected with it.

8) **Nutritional** – Pertaining to any disease or injury resulting from an alteration in the processes involved in taking nutrients into the body and assimilating and utilizing them or from deficiencies or excesses of specific feed nutrients.

a) Starvation – A long continued deprival of food accompanied by associated clinical signs which may include: hunger, loss of body weight, decreased muscle power and endurance, reduced urination and defecation which may cease, emaciation, weakness, slow-heart rate and hypothermia.

b) Obesity – An excessive accumulation of fat in the body considered "normal" for that species under present conditions.

c) Inappropriate Diet – Injuries or illness resulting from an unsuitable diet for that species. This may lead to related issues such as food allergies, gastrointestinal illness, or metabolic deficiencies.

i) *Metabolic Bone Disease* – A range of bone diseases associated with metabolic disease. In wildlife, this mainly refers to a condition known as secondary hyperparathyroidism caused by an imbalance in the calcium and phosphorus ratio in the body usually resulting from a dietary deficiency in calcium.

9) **Inflammatory** – Pertaining to a localized protective response from the body brought on by injury or destruction of tissues which serves to destroy, dilute or wall off both the injurious agent and the injured tissue. Classic signs of inflammation include heat, redness, swelling, pain, and loss of function.

10) **Infectious** – Pertaining to invasion and multiplication of microorganisms in the body tissues often resulting in cellular injury due to the pathogen's competitive metabolism within the body, production of harmful toxins, replication within host cells, or through damage by the host's own immune response.

a) Bacterial – Diseases in which bacteria play a significant but not necessarily an exclusive role.

i) *Mycoplasma* – A bacterial infection caused by a member of the genera *Mycoplasma*.

ii) *Rickettsia* – A bacterial infection caused by a member of the family Rickettsiaceae.

iii) *Chlamydiophila* – A bacterial infection in birds caused by a *Chlamydophila psittaci*.

b) Viral – Diseases in which viruses play a significant but not necessarily an exclusive role.

i) *Pox Virus* – A viral infection caused by a member of the family Poxviridae.

ii) *Rabies* – A viral infection caused by Rabies Virus, a specific member of the genus *Lyssavirus* and family Rhabdoviridae.

iii) *West Nile Virus* – A viral infection caused by West Nile virus, a specific member

of the genus *Flavivirus*.

iv) *Canine Distemper* – A viral infection caused by Canine Distemper Virus, a specific member of the genus *Morbillivirus*.

v) Fungal – Diseases in which fungi play a significant but not necessarily an exclusive role.

(1) *Aspergillosis* – A fungal infection caused by any member of the genus *Aspergillus*.

vi) Parasitic – Diseases in which parasites play a significant but not necessarily an exclusive role.

(1) *External* – Infestation with any one of a number of parasites that use the outer surface of the body to complete part of its life cycle. External parasites may infect the animal's skin, feathers, fur, or surface of the respiratory tract.

(a) Fleas – An external parasitic infestation with fleas.

(b) Flies – An external parasitic infestation with flies or maggots.

(c) Lice – An external parasitic infestation with lice.

(d) Mites – An external parasitic infestation with mites. This includes sarcoptic mange, notoedric mange, demodectic mange, feather mites, chiggers, ear mites, etc.

(e) Ticks – An external parasitic infestation with any of the variety of tick species.

(2) *Internal* – Infestation with any one of a number of parasites that require an internal body compartment to complete its life cycle.

(a) Protozoa - Diseases in which Protozoa (a single-celled parasite) plays a significant but not necessarily an exclusive role

(i) Trichomoniasis – A parasitic infestation by a member of the family Trichomonadidae. In wildlife, this mostly refers to *Trichomonas gallinae* found in doves and bird eating raptors.

(ii) Hemoparasites – An infection by one of several species of parasites that may be found in the blood (within or outside of the blood cells).

(iii) Giardiasis – An infection by a member of the genus *Giardia* resulting in a range of subclinical to severe gastrointestinal illness.

(iv) Toxoplasmosis – A contagious disease of all species caused by the

sporozoan parasite *Toxoplasma gondii*. The primary host is usually a member of the cat family.

(b) Nematodes (Roundworms) – An infestation by roundworms found in the class Nematoda. This group is diverse and includes a significant proportion of the internal parasitic infestations in animals.

(c) Cestodes (Tapeworms) – An infestation by a worm from the class Eucestoda.

d) Trematodes (Flukes & Flatworms) – An infestation by a parasitic worm/fluke from the class Trematoda.

11) **Non-infectious** – Pertaining to an injury that usually causes inflammation but does not originate from an infectious source. Examples may include vasculitis (inflammation of a vessel) or inflammation caused by irritation by a drug or foreign substance. Often caused by an allergic or auto-immune reaction.

12) **Iatrogenic** – Any adverse condition in a patient resulting from treatment by a medical professional or person responsible for the animal's well being.

13) **Idiopathic** – Pertaining to a disease or illness of unknown cause despite thorough testing. This may also apply to diseases for which there is currently no test.

14) **Toxicity** – The characteristic or quality of being poisonous.

a) Hydrocarbon – Toxicity from a compound that only contains hydrogen and carbon as a *result of internalization*. Typical compounds include products derived from crude oil such as gasoline, motor oil, natural gas, etc.

b) Heavy Metal – Toxicity caused by a number of metals known to impact the health of living beings. These metals typically include lead, mercury, silver, zinc, copper, arsenic, cadmium, chromium, cobalt, tin, nickel, thallium, manganese, and iron.

i) *Lead* – Toxicity caused by the internalization and systemic spread of lead. Typically caused when lead is absorbed into the body from the gastrointestinal tract, bone marrow, or joint spaces. The term does not apply to animals that have been shot with lead bullets/pellets not causing clinical signs of lead toxicosis.
(1) *Clinical*
(2) *Sub-clinical*

ii) *Mercury* - Toxicity caused by the internalization and systemic spread of mercury.
(1) *Clinical*
(2) *Sub-clinical*

c) Cholinesterase Inhibitors – Pertaining to any chemical that prevents function of the enzyme cholinesterase. In wildlife medicine, this term mainly refers to insecticides used on a variety of animals and plants from the Carbamate and Organophosphate families.

d) Rodenticides – Pertaining to any pest control chemical destructive to rodents. These typically include *anticoagulants* (warfarin, brodifacoum, difethialone, etc.), *metal phosphides* (zinc phosphide), *chemicals causing hypercalcemia* (cholecalciferol) and *other poisons* such as "1080", strychnine, and white phosphorus.

e) Harmful Algal Blooms – Pertaining to toxins released from *Cyanobacteria* that may cause sudden death due to neurotoxins or severe liver damage due to hepatotoxins (liver toxins).

f) Envenomation – The poisonous effects caused by bites or stings of insects/arthropods or the bites of snakes.

g) Botulism – A toxemia caused by the ingestion of the toxin of *Clostridium botulinum*. Often known as "limberneck" in effected waterfowl.

15) **Undetermined** – Pertaining to a disease or illness whose identity is unknown due to either lack of testing or inability to test.

16) **Pending** – Pertaining to the time before a diagnosis or case resolution is decided, confirmed, or finished.

17) **Clinically healthy** – Pertaining to any patient lacking signs of illness.

18) **Dead on arrival** – Any patient no longer living when admitted to the rehabilitation facility.

Clinical Wildlife Health Initiative: Pilot Project
Pathophysiology of Clinical Signs
Chart of PP Codes

Code						**Code**
1	Degenerative					**1**
2	Dev/Cong/Inherited					**2**
3	Autoim/Allergy/Im-Med					**3**
4	Metabolic					**4**
5	Physical injury					**5**
6		Trauma				**6**
7			External			**7**
8			Internal			**8**
9		Burns				**9**
10		Radiation				**10**
11		Foreign Substance				**11**
12			Oil			**12**
13		Ischemia				**13**
14			Frostbite			**14**
15	Mental					**15**
16		Abn Behavior				**16**
17			Imprint			**17**
18	Neoplasia					**18**
19		Benign				**19**
20		Malignant				**20**
21			Metastatic			**21**
22			Non-metastatic			**22**
23	Nutritional					**23**
24		Starvation				**24**
25		Obesity				**25**
26		Inappropriate Diet				**26**
27			MBD			**27**
28	Inflammatory					**28**
29	Infectious					**29**
30		Bacterial				**30**
31			Mycoplasma			**31**
32			Rickettsia			**32**
33			Chlamydophila			**33**
34		Virus				**34**
35			Pox virus			**35**
36			Rabies			**36**
37			West Nile Virus			**37**
38			Distemper			**38**
39		Fungal				**39**
40			Aspergillosis			**40**

29	Infectious					**29**
41		Parasitic				**41**
42			External			**42**
43				Fleas		**43**
44				Flies		**44**
45				Lice		**45**
46				Mites		**46**
47				Ticks		**47**
48			Internal			**48**
49				Protozoa		**49**
50					Trichomoniasis	**50**
51					Hemoparasites	**51**
52					Giardiasis	**52**
53					Toxoplasmosis	**53**
54				Nematodes		**54**
55				Cestodes		**55**
56				Trematodes		**56**
57	Non-infectious					**57**
58	Iatrogenic					**58**
59	Idiopathic					**59**
60	Toxicity					**60**
61		Hydrocarbon				**61**
62		Heavy Metal				**62**
63			Lead			**63**
64				Clinical		**64**
65				Sub-clinical		**65**
66			Mercury			**66**
67				Clinical		**67**
68				Sub-clinical		**68**
69		Cholinesterase Inhs				**69**
70		Rodenticides				**70**
71		HABlooms				**71**
72		Envenomation				**72**
73		Botulism				**73**
74	Undetermined					**74**
75	Pending					**75**
76	Clinically Healthy					**76**
77	Dead on Arrival					**77**

Attachment A: Budget Detail for 2008 Projects - Summary and a Budget page for each partner (if applicable)

Project Title: Wildlife Health Data System

Project Manager Name: Patrick T. Redig, DVM Ph.D.

Trust Fund Appropriation: $ *100,000*

1) See list of non-eligible expenses, do not include any of these items in your budget sheet

2) Remove any budget item lines not applicable

2008 Trust Fund Budget	**Revised Budget: Amendment accepted 3/10/2010**	**Amount Spent**	**Balance**	**Result 2 Budget:**	**Amount Spent**	**Balance**	**TOTAL BUDGET**	**TOTAL BALANCE**
				Web-based database				
BUDGET ITEM			0			0	0	0
PERSONNEL: wages and benefits* **	26,000	23,180	2,820	27,000	32,088	-5,088	53,000	-2,268
Contracts			0			0	0	0
Professional/technical *(Virtual workshop, software development, USGS - development of database)*	15,500	13,363	2,138	20,000	20,000	0	35,500	2,138
Other contracts *(Wildlife Rehabilitation Center - veterinarian and clinical staff for*	3,500	3,500	0	3,500	3,500	0	7,000	0
Other direct operating costs *(for what? – be specific)*			0			0	0	0
Equipment / Tools			0			0	0	0
Office equipment & computers - Computer system for use with electronic medical records to integrate data)	3,000	2,827	173			0	3,000	173
Other Capital equipment *(list specific items)*			0			0	0	0
Land acquisition			0			0	0	0
Land rights acquisition *(less than fee)*			0			0	0	0
Professional Services for Acq.			0			0	0	0
Printing			0			0	0	0
Other Supplies *(list specific categories)*			0			0	0	0
Travel expenses in Minnesota	1,500	1,516	-16			0	1,500	-16
Travel outside Minnesota *(where?)*			0			0	0	0
Construction *(for what?)*			0			0	0	0
Other land improvement *(for what?)*			0			0	0	0
Other *(Describe the activity and cost) be specific*			0			0	0	0
COLUMN TOTAL	**$49,500**	**$44,385**	**5,115**	**$50,500**	**$55,588**	**-$5,088**	**$100,000**	**$27**

****Contract dollars were underspent and shifted to personnel costs - an amendment request should have been made.*

2008 Project Abstract
For the Period Ending June 30, 2011

PROJECT TITLE: Easement Inventory and Application/Database Development
PROJECT MANAGER: Kevin J. Lines
AFFILIATION: Board of Water and Soil Resources
MAILING ADDRESS: 520 Lafayette Road
CITY/STATE/ZIP: St. Paul, MN 55155
PHONE: 651-297-8025
E-MAIL: kevin.lines@state.mn.us
WEBSITE: www.bwsr.state.mn.us
FUNDING SOURCE: Environment and Natural Resources Trust Fund
LEGAL CITATION: ML 2008, [Chap. 367], Sec. 2, Subd. 5(g).

APPROPRIATION AMOUNT: $180,000

Overall Project Outcome and Results

Since collection of digital easement data within the Minnesota Board of Water & Soil Resources (BWSR) first began in the late 1990's, every effort had been made to keep the database accurate and complete. However, over a decade later, and with over 5,000 easements and growing it became prudent (particularly with the advent of more advanced technology) to reexamine, update and enhance that database.

Attributes and boundaries for easements and conservation practices (planned land cover types based on the NRCS Field Office Technical Guide) that previously only existed in paper format were scanned and digitized, then added to a Geographic Information Systems (GIS) database for the RIM Reserve easement program. The GIS database is flexible enough to implement future easement monitoring technology that can capture stewardship data such as easement condition and compliance, habitat quality, easement maintenance and enhancement.

Prior to this undertaking, it would have been impossible to implement a modern long-term conservation easement stewardship plan. Easement boundaries only existed on paper and an outdated database placed limitation on reporting and analysis. As a result of this project, the framework is in place for implementing such a plan. A modern database is being implemented. 220,329 acres of conservation practices within 5,882 easements have been digitized into a GIS database, and a GIS-based monitoring field application has gone through pilot testing.

BWSR now has increased capabilities to target new easement projects using GIS reporting and analysis, as well as ensure the quality of past projects through easement stewardship and monitoring. This maximizes the return of each dollar spent, benefitting Minnesotans through better water quality, reduced soil erosion, and enhanced wildlife habitat.

Project Results Use and Dissemination

As a result of this project, a conservation easement database that is more streamlined has been implemented, giving BWSR staff the ability to edit and update easement boundaries and attributes, conduct geospatial reporting and analysis using GIS technology, create online delivery applications available via BWSR's website, and develop and test future easement stewardship and monitoring applications.

Conservation easement data has been made publically available as both an interactive online web map and a GIS shapefile download, both available at BWSR's web site:
http://www.bwsr.state.mn.us/easements

Environmental and Natural Resources Trust Fund
2008 Work Program Final Report

Date of Report: September 1st, 2011 – Final Report
Date of Work program Approval: June 10, 2008
Project Completion Date: June 30, 2011

I. PROJECT TITLE: Easement Inventory and Application/Database Development

Project Manager: Kevin J. Lines
Affiliation: Board of Water and Soil Resources
Mailing Address: 520 Lafayette Road
City / State / Zip: St. Paul, MN 55155
Telephone Number: 651-297-8025
E-mail Address: kevin.lines@state.mn.us
FAX Number: 651-297-5615
Web Page address: www.bwsr.state.mn.us

Location: Statewide

Total Trust Fund Project Budget:	**Trust Fund Appropriation:**	$180,000
	Minus Amount Spent:	$129,449.76
	Equal Balance:	$ 50,550.24

Legal Citation: ML 2008, [Chap. 367], Sec. 2, Subd. 5(g).

Appropriation Language: $180,000 is from the trust fund to the Board of Water and Soil Resources to enhance long-term stewardship, oversight, and maintenance of conservation easements held by the board and to update the current easement database. This effort must be done in cooperation with the Department of Natural Resources. This appropriation is available until June 30, 2011, at which time the project must be completed and final products delivered, unless an earlier date is specified in the work program.

II. and III. FINAL PROJECT SUMMARY:

Since collection of digital easement data within the Minnesota Board of Water & Soil Resources (BWSR) first began in the late 1990's, every effort had been made to keep the database accurate and complete. However, over a decade later, and with over 5,000 easements and growing it became prudent (particularly with the advent of more advanced technology) to reexamine, update and enhance that database.

Attributes and boundaries for easements and conservation practices (planned land cover types based on the NRCS Field Office Technical Guide) that previously only existed in paper format were scanned and digitized, then added to a Geographic Information Systems (GIS) database for the RIM Reserve easement program. The GIS database is flexible enough to implement future easement monitoring technology that can capture stewardship data such as easement condition and compliance, habitat quality, easement maintenance and enhancement.

Prior to this undertaking, it would have been impossible to implement a modern long-term conservation easement stewardship plan. Easement boundaries only existed on paper and an outdated database placed limitation on reporting and analysis. As a result of this project, the framework is in place for implementing such a plan. A modern database is being implemented. 220,329 acres of conservation practices within 5,882 easements have been digitized into a GIS database, and a GIS-based monitoring field application has gone through pilot testing.

BWSR now has increased capabilities to target new easement projects using GIS reporting and analysis, as well as ensure the quality of past projects through easement stewardship and monitoring. This maximizes the return of each dollar spent, benefitting Minnesotans through better water quality, reduced soil erosion, and enhanced wildlife habitat.

IV. OUTLINE OF PROJECT RESULTS*:*

Result 1: *Easement Inventory, Database Development and Field Application*

Description: Since collection of digital easement data within the Minnesota Board of Water & Soil Resources (BWSR) first began in the late 1990's, every effort had been made to keep the database accurate and complete. However, over a decade later, and with over 5,000 easements and growing it became prudent (particularly with the advent of more advanced technology) to reexamine, update and enhance that database.

This involved assessing the spatial database accuracy and completeness, e.g. by searching for missing easements or correcting easements with spatial inaccuracies. This also involved restructuring the tabular database to allow for procedures that are more streamlined for editing and updating, e.g. migration of the tabular database into an Oracle database and structuring the spatial data through ArcSDE (GIS spatial database) to work dynamically with tabular easement data. This restructured data made it possible to develop online delivery applications available via BWSR's website. These applications allow users dynamic viewing and selection capability as well as online map creation and printing capability using a variety of layers currently available through GIS technology (see Attachment D).

Subsequently, in order to make the easement data more useable and meaningful for future monitoring and management efforts, data for 220,329 acres of conservation practices (planned land cover types based on the NRCS Field Office Technical Guide) that previously only existed in paper format for 5,882 easements have been scanned and digitized and added to a GIS database for the RIM Reserve easement program (see Attachment C). The GIS database is flexible enough to capture other data pertinent to potential future monitoring efforts as well, such as updated easement conditions, easement compliance data, easement condition/habitat quality and easement maintenance and enhancement needs.

A GIS field application (see Attachment E) was developed and tested that runs on a field tablet PC and utilizes the aforementioned GIS database to collect data pertinent to potential future monitoring and field data collection efforts, while enhancing data quality and accuracy. While positive feedback was received from local field staff during the testing phase, funds were not sufficient to deploy, train and support local field technicians on a statewide basis. Additional funds are necessary to implement and support this technology at the state and local levels.

Budget balance:

In order to properly utilize the newly created RIM database, a new data entry client was built and has undergone testing. Although the database that feeds the data entry client is completed, implementation of the new database and new data entry client has been delayed due to work flow considerations (including complications brought about by the state government shutdown in June 2011). Implementation of the new "system" is expected to take place in early fall 2011, and all additional implementation costs for client software will be borne by BWSR.

Spending was less than budget projections due to less than expected hardware and software needs associated with the testing phase of the field application. This was done by completing the work in-house instead of contracting it out, as well as conducting a smaller-scale pilot test in order to meet project deadlines that had been affected by the state government shutdown of June 2011.

Final Report Summary:

Summary Budget Information for Result 1:	**Trust Fund Budget:**	**$180,000**
	Amount Spent:	$129,449.76
	Balance:	$ 50,550.24

Deliverables

1. Inventoried and updated RIM Reserve easement database to allow for better integration with other data (such as soils information) as well as viewing and querying data online. (See LCMR approved project entitled Soil Surveys: Their Completion and Web-based Delivery; Greg Larson, Project Manager.) Scanned and digitize conservation plan practice layers (i.e., easement land cover) for integration with a RIM Reserve easement GIS database.

Completion Date: June 30, 2009
Budget: $85,000
Status: Complete

2. Develop GIS database for easement and plan practice data as well as data pertinent to future potential monitoring and field data collection efforts, which will be integrated with the Oracle easements database and data entry application. Create and field test a GIS field application that utilizes this database.

Completion Date: June 30, 2011
Budget: $95,000
Status: database complete; field application and pilot testing complete; data entry client complete (to be implemented by end of 2011).

V. TOTAL TRUST FUND PROJECT BUDGET:	LCCMR Budget:	$180,000
	Other Funds :	$0
	Total Budget:	**$180,000**

Staff	Equipment	Other	Total
$117,000	$15,000	$48,000	$180,000

Staff	**Cost**
BWSR GIS staff and student interns	$ 117,000

Equipment

Hardware – (2) GIS workstations	$	5,000
Software – (7) ArcPad 8.0/10.0 licenses	$	4,500
Hardware – (7) Trimble Juno handheld GPS units	$	5,500

Other

Contract to develop oracle database	$	23,000
SWCD Staff - field application pilot testing (5 districts)	$	25,000

VI. OTHER FUNDS & PARTNERS

A. Project Partners: DNR, SWCDs, Attorney General's Office, Legislative Auditor

B. Other Funds Budget and Sources: None.

C. Past ETF Spending: 2001: $0; 2003: $0; 2005: $0
Past Other Funds Spending: BWSR received general revenue appropriations earmarked by the legislature each session for SWCD Service Grants that included money for marketing, administrative and monitoring. From 1986 through 2004 that amount was $750,000. Beginning in 2005, that amount was reduced by half to $345,000 per year.

D. Time: Funds must be available through June of 2011.

VII. DISSEMINATION: The newly restructured data and software developed as a result of this project is being utilized in current and future online delivery applications available via BWSR's website. These applications allow users dynamic viewing and selection capability, as well as online map creation and printing using a variety of layers currently available through GIS technology.

Conservation practice data (planned land cover types based on the NRCS Field Office Technical Guide) that previously only existed in paper format for each easement have been scanned, digitized and added to a GIS database for the RIM Reserve easement program. The GIS database has been designed to capture other data pertinent to potential future monitoring efforts as well, such as updated easement conditions, easement compliance data, easement condition/habitat quality and easement maintenance and enhancement needs.

VIII. REPORTING REQUIREMENTS: Periodic work program progress reports have been submitted not later than July 31, 2010, and January 31, 2011. A final work program report and associated products will be submitted between June 30 and August 15th, 2011 as requested by the LCCMR.

Attachments:

- **Attachment A:** Budget Sheet
- **Attachment B:** Statewide Conservation Easement Map
- **Attachment C:** Easement Inventory and Digitizing
- **Attachment D:** RIM Online (Easements Web Map)
- **Attachment E:** RIM Field Application for Easement Stewardship

Attachment A: Budget Detail for 2008 Projects

Project Title: *Easement Inventory and Application/Database Development*
Minnesota's Habitat Conservation Partnership (V)

Project Manager Name: Kevin Lines

Trust Fund Appropriation: $180,000

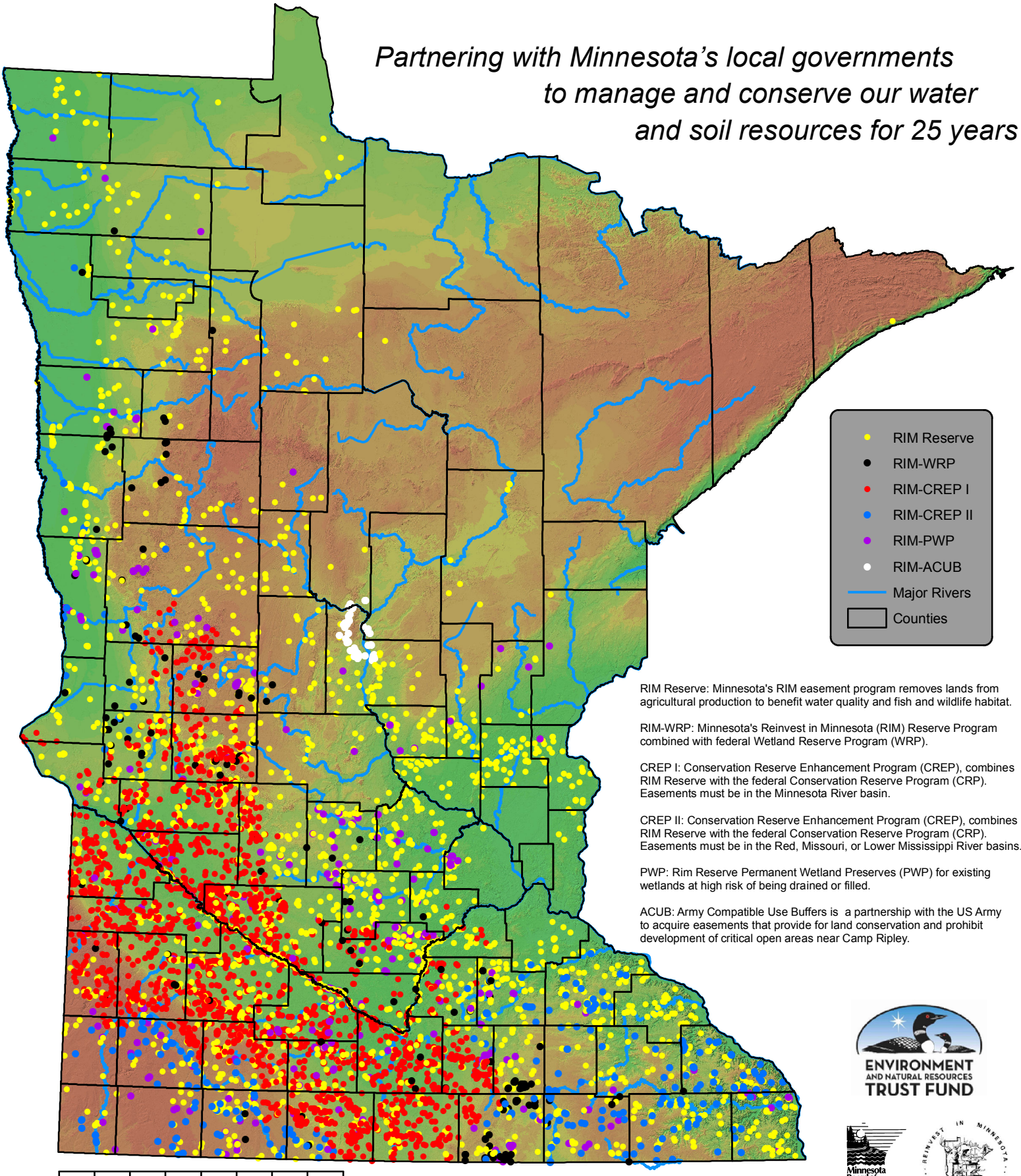
2008 Trust Fund Budget	**Result 1 Budget:**	**Revised Result 1 Budget 06/11/2010**	**Amount Spent** *(06/30/2011)*	**Balance** *(06/30/2011)*	**TOTAL BUDGET**	**TOTAL BALANCE**
	Easement Inventory and Database Development					
BUDGET ITEM				0		
PERSONNEL: (3) student interns, (1) GIS Technician.	~~$100,000~~	$117,000	$101,965.95	$15,034.05	117,000.00	15,034.05
CONTRACT: easement database development and deployment; field testing of mobile application.	~~$60,000~~	$48,000	$20,506.19	$27,493.81	48,000.00	27,493.81
Office equipment & computers: GIS workstations, handheld GPS units, software licenses.	~~$20,000~~	$15,000	$6,977.62	$8,022.38	15,000.00	8,022.38
COLUMN TOTAL	**$180,000**	**$180,000**	**$129,449.76**	**$50,550.24**	**180,000.00**	**50,550.24**

Attachment B – Statewide Conservation Easement Map

Reinvest in Minnesota (RIM) Reserve

Conservation Easements (5,882 total): 1986 - 2011

Partnering with Minnesota's local governments to manage and conserve our water and soil resources for 25 years



RIM Reserve: Minnesota's RIM easement program removes lands from agricultural production to benefit water quality and fish and wildlife habitat.

RIM-WRP: Minnesota's Reinvest in Minnesota (RIM) Reserve Program combined with federal Wetland Reserve Program (WRP).

CREP I: Conservation Reserve Enhancement Program (CREP), combines RIM Reserve with the federal Conservation Reserve Program (CRP). Easements must be in the Minnesota River basin.

CREP II: Conservation Reserve Enhancement Program (CREP), combines RIM Reserve with the federal Conservation Reserve Program (CRP). Easements must be in the Red, Missouri, or Lower Mississippi River basins.

PWP: Rim Reserve Permanent Wetland Preserves (PWP) for existing wetlands at high risk of being drained or filled.

ACUB: Army Compatible Use Buffers is a partnership with the US Army to acquire easements that provide for land conservation and prohibit development of critical open areas near Camp Ripley.

Explore and query this map online:
http://maps.bwsr.state.mn.us/RIMOnline

ENVIRONMENT AND NATURAL RESOURCES TRUST FUND

Minnesota Board of Water & Soil Resources
WWW.BWSR.STATE.MN.US

REINVEST IN MINNESOTA R.I.M. RESERVE PROGRAM

Attachment C – Easement Inventory and Digitizing

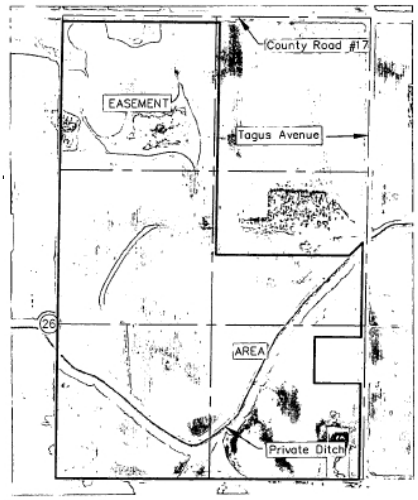


Fig. 1: Easement boundaries for 5,882 easements totaling 220,329 acres were imported into a geodatabase from existing CAD files or digitized using existing Exhibit A easement maps (pictured).

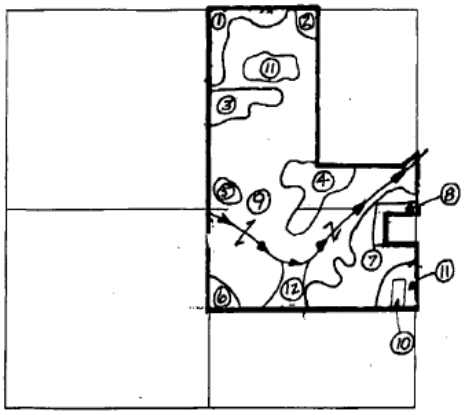


Fig. 2: Interns then digitized 20,719 conservation practices using practice plan maps (pictured) from the original easement plan, as well as associated practice type and acreage values. During this process, inaccuracies and errors were corrected as well.

Fig. 3: Data for each easement was then assigned to each record, allowing for querying, reporting and mapping based on various characteristics, such as easement and conservation practice type (wetland restoration, grassland restoration, etc.), program type (RIM, RIM-WRP, CREP, etc.), duration (limited or perpetual), cost, size and other program and geographic criteria.

The final product, in shapefile format, is available for download at: http://www.bwsr.state.mn.us/easements.

Attachment D – RIM Online Easements Web Map

An easements website has been developed which provides easement location and attribute information online via an interactive web mapping application (Fig. 1). Examples of data provided are easement location and boundary (Fig 2.), type of easement (e.g. RIM, RIM-WRP, CREP, PWP, etc.), funding source, paid acres, easement cost, and easement duration (Fig. 3).

The map can be access at: http://maps.bwsr.state.mn.us/RIMOnline/

Fig. 1 – Statewide Easements Map

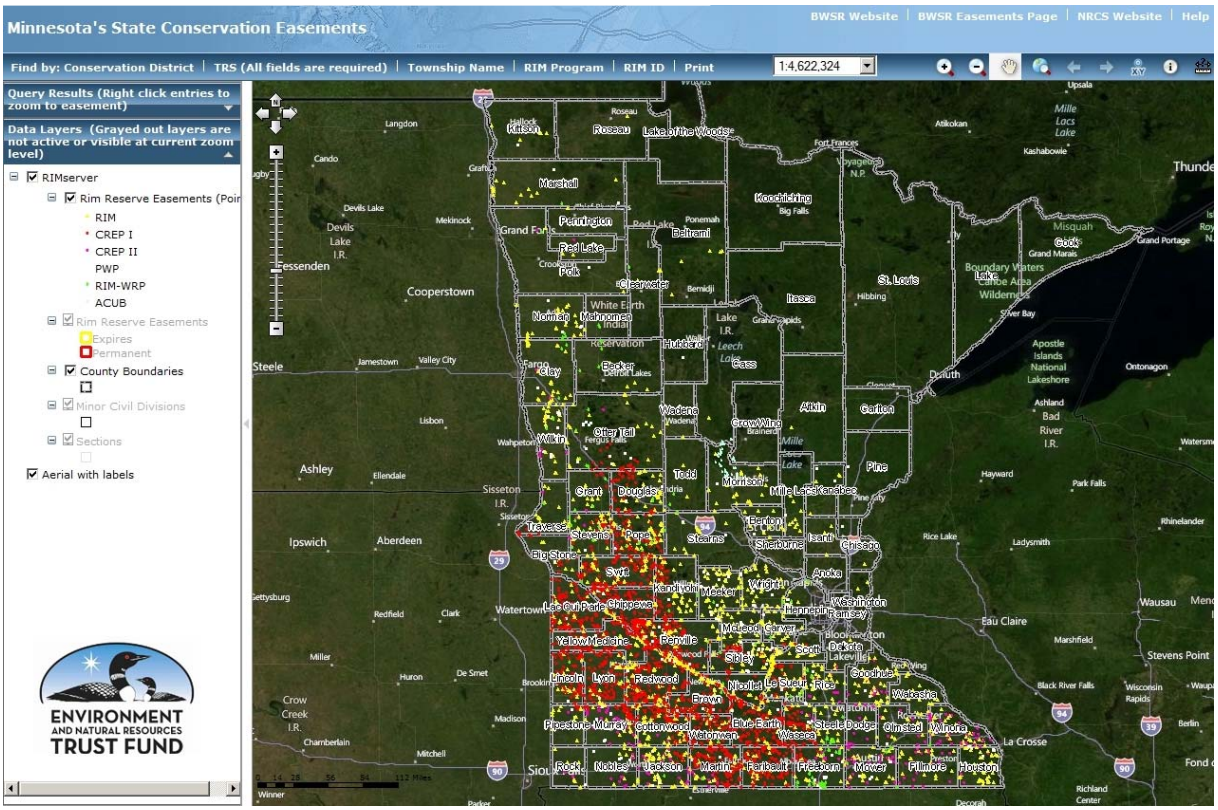


Fig. 2 – Easement Boundary

Fig. 3 – Easement Attributes

SWCD: McLeod - Township: ROUND GROVE

RIM ID	43-06-02-01- -
Start Date	3/3/2003
Description	CREP WR
SWCD	McLeod
Funding Source	BONDING
Township Name	ROUND GROVE
Township	114
Range	30
Section	26
Acres	176.4
Cost	122853.59
Easement Year	2002
Expiration Date	Null
Duration	Permanent
Expiration Range	Permanent
Easement Program	**CREP I: 1998 - 2003**

Attachment E – RIM Field Application for Easement Stewardship

Easement stewardship is a critical component of a successful conservation easement. To aid in these efforts, a GIS field application has been developed and tested that runs on a mobile device which utilizes the aforementioned GIS database to collect data pertinent to monitoring and field data collection, while enhancing data quality and accuracy.

The field application leverages mobile GIS and GPS technologies to give technicians the capability to locate and view an easement and its associated conservation practices (Fig. 1), view past and present satellite imagery, adjust easement and/or conservation practice boundaries, collect inspection information (Fig. 2) and take georeferenced photos of possible violations or areas of concern. Any data collected through the field application is then readily available to BWSR staff, giving them better capability to report on past projects and target future projects while ensuring successful conservation easements.

This portion of the project made it through the pilot phase, which received positive feedback from local field staff. However, additional funds are needed to deploy, train and support local field technicians to implement the system on a statewide basis.

Fig. 1 – Easement & Practice Boundaries

Fig. 2 – Easement Inspection Data

2008 Project Abstract
For the Period Ending June 30, 2011

PROJECT TITLE: Conservation Easement Stewardship and Enforcement Program Plan - DNR
PROJECT MANAGER: Kathy Lewis
PROJECT CONSULTANT: Susan Damon
AFFILIATION: Minnesota Dept. of Natural Resources
MAILING ADDRESS: 500 Lafayette Road
CITY/STATE/ZIP: St. Paul, Minnesota 55155
PHONE: 651-259-5404 (K. Lewis); 651-259-5961 (S. Damon)
E-MAIL: kathy.lewis@state.mn.us; susan.damon@state.mn.us
WEBSITE: www.dnr.mn.gov
FUNDING SOURCE: Environment and Natural Resources Trust Fund
LEGAL CITATION: ML 2008, Chap. 367, Sec. 2, Subd. 5(h)

APPROPRIATION AMOUNT: $520,000

Overall Project Outcome and Results

The DNR needed comprehensive information about its conservation easements in a centralized database and an agency-wide plan to monitor and enforce the easements.

Project objectives were to: (1) conduct a comprehensive inventory of DNR's easements, classify conservation easements by type and capture relevant data about each easement in DNR's land records system; (2) develop a conservation easement stewardship plan that integrates an easement monitoring computer application developed through DNR's Land Records Management Project; and (3) recommend solutions to long-term conservation easement stewardship funding.

The inventory consisted of a review of all deed and easement records maintained by DNR's Lands and Minerals Division, capture of relevant easement data and reconciliation of the data with records maintained by DNR's conservation easement administrators. The stewardship plan was developed after test monitoring a sample of existing conservation easements and obtaining extensive input from a working group comprised of representatives of DNR divisions that administer conservation easements.

The inventory identified 13 DNR conservation easement types and a total of 974 conservation easements covering 355,623 acres. The stewardship plan outlines monitoring methods and monitoring frequency for each conservation easement type, estimates stewardship costs and identifies options for funding. Project results are detailed in the Conservation Easement Stewardship and Enforcement Program Plan – DNR Final Report dated Feb. 28, 2011.

Under a work program amendment, project staff converted scans of 600 conservation easements into a format for use in the new conservation easement monitoring application, developed GIS tools that identified subdivisions and ownership of 557 trout stream easements and created shapefiles for 170 conservation easements from legal descriptions. The Aug. 15, 2011 Final Report Supplement contains examples of these work products.

The database, forms, tools and plans developed in this project provide the foundation for the DNR to implement an agency-wide conservation easement stewardship program.

Project Results Use and Dissemination

Project results are currently being used by the DNR in several ways:

- Conservation easement data entered into the DNR's existing land records system in the project are being used to respond to inquiries from DNR staff and the public about DNR's conservation easements.
- A conservation easement Geographic Information Systems (GIS) layer developed by project staff and Division of Lands and Minerals GIS staff is available to all DNR ArcGIS users.
- The DNR is beginning the process of implementing the conservation easement stewardship plan developed in the project.
- Staff in divisions that administer conservation easements are currently using the baseline property report and monitoring forms developed in the project.
- The DNR's land records system contractor, International Land Systems, Inc. (ILS), is using the baseline property report and monitoring forms developed in the project and input about application design provided through the project to build the conservation easement administration application in the DNR's new land records system.
- Staff in divisions that administer conservation easements and project staff for the Conservation Easement Stewardship and Enforcement Program, Phase II will use shapefiles prepared under the Jan. 31, 2011 Work Program Amendment to create maps for baseline property reports and conservation easement monitoring.
- The Division of Fish and Wildlife is in the process of merging its existing GIS layer, which contains trout stream easement shapefiles, with the geoprocessing tools developed in the project to identify subdivisions and current landowners. This will enable Fisheries staff statewide to access the subdivision and landowner data using ArcGIS.
- All data entered into DNR's existing land records system in the project, as well as trout stream subdivision and landowner data and the Access database of easement terms created under the Work Program Amendment, will be migrated to and used in the new land records system currently being built by ILS.

Project results have been disseminated both within the DNR and to members of the public:

- Presentations about the project have been made to regional managers in all four DNR regions and to DNR senior managers.
- The Conservation Easement Stewardship and Enforcement Program Plan – DNR Final Report dated Feb. 28, 2011 has been distributed to all DNR divisions that administer conservation easements and made available to the general public on the DNR's website at the following link:

http://files.dnr.state.mn.us/lands_minerals/conservation_easement_stewardship_final_report.pdf

- The conservation easement GIS layer has been made available to the general public through the DNR Data Deli.
- The Commissioner of Natural Resources provided copies of the Final Report dated Feb. 28, 2011 to the chairs and ranking minority members of the house and senate natural resources committee.
- Copies of the Final Report dated Feb. 28, 2011 were provided to staff of the Lessard-Sams Outdoor Heritage Council, and the project was discussed at a June 21, 2011 L-SOHC issues seminar.
- Project staff have contacted the Association of Minnesota Counties to determine the best way to disseminate information about the conservation easement GIS layer and other project results to the counties.

Environment and Natural Resources Trust Fund
2008 Work Program Final Report

Date of Report: August 15, 2011
Final Report
Date of Work Program Approval: June 17, 2008
Project Completion Date: June 30, 2011

I. PROJECT TITLE: Conservation Easement Stewardship and Enforcement Program Plan - DNR

Project Manager: Kathy Lewis
Project Consultant: Susan Damon
Affiliation: Minnesota Dept. of Natural Resources
Mailing Address: 500 Lafayette Road
City / State / Zip: St. Paul, Minnesota 55155
Telephone Number: 651-259-5404 (K. Lewis); 651-259-5961 (S. Damon)
E-mail Address: kathy.lewis@state.mn.us; susan.damon@state.mn.us
FAX Number: 651-296-5939
Web Page address: www.dnr.mn.gov

Location: Statewide

Total Trust Fund Project Budget:	**Trust Fund Appropriation:**	**$520,000**
	Minus Amount Spent:	**$504,613**
	Equal Balance:	**$ 15,387**

Legal Citation: ML 2008, Chap. 367, Sec. 2, Subd. 5(h).

Appropriation Language: Conservation Easement Stewardship and Enforcement Program Plan

$520,000 is from the trust fund to the commissioner of natural resources to inventory and digitize the department's conservation easements and prepare a plan for monitoring, stewardship, and enforcement. This effort must be done in cooperation with the Board of Water and Soil Resources. This appropriation is available until June 30, 2011, at which time the project must be completed and final products delivered, unless an earlier date is specified in the work program.

II. and III. FINAL PROJECT SUMMARY

The DNR needed comprehensive information about its conservation easements in a centralized database and an agency-wide plan to monitor and enforce the easements.

Project objectives were to: (1) conduct a comprehensive inventory of DNR's easements, classify conservation easements by type and capture relevant data about each easement in

DNR's land records system; (2) develop a conservation easement stewardship plan that integrates an easement monitoring computer application developed through DNR's Land Records Management Project; and (3) recommend solutions to long-term conservation easement stewardship funding.

The inventory consisted of a review of all deed and easement records maintained by DNR's Lands and Minerals Division, capture of relevant easement data and reconciliation of the data with records maintained by DNR's conservation easement administrators. The stewardship plan was developed after test monitoring a sample of existing conservation easements and obtaining extensive input from a working group comprised of representatives of DNR divisions that administer conservation easements.

The inventory identified 13 DNR conservation easement types and a total of 974 conservation easements covering 355,623 acres. The stewardship plan outlines monitoring methods and monitoring frequency for each conservation easement type, estimates stewardship costs and identifies options for funding. Project results are detailed in the Conservation Easement Stewardship and Enforcement Program Plan – DNR Final Report dated Feb. 28, 2011.

Under a work program amendment, project staff converted scans of 600 conservation easements into a format for use in the new conservation easement monitoring application, developed GIS tools that identified subdivisions and ownership of 557 trout stream easements and created shapefiles for 170 conservation easements from legal descriptions. The Aug. 15, 2011 Final Report Supplement contains examples of these work products.

The database, forms, tools and plans developed in this project provide the foundation for the DNR to implement an agency-wide conservation easement stewardship program.

IV. OUTLINE OF PROJECT RESULTS*:*

Result 1: Easement Inventory

The first step is to determine the level of effort needed to inventory the historical documents. While DNR easements have been computerized over the last decade, an assessment of what data can be provided in a searchable digital format versus a scanned image is needed to facilitate developing a process for tracking the monitoring and enforcement of conservation easements. Recent DNR computerized easements show location, easement type, grantor, DNR document number, county document number, administrator, program/project, and acreage, but are missing the source of funding. The minimum data fields to be collected for this phase of the project are the current collected information plus federal aid and funds where possible and the scanned paper document(s). Additional information, needed for results 2 and 3 may be obtained from the scanned documents through clipping information and converting it to their own fields. This could include information that will be part of the monitoring and enforcement phase integrated into the Land Records Management Project, such as agreed upon duties and eased rights. See result 2 for additional data requirements, which will also be defined by Land Records

Management Project's "Administer Conservation Easements." If work of this result uncovers more easements than this funding can inventory and computerize, DNR will prioritize the known easements by funding source, length, and eased rights to keep this result within budget.

Summary Budget Information for Result 1:	**Trust Fund Appropriation:**	**$ 273,000[1]**
	Amount Spent:	**$ 272,550**
	Balance:	**$ 450**

Deliverable	**Completion Date**	**Budget**	**Status**
1. Analyze/input a sample of easements	**December 2008**	**$ 10,000**	**Done**
2. Develop a data coding schema	**January 2009**	**$ 5,000**	**Done**
3. Input data for easements	**July 2010**	**$203,000[2]**	**Done**
4. Validate sample of data	**Sept. 2010**	**$ 25,000**	**Done**
5. Revise data	**Nov. 2010**	**$ 25,000**	**Done**
6. Migrate data to Land Records	**June 2011**	**$ 5,000**	**Done**

Final Report Summary:

Project staff reviewed all deed and easement records maintained by the DNR's Lands and Minerals Division (approximately 17,000 documents), identified and classified each conservation easement as one of 13 conservation easements types per the coding schema finalized during this project. Project staff entered additional relevant data into DNR's land records system about each easement, including DNR region, county, DNR and county document numbers, grantor, project name, administrator, acquisition date, location and acreage. The final easement inventory identified a total of 974 DNR conservation easements covering 355,623 acres. During the inventory process, project staff also captured data on DNR-owned or managed land that is subject to deed restrictions or to conservation easements held by other entities.

Project staff collaborated with the Division of Lands and Minerals Geographic Information Systems (GIS) staff to create a GIS layer, which shows the location of DNR's conservation easements according to the Public Land Survey (i.e., township/range/section and quarter-quarter section (40 acres) or government lot). This GIS conservation easement layer is available to the general public on the DNR Data Deli.

The Conservation Easement Stewardship and Enforcement Program Plan – DNR Final Report dated Feb. 28, 2011describes each of DNR's 13 conservation easement types,

[1] This is the revised budget amount following the shift of Result 1 and Result 3 funds to Result 2 per the Work Program Amendment approved on Jan. 31, 2011. The Result 1 Budget in the original Work Program was $300,000. This was revised to $298,000 following a Work Program Amendment approved on May 19, 2009 that shifted $2,000 of the Result 1 Budget to Result 2 for travel.
[2] This is the revised budget amount per the Jan. 31, 2011 Work Program Amendment.

contains the final inventory results statewide and by region, county and easement type, describes the inventory process and provides information about uses of the conservation easement dataset created in the project. See section V. DISSEMINATION below for a link to the report.

Project staff added all conservation easement data captured in the project to DNR's existing land records system, and, accordingly, completed all of this project's work associated with Deliverable 6. Migration of all state land records data to DNR's new land records system will be completed when the conversion from the existing system to the new system occurs. The conversion is currently scheduled for October 2011. DNR's information technology staff and International Land Systems, Inc., the contractor hired to build DNR's new land records system, will perform the data migration.

Result 2: Develop Monitoring Plan

Step two is to use the inventory to develop an easement-monitoring plan by type of easement. This part of the project is tightly integrated with the Land Records Management Project in order to use available technologies such as work flow management, electronic document management, electronic field data capture, and forms driven data collection. Additional data/forms may be defined such as staff contacts, frequency of inspections, baseline description / property report, eased rights, agreed upon duties, monitoring forms, incident reports, amendments, and action plans. Initially we will draw a sample of the inventoried easements and determine the best ways to monitor them and test monitor the easements in the sample. This will require, in part, warm season field activity to be able to access and assess some easements.

One of the critical outputs of this task is to obtain enough sampled data to make a reasonable estimate of the variety of easements to be managed as well as the rate of violation. Many easements have not been visited in years and one objective of developing the monitoring plan is to determine the accrued liability of easement violations that need to be addressed. The next task is to classify each easement for monitoring purposes, based on the experience gained from the sample monitoring. For example easements may be classified by inspection frequency, type of inspection (visit photo, drive by, fly over), etc. These classifications need to be tied to annual costs. Then, finally, the individual monitoring steps and costs are aggregated to cost out the annual monitoring costs. That is, a periodic cost for monitoring each easement or class of easement will be estimated. The protocol developed for stewardship and monitoring will be consistent with the standards adopted by the conservation easement standards report required by M.L. 2007, Article 1, Section 4, Subdivision 2.

Summary Budget Information for Result 2: **Trust Fund Budget: $202,000[3]**
Amount Spent: $201,440
Balance: $ 560

Deliverable	Completion Date	Budget	Status
1. Sample monitor easements	June 2010	$61,000	Done
2. Classify all easements for monitoring	September 2010	$21,000	Done
3. Cost out monitoring plan	October 2010	$20,000	Done
4. Document monitoring plan	November 2010	$10,000	Done
5. Develop Application	June 2011	$ 60,000	In process
6. Work Program Amendment	June 2011	$ 30,000	Done

Final Report Summary:

Project staff collaborated with staff of DNR divisions that administer conservation easements to test monitor several conservation easements of different types, to develop templates for baseline property reports and conservation easement monitoring forms and to develop an agency-wide stewardship plan as well as individual stewardship (monitoring) plans by easement administrator or type. The stewardship plan addresses DNR's conservation easement stewardship goals, baseline property reports, easement monitoring, landowner relations, record keeping, staffing and enforcement. Monitoring plans by easement administer or type identify the primary monitor by job class/location, any additional staffing needs, monitoring method(s) that will be used and frequency of routine monitoring. The stewardship plan contains annualized cost estimates by easement type to implement the plan and identifies existing funding sources. It also contains estimated costs to complete baseline property reports for existing conservation easements.

The complete stewardship plan is documented in the Conservation Easement Stewardship and Enforcement Program Plan – DNR Final Report dated Feb. 28, 2011. The Appendix to the report contains baseline property report and monitoring form templates developed through this project. See section V. DISSEMINATION below for a link to the report.

As outlined in the July 15, 2009 Status Report and subsequent status reports, the computer application for conservation easement administration (Deliverable 5 of Result 2), is to be built into DNR's new land records system by the DNR Land Records Management Project's contractor, International Land Systems, Inc. (ILS). The $60,000 budgeted for application development in this project was contributed toward the technical services contract with ILS. (See July 15, 2001 Status Report & Appendix A to July 15, 2010 Status Report.) The computer application for conservation easement administration and monitoring is currently in development and design review with completion expected in October 2011.

[3] This is the revised budget amount following the shift of Result 1 and Result 3 funds to Result 2 per the Jan. 31, 2011 Work Program Amendment. The Result 2 Budget in the original Work Program was $170,000. This was revised to $172,000 following a May 19, 2009 Work Program Amendment that shifted $2,000 of the Result 1 Budget to the Result 2 Budget for travel.

Jan. 31, 2011 Work Program Amendment Results Summary

On January 31, 2011, LCCMR approved a January 27, 2011 Work Program Amendment request. The Work Program Amendment authorized the DNR to shift $30,000 in project funds from Results 1 and 3 to Result 2 to perform additional digitization of the DNR's conservation easements beyond that contemplated by the original Work Program. The Jan. 31, 2011 Work Program Amendment had three components:

1. Convert the digital format of at least half of the scanned 977 existing conservation easements from PDF to Word using optical character recognition software and prepare "monitorable" easement terms for migration to the conservation easement administration application being developed by ILS.
2. Overlay county parcel data shapefiles on approximately 175 trout stream easement shapefiles to determine and show ownership boundaries of conservation easements that have been subdivided; create a table of corresponding current ownership data for migration to the new land records system and use with the conservation easement administration application.
3. Create shapefiles from legal descriptions for at least 20-25 conservation easements that have not been mapped electronically.

The DNR hired two temporary project analysts, one with ArcGIS expertise and one with survey and AutoCAD expertise, to fulfill the project goals set forth in the Work Program Amendment. As discussed below, the results of all three components of the Work Program Amendment far exceeded stated goals.

Digital Format Conversion: Project staff used Omnipage optical character recognition software to scan conservation easements that were in PDF format and create an output in Word format. A Microsoft Access application was created to record the terms for each easement in the scan set. A set of headers was developed to enable classification of each easement term by type (e.g., Surface Alteration, Structures and Improvements, Waste or Hazardous Materials). The headers will facilitate future reporting about types of conservation easement violations. A field was also included in the Access application to allow DNR staff to specify whether the easement term will be monitored by field staff. Terms were copied, pasted into the Access application, proofread for accuracy and classified by header type. A total of 600 easements with 5772 total terms were processed. This represents all conservation easements in the DNR Central and Southern Regions that have been "finalized" (i.e., final title opinion completed, DNR document number assigned, all data entry completed in land records system, copy of document filed with DNR's land records in Division of Lands and Minerals, document scanned). Having the Access application as a repository allows excellent flexibility to create a dataset in whatever format International Land Systems, Inc. may require to populate the new land records system. It also allows prototyping of conservation monitoring forms for use by field staff prior to implementation of DNR's new land records system.

Subdivisions and Ownership of Trout Stream Easements: Project staff were able to use geoprocessing tools available in ArcGIS (Python script) to systematically define underlying fee interest ownership by comparing existing trout stream shapefiles to county parcel data. Automating this activity allowed project staff to capture ownership information for 557 trout stream easements statewide. Results show that the 557 trout stream easements cover portions or all of 1581 separate land parcels owned by 1148 persons. Where parcel information was not available to DNR on a countywide basis, staff researched county websites to obtain the information and captured this information into the process. Parcel information for the remaining trout stream easements could not be identified during the process either because the counties in which the easements are located do not yet have parcel data or because the information was missing from the county dataset or otherwise unclear.

Shapefiles from Legal Descriptions: Project staff used AutoCAD design and engineering software to draw shapefiles from the legal descriptions of conservation easements. Each shapefile was divided into "forty-level" sections to enable the shapefiles to be tied to forty-level tabular data in DNR's land records system. Shapefiles were completed for 170 conservation easements. Project staff reviewed the AutoCAD shapefiles for compatibility with GIS and converted the shapefiles into a single GIS shape layer for future use in GIS.

The Conservation Easement Stewardship and Enforcement Program Plan – DNR Final Report Supplement dated Aug. 15, 2011 contains examples of work produced under the Jan. 31, 2011 Work Program Amendment.

Result 3: Design Long-Term Solution

The last task is to design the long-term solution to the easement stewardship (administration and monitoring). A final project report will outline how to ensure an ongoing source of financial support for easement stewardship. This requires consultation between the DNR, the Attorney General's Office, the Legislative Auditor, the Department of Finance, BWSR and the State Board of Investment. The final product will list the legal requirements governing easement stewardship, any statutory changes, fiscal requirements, and solutions to ongoing financial support in the administration and monitoring of easements.

Summary Budget Information for Result 3:	**Trust Fund Budget:**	**$ 45,000**[4]
	Amount Spent:	**$ 30,623**
	Balance:	**$ 14,377**

Deliverable	**Completion Date**	**Budget**	**Status**
1. Long-term monitoring solution	**February 2011**	**$45,000**	**Done**

[4] This is the revised budget amount following the shift of Result 1 and Result 3 funds to Result 2 per the Jan. 31, 2011 Work Program Amendment. The Result 3 Budget in the original Work Program was $50,000.

Final Report Summary:

In collaboration with representatives of DNR divisions that administer conservation easements and representatives of DNR's senior management team, project staff developed recommendations for staffing increases and options for stewardship funding to ensure that the DNR's long-term conservation easement stewardship obligations can be met. It was recommended that at least 4.5 additional FTE's be assigned or hired to be dedicated to conservation easement stewardship. Options for funding of stewardship for both existing conservation easements and new conservation easement acquisitions were provided along with explanations of the advantages and disadvantages of each option. One of the funding options provided for both existing and new conservation easements was creation of an interest-bearing special revenue account to be used for conservation easement stewardship funding.

Part III of the Conservation Easement Stewardship and Enforcement Program Plan – DNR Final Report dated Feb. 28, 2011 outlines existing legal requirements for conservation easement stewardship in Minnesota and details the project's recommendations for staffing increases and the options for conservation easement stewardship funding. See section V. DISSEMINATION below for a link to the report.

Following completion of the Conservation Easement Stewardship and Enforcement Program Plan – DNR Final Report dated Feb. 28, 2011, the Commissioner of Natural Resources sent copies of the report to the chairs and ranking minority members of the house and senate natural resources committees along with a letter announcing the DNR's intention to develop a proposal for legislation that would create an interest-bearing special revenue account dedicated to administration, monitoring and enforcement of DNR conservation easements. The Commissioner's letter further stated that upon passage of such legislation, the DNR would seek to build a fund corpus that would generate sufficient annual interest to cover the cost of implementing the DNR's conservation easement stewardship plan and would seek stewardship funding to add to the account at the time any new conservation easement is acquired.

There is a $14,377 balance for this Result due to less staff time being needed than was initially anticipated.

V. TOTAL PROJECT REQUEST BUDGET:

Staff or Contract Services:	**$520,000**
Equipment:	**$ 0**
Development:	**$ 0**
Restoration:	**$ 0**

Acquisition, including Easements:	**$ 0**
TOTAL BUDGET:	**$520,000**

VI. OTHER FUNDS AND PARTNERS

A. Project Partners
BWSR

B. Other Nonstate Funds being Leveraged during the Project Period
None

C. Past Spending
M.L. 2007, Article 1, Section 4, Subdivision 2, Conservation Easement Standards Report $15,000

D. Time
Funds must be available through June of 2011.

V. DISSEMINATION: Products and findings of the original Work Program are reported in the Conservation Easement Stewardship and Enforcement Program Plan – DNR Final Report dated Feb. 28, 2011, which is on the DNR's website at the following link:

http://files.dnr.state.mn.us/lands_minerals/conservation_easement_stewardship_final_report.pdf

The Geographic Information Systems (GIS) conservation easement layer developed in the project is available to the general public through the DNR Data Deli.

VI. REPORTING REQUIREMENTS: Periodic work program reports will be submitted no later than December 15, 2008, July 15, 2009, December 15, 2009, July 15, 2010, and December 15, 2010. A final work program report and associated products will be submitted between January 2011 and March 2011 as requested by the LCCMR.

Attachment A: Budget Detail for 2008 Projects - Summary and a Budget page for each partner (if applicable)

Project Title: Conservation Easement Stewardship and Enforcement Program Plan DNR

Project Manager Name: Kathy Lewis

Trust Fund Appropriation: $ 520,000

1) See list of non-eligible expenses, do not include any of these items in your budget sheet

2) Remove any budget item lines not applicable

2008 Trust Fund Budget	Revised Result 1 Budget: *01/31/11*	Amount Spent *(12/15/08)*	Amount Spent *(07/15/09)*	Amount Spent *(12/15/09)*	Amount Spent *(7/15/10)*	Amount Spent *(12/15/10)*	Amount Spent *(6/30/11)*	Balance *(6/30/11)*	Revised Result 2 Budget: *01/31/11*	Amount Spent *(12/15/08)*	Amount Spent *(7/15/09)*	Amount Spent *(12/15/09)*	Amount Spent *(7/15/10)*	Amount Spent *(12/15/10)*	Amount Spent *(6/30/11)*	Balance *(6/30/11)*	Revised Result 3 Budget: *1/31/11*	Amount Spent *(12/15/08)*	Amount Spent *(7/15/09)*	Amount Spent *(12/15/09)*	Amount Spent *(7/15/10)*	Amount Spent *(12/15/10)*	Amount Spent *(6/30/11)*	Balance *(6/30/11)*	REVISED TOTAL BUDGET (1/31/11)	TOTAL BALANCE *(6/30/11)*
	Easement Inventory								*Develop Monitoring Plan*								*Design Long-Term Solution*									
BUDGET ITEM																										
PERSONNEL: wages and benefits	272,000	10,981	80,521	53,357	73,412	46,231	7,498	0	140,000	7,000	28,500	19,000	19,500	15,000	51,000	0	45,000	314	1,500	100	3,500	5,000	20,209	14,377	457,000	14,377
CONTRACT SERVICES	0	0	0	0	0	0	0	0	60,000	0	0	0	60,000	0	0	0	0	0	0	0	0	0	0	0	60,000	0
IN-STATE TRAVEL: Transportation and travel expenses	1,000	0	0	500	0	50	0	450	2,000	0	0	736	0	455	249	560	0	0	0	0	0	0	0	0	3,000	1,010
COLUMN TOTAL	**$273,000**	**$10,981**	**$80,521**	**$53,857**	**$73,412**	**$46,281**	**$7,498**	**$450**	**$202,000**	**$7,000**	**$28,500**	**$19,736**	**$79,500**	**$15,455**	**$51,249**	**$560**	**$45,000**	**$314**	**$1,500**	**$100**	**$3,500**	**$5,000**	**$20,209**	**$14,377**	**$520,000**	**$15,387**

CONSERVATION EASEMENT STEWARDSHIP AND ENFORCEMENT PROGRAM PLAN—DNR
FINAL REPORT SUPPLEMENT
August 15, 2011

ENVIRONMENT
AND NATURAL RESOURCES
TRUST FUND

BACKGROUND

The Minnesota Legislature funded this project in 2008 through an appropriation from the Environment and Natural Resources Trust Fund, Minn. Laws 2008, ch. 367, sec. 2, subd. 5(h). The appropriation language provides:

> **(h) Conservation Easement Stewardship and Enforcement Program Plan**
>
> $520,000 is from the trust fund to the commissioner of natural resources to inventory and digitize the department's conservation easements and prepare a plan for monitoring, stewardship and enforcement. This effort must be done in cooperation with the Board of Water and Soil Resources. This appropriation is available until June 30, 2011, at which time the project must be completed and final products delivered, unless an earlier date is specified in the work program.

The LCCMR approved the original Work Program for the project on June 17, 2008. The original Work Program had three results:

1. Easement Inventory
2. Develop Monitoring (or Stewardship) Plan
3. Design Long-Term Solution

Outcomes of the original Work Program are reported in the Conservation Easement Stewardship and Enforcement Program Plan—DNR Final Report dated Feb. 28, 2011.

On Jan. 31, 2011, LCCMR approved a Work Program Amendment that shifted $30,000 in project funds from Results 1 and 3 to Result 2 to enable the DNR to undertake digitization of DNR's conservation easements beyond what was contemplated by the original Work Program. The Work Program Amendment had three components :

1. Convert the digital format of at least half of the scanned 977 existing conservation easements from PDF to Word using optical character recognition software; proofread and make necessary corrections following conversion; select and prepare "monitorable" easement terms for migration to the conservation easement administration application under development by International Land Systems.
2. Overlay county parcel data shapefiles on shapefiles of approximately 175 existing trout stream easements to determine and show ownership boundaries of conservation easements that have been subdivided; create a table of corresponding ownership data for migration to the new land records system and use with the conservation easement administration application.
3. Create shapefiles from legal descriptions for at least 20-25 conservation easements that have not been mapped electronically.

This Supplement to the August 15, 2011 Final Report illustrates and provides examples of work completed under the Jan. 31, 2011 Work Program Amendment.

Work Program Amendment Component 1: Digital Format Conversion

The first component of the Jan. 31, 2011 Work Program Amendment was to convert the terms of existing conservation easements from a scanned image (PDF) format to a Word format using optical character recognition (OCR) software, to create an Access database in which existing easements are organized by DNR document number and to capture each of the monitorable terms in a separate field on a database data entry screen by copying and pasting from the Word document. After the terms were entered into the separate fields, project staff corrected any OCR conversion errors, assigned a header that describes the type of easement term and checked a box to indicate whether the easement term is one that should be monitored. Conversion was completed for 600 existing conservation easements.

The purpose of this work was to prepare data from existing conservation easements for migration to DNR's new land records system. The data will be used to populate baseline property reports, monitoring forms and other fields within the conservation easement administration application in DNR's new land records system. This will enable the application to be used for stewardship of existing easements as well as for any new conservation easements that are drafted using the new land records system.

Illustration 1.a. shows the process flow that staff used for the digital format conservation.

Illustration 1.b. shows the data entry screen into which the easement terms were pasted after being copied from Word.

Illustration 1.c. shows a report created in Access to facilitate proof-reading and error correction by project staff.

Illustration 1.d. shows a portion the Access table created through the project, which contains existing easement terms and reserved rights.

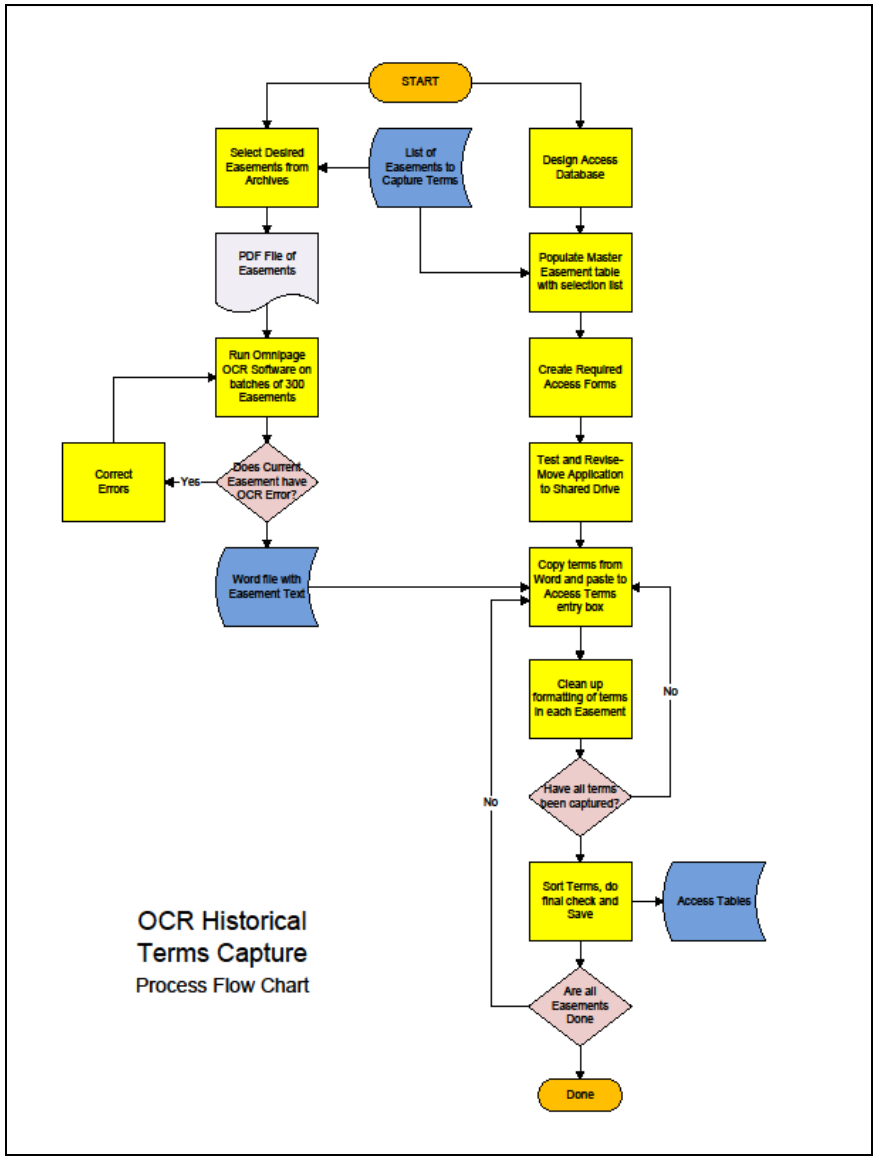


Illustration 1.a. Process flow used for digital format conversion

Work Program Amendment Component 1: Digital Format Conversion

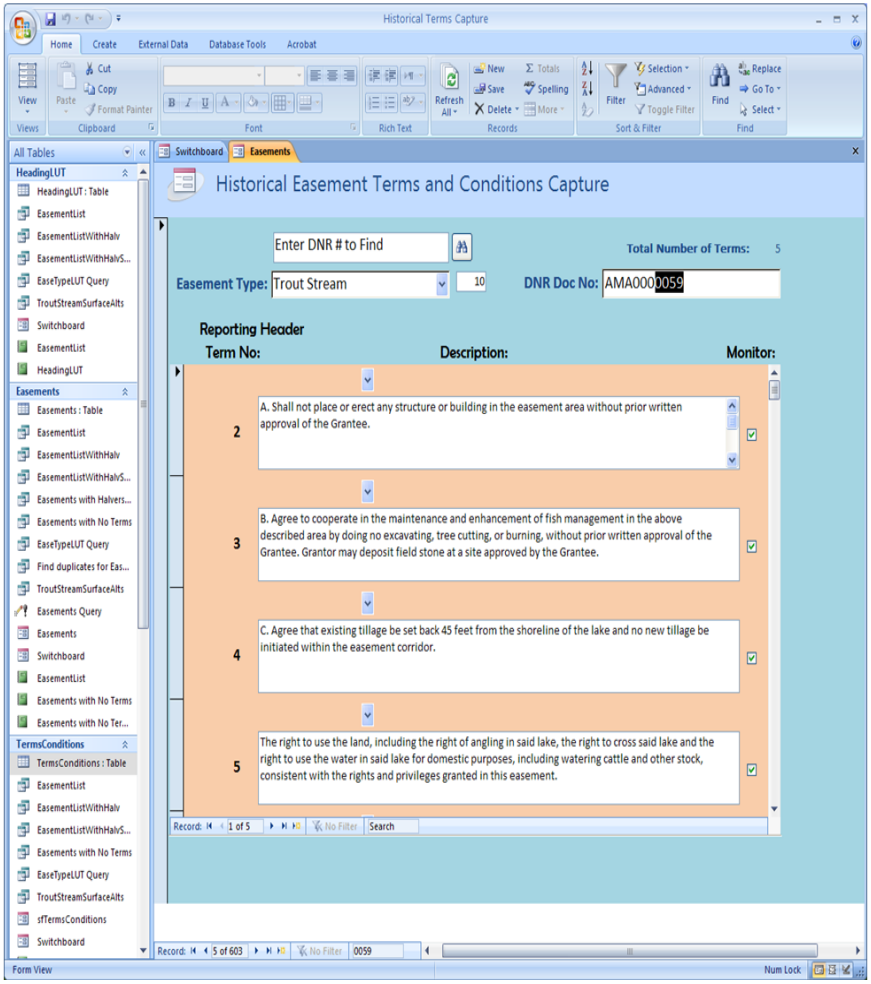


Illustration 1.b.
Access database data entry screen

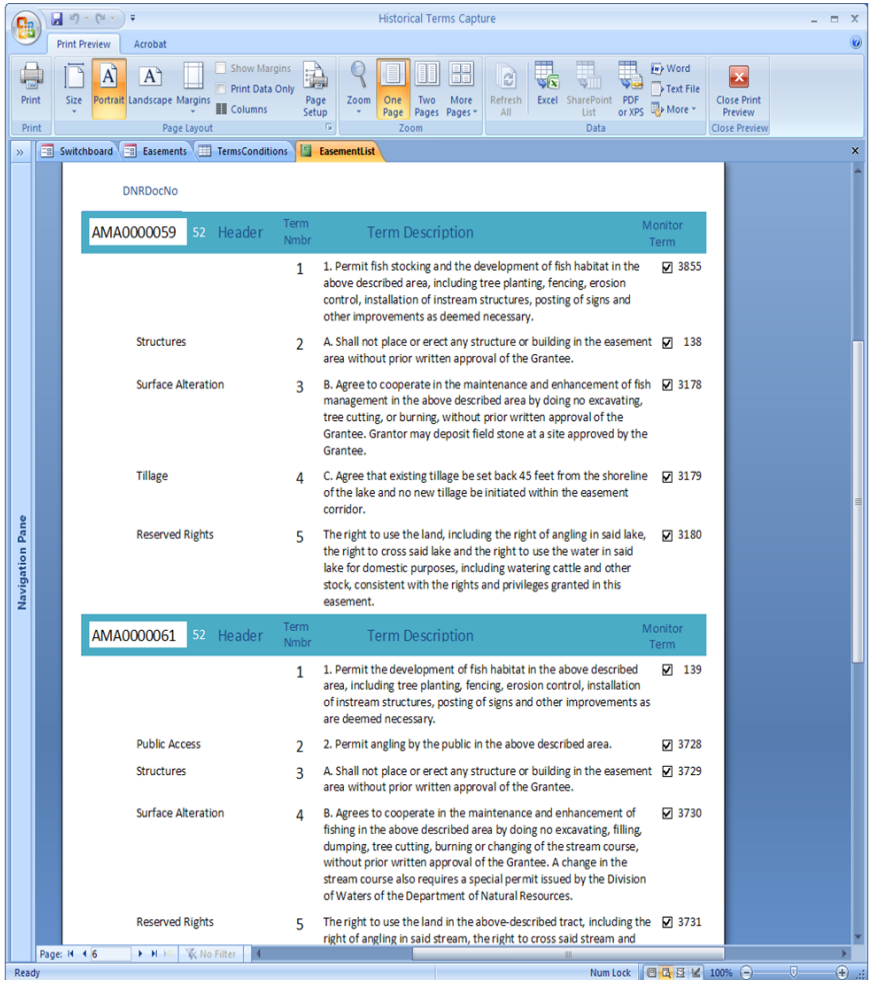
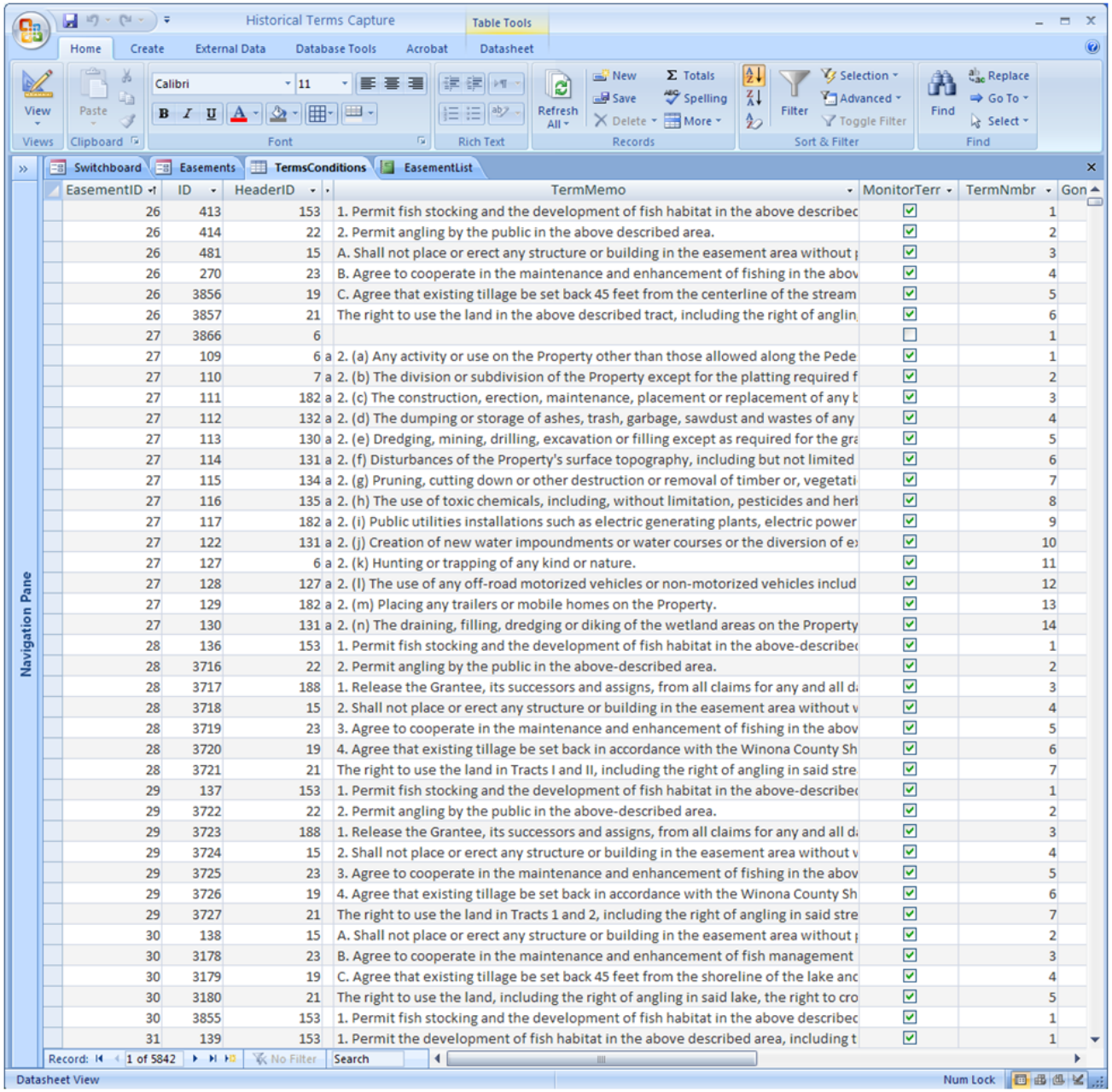


Illustration 1.c.
Access report

Work Program Amendment Component 1: Digital Format Conversion



EasementID	ID	HeaderID		TermMemo	MonitorTerr	TermNmbr	Gon
26	413	153		1. Permit fish stocking and the development of fish habitat in the above describec	☑	1	
26	414	22		2. Permit angling by the public in the above described area.	☑	2	
26	481	15		A. Shall not place or erect any structure or building in the easement area without p	☑	3	
26	270	23		B. Agree to cooperate in the maintenance and enhancement of fishing in the abov	☑	4	
26	3856	19		C. Agree that existing tillage be set back 45 feet from the centerline of the stream	☑	5	
26	3857	21		The right to use the land in the above described tract, including the right of anglin	☑	6	
27	3866	6			☐	1	
27	109	6	a	2. (a) Any activity or use on the Property other than those allowed along the Pede	☑	1	
27	110	7	a	2. (b) The division or subdivision of the Property except for the platting required f	☑	2	
27	111	182	a	2. (c) The construction, erection, maintenance, placement or replacement of any b	☑	3	
27	112	132	a	2. (d) The dumping or storage of ashes, trash, garbage, sawdust and wastes of any	☑	4	
27	113	130	a	2. (e) Dredging, mining, drilling, excavation or filling except as required for the gra	☑	5	
27	114	131	a	2. (f) Disturbances of the Property's surface topography, including but not limited	☑	6	
27	115	134	a	2. (g) Pruning, cutting down or other destruction or removal of timber or, vegetati	☑	7	
27	116	135	a	2. (h) The use of toxic chemicals, including, without limitation, pesticides and herb	☑	8	
27	117	182	a	2. (i) Public utilities installations such as electric generating plants, electric power	☑	9	
27	122	131	a	2. (j) Creation of new water impoundments or water courses or the diversion of ex	☑	10	
27	127	6	a	2. (k) Hunting or trapping of any kind or nature.	☑	11	
27	128	127	a	2. (l) The use of any off-road motorized vehicles or non-motorized vehicles includ	☑	12	
27	129	182	a	2. (m) Placing any trailers or mobile homes on the Property.	☑	13	
27	130	131	a	2. (n) The draining, filling, dredging or diking of the wetland areas on the Property	☑	14	
28	136	153		1. Permit fish stocking and the development of fish habitat in the above-describec	☑	1	
28	3716	22		2. Permit angling by the public in the above-described area.	☑	2	
28	3717	188		1. Release the Grantee, its successors and assigns, from all claims for any and all da	☑	3	
28	3718	15		2. Shall not place or erect any structure or building in the easement area without v	☑	4	
28	3719	23		3. Agree to cooperate in the maintenance and enhancement of fishing in the abov	☑	5	
28	3720	19		4. Agree that existing tillage be set back in accordance with the Winona County Sh	☑	6	
28	3721	21		The right to use the land in Tracts I and II, including the right of angling in said stre	☑	7	
29	137	153		1. Permit fish stocking and the development of fish habitat in the above-describec	☑	1	
29	3722	22		2. Permit angling by the public in the above-described area.	☑	2	
29	3723	188		1. Release the Grantee, its successors and assigns, from all claims for any and all da	☑	3	
29	3724	15		2. Shall not place or erect any structure or building in the easement area without v	☑	4	
29	3725	23		3. Agree to cooperate in the maintenance and enhancement of fishing in the abov	☑	5	
29	3726	19		4. Agree that existing tillage be set back in accordance with the Winona County Sh	☑	6	
29	3727	21		The right to use the land in Tracts 1 and 2, including the right of angling in said stre	☑	7	
30	138	15		A. Shall not place or erect any structure or building in the easement area without p	☑	2	
30	3178	23		B. Agree to cooperate in the maintenance and enhancement of fish management	☑	3	
30	3179	19		C. Agree that existing tillage be set back 45 feet from the shoreline of the lake anc	☑	4	
30	3180	21		The right to use the land, including the right of angling in said lake, the right to cro	☑	5	
30	3855	153		1. Permit fish stocking and the development of fish habitat in the above describec	☑	1	
31	139	153		1. Permit the development of fish habitat in the above described area, including t	☑	1	

Illustration 1.d.
Portion of Access table with final work product

Work Program Amendment Component 2: Subdivisions and Ownership of Trout Stream Easements

The objective of the second component of the Jan 31, 2011 Work Program Amendment was to identify subdivisions of fee title interests in land subject to existing trout stream easements and to identify current fee owners. Land owned by one person at the time the DNR acquired a trout stream easement on it may now be divided into multiple underlying property parcels and have multiple owners.

Project staff were able to use geoprocessing tools available in ArcGIS (Python script) to systematically define underlying fee interest ownership by comparing existing trout stream shapefiles (contained in a GIS layer developed by the DNR's Fisheries section) to county parcel data. Automating this activity allowed project staff to capture ownership information for 557 trout stream easements statewide. These 557 trout stream easements cover portions or all of 1581 separate land parcels owned by 1148 persons.

Illustration 2.a. on the right-hand side of this page contains GIS screenshots of Hay Creek, a designated trout stream in Goodhue County. The photograph on the top shows the boundaries and original ownership of four trout stream easements acquired by the DNR in 1977. The photograph on the bottom is a screenshot of the same stream segment and easements after processing in ArcGIS with the script developed in the project. This shows current county parcel boundaries and identifies subdivisions and fee ownership of the property underlying the easements.

Illustration 2.b. on the following page shows the process model developed by project staff to complete component 2 of the Jan. 31, 2011 Work Program Amendment.

Hay Creek - Goodhue Co. with Original Grantors

Hay Creek - Goodhue Co. with Current Landowners

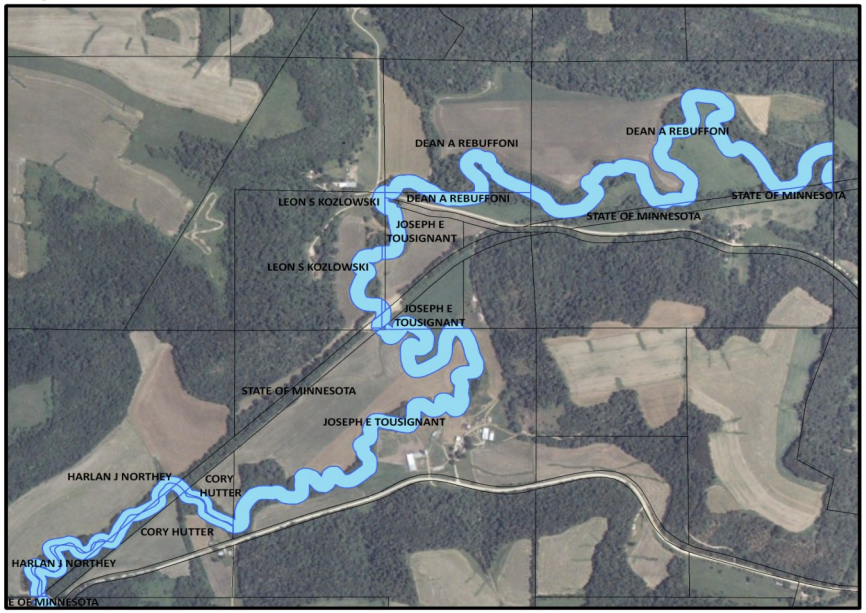


Illustration 2.a.

Work Program Amendment Component 2: Subdivisions and Ownership of Trout Stream Easements

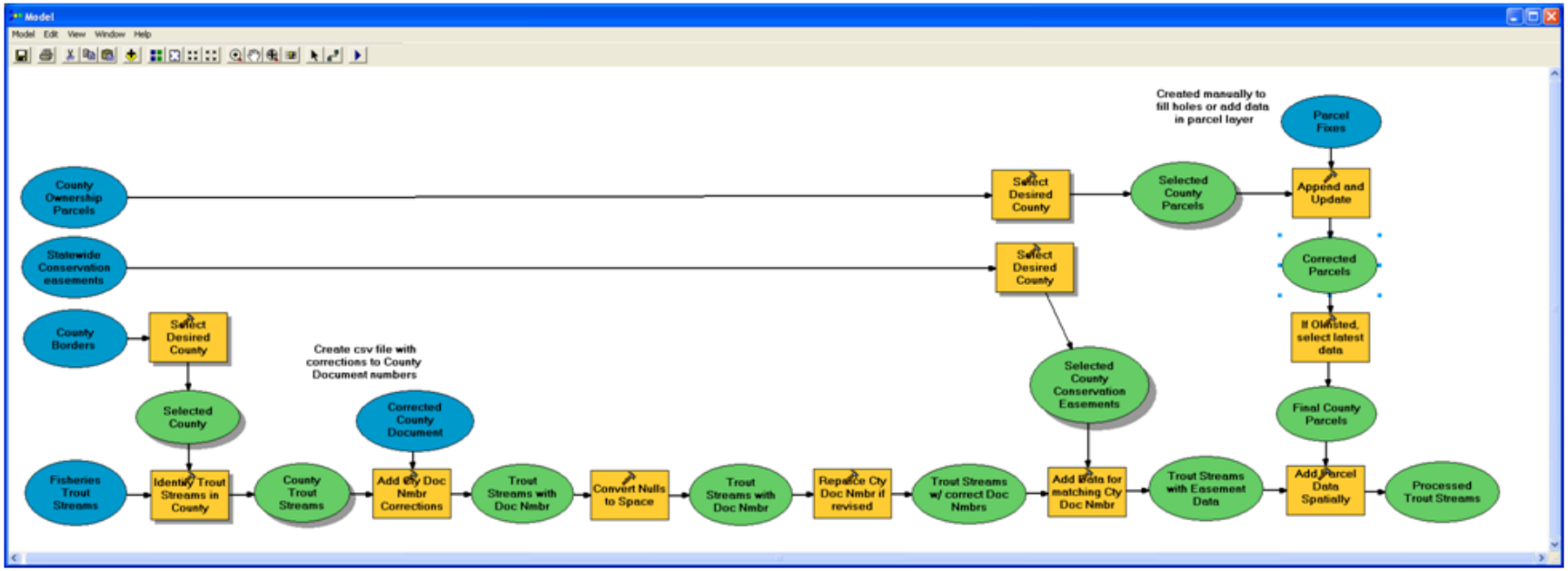
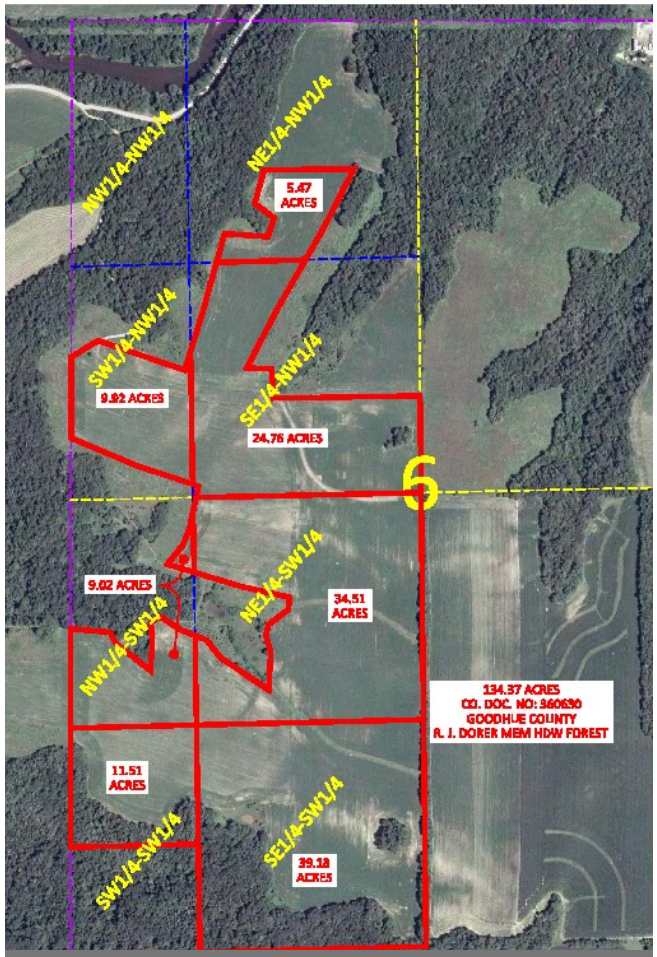


Illustration 2.b.
Process model for identification of trout stream easement subdivisions and current owners

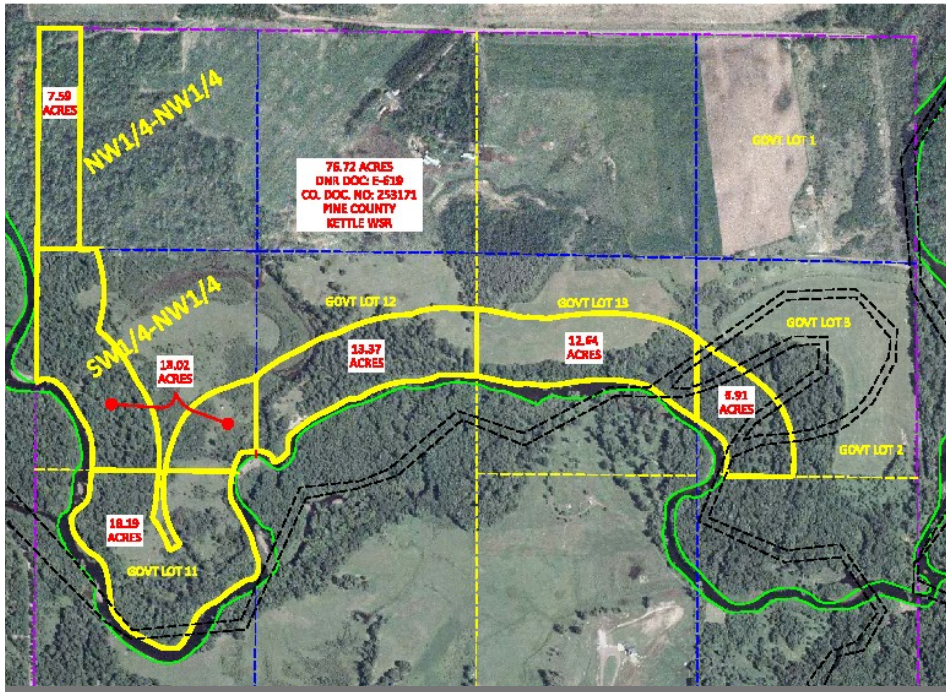
Work Program Amendment Component 3: Shapefiles from Legal Descriptions

Project staff created shapefiles for 170 conservation easements from their legal descriptions, using AutoCAD design and engineering software. Each shapefile was divided into "forty-level" sections, which will enable the shapefiles to be tied to forty-level tabular data in DNR's land records system.

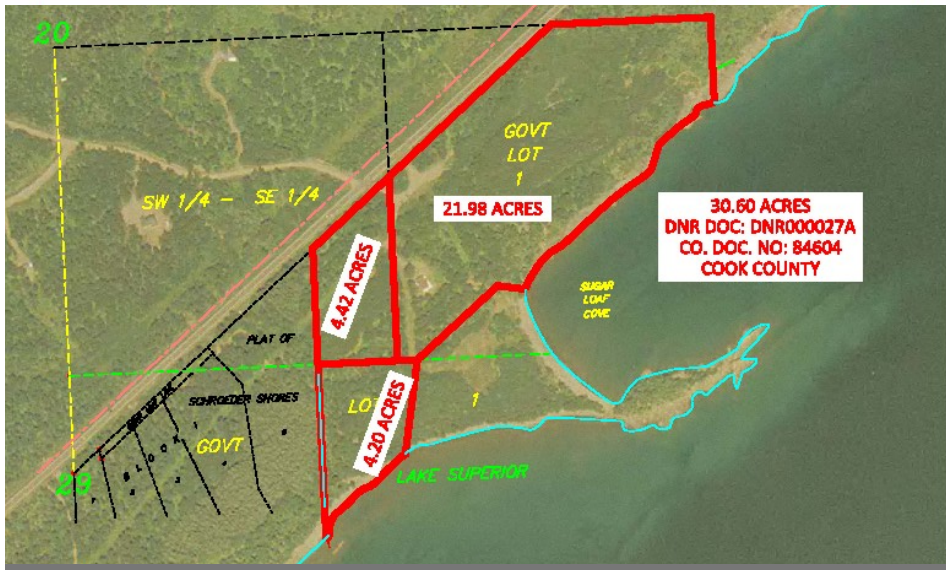
Illustrations 3.a., 3.b. and 3.c. show three of the shapefiles created in the project overlaid on FSA aerial photographs.



Illustr. 3.a. Forestry Div. Conservation Easement, Goodhue Co.



Illustr. 3.b. Wild and Scenic River Easement, Pine Co.



Illustr. 3.c. SNA Program-Administered Miscellaneous Conservation Easement, Cook Co.

Conservation Easement Stewardship and Enforcement Program Plan—DNR

Final Report

February 28, 2011

INTRODUCTION

The Minnesota Legislature funded this project in 2008 through an appropriation from the Environment and Natural Resources Trust Fund, Minn. Laws 2008, ch. 367, sec. 2, subd. 5(h). The appropriation language provides:

> **(h) Conservation Easement Stewardship and Enforcement Program Plan**
>
> $520,000 is from the trust fund to the commissioner of natural resources to inventory and digitize the department's conservation easements and prepare a plan for monitoring, stewardship and enforcement. This effort must be done in cooperation with the Board of Water and Soil Resources. This appropriation is available until June 30, 2011, at which time the project must be completed and final products delivered, unless an earlier date is specified in the work program.

The LCCMR approved the Work Program for the project on June 17, 2008. The Work Program has three results:

1. Easement Inventory
2. Develop Monitoring (or Stewardship) Plan
3. Design Long-Term Solution

The Work Program required the project to coordinate with the easement stewardship efforts of the Board of Water and Soil Resources (BWSR), which received a 2008 Environment and Natural Resources Trust Fund appropriation to enhance its long-term conservation easement stewardship, to avoid duplication of effort. Project staff met with BWSR representatives early in the project and determined that BWSR was using its 2008 ENRTF appropriation to map cover-typing of its conservation easements with GIS and was not duplicating any DNR efforts with the Conservation Easement Stewardship and Enforcement Program Plan.

This report is in three parts, which correspond to the Work Program's results. Part I provides an overview of the conservation easement types held by DNR, includes the inventory results, and outlines the inventory process. Part II explains how DNR's conservation easement stewardship plan is integrated with the design and development of DNR's new land records system and describes DNR's agency-wide conservation easement stewardship plan as well as administrator- and type-specific plans. Part III contains an estimate of DNR's funding needs for conservation easement stewardship and provides options for long-term stewardship funding.

CONTENTS

	Page
PART I: EASEMENT INVENTORY	1
Overview of DNR's Conservation Easement Types	1
Army Compatible Use Buffer Easements	2
Aquatic Management Area Easements	2
Cave (Parks) Easements	3
Working Forest Easements: Forest Legacy and Minnesota Forests for the Future	4
Metro Greenways Easements	5
Native Prairie Bank Easements	6
Northern Pike Spawning Easements	7
Scientific and Natural Area Easements	7
Trout Stream Easements	8
Water Bank Easements	9
Wild and Scenic River Easements	9
Other Conservation Easements	11
Easement Inventory Results	14
Statewide Results	14
Results by Region	15
The Inventory Process	19
PART II: CONSERVATION EASEMENT STEWARDSHIP PLAN	22
Integration of Conservation Easement Stewardship Plan with DNR's New Land Records System	22
Agency-Wide Conservation Easement Stewardship Plan	23
Individual Conservation Easement Stewardship Plans by Administrator or Type	28
Key Components of Monitoring Plans by Easement Type (Table)	46
PART III: OPTIONS FOR LONG-TERM CONSERVATION EASEMENT STEWARDSHIP FUNDING	47
Existing Legal Requirements	47
Conservation Easement Stewardship Plan Cost Estimates	48
Options for Stewardship Funding	52
Other Legislative Changes to Improve Conservation Easement Stewardship	55

PART I: EASEMENT INVENTORY

Minnesota's conservation easement law, Minnesota Statutes chapter 84C, was enacted in 1985. Minn. Laws 1985, ch. 232, sec. 1. This law is a verbatim enactment of the Uniform Conservation Easement Act, developed by the National Conference of Commissioners on Uniform State Laws.

The law authorizes two types of entities to hold conservation easements: (1) governmental entities that are authorized to hold interests in land; and (2) non-profit organizations with purposes that include "protecting the natural, scenic, or open-space values of real property, assuring the availability of real property for agricultural, forest, recreational, or open-space use, protecting natural resources, maintaining or enhancing air or water quality, or preserving the historical, architectural, archaeological, or cultural aspects of real property." Minn. Stat. sec. 84C.01(2).

Chapter 84C applies to all interests created after August 1, 1985 that comply with chapter 84C even if the interests are not specifically called conservation easements. Minn. Stat. sec. 84C.05(b). It also "grandfathers in" certain easements, conservation restrictions and other interests in land that predate chapter 84C's effective date, August 1, 1985, if those interests would have been enforceable had they been created after that date. Minn. Stat. sec. 84C.05(c). This provision applies to a number of DNR's "conservation restrictions," which were acquired under the authority of Minnesota's conservation restrictions statute, Minn. Stat. sec. 84.64. This statute authorized the Commissioner of Natural Resources, home rule charters, statutory cities and non-profit organizations whose purposes included conservation of land and water areas to acquire conservation restrictions and was a precursor to chapter 84C.

Chapter 84C defines a "conservation easement" as "a nonpossessory interest of a holder in real property imposing limitations or affirmative obligations the purposes of which include retaining or protecting natural, scenic, or open-space values of real property, assuring its availability for agricultural, forest, recreational, or open-space use, protecting natural resources, maintaining or enhancing air or water quality, or preserving the historical, architectural, archaeological, or cultural aspects of real property." Minn. Stat. sec. 84C.01(1). All of the easements listed in the inventory results and subject to DNR's Conservation Easement Stewardship Plan meet this definition.

Overview of DNR's Conservation Easement Types

DNR holds 13 types of conservation easements:

1. Army Compatible Use Buffer	7. Native Prairie Bank
2. Aquatic Management Area	8. Northern Pike Spawning
3. Cave	9. Scientific and Natural Area
4. Forest Legacy	10. Trout Stream
5. Minnesota Forests for the Future	11. Water Bank
6. Metro Greenways	12. Wild and Scenic River
13. Other Conservation	

Each of the first 12 types listed above has one or more distinguishing features (e.g., specific statutory authority, a specific funding source or a specific conservation purpose). DNR's "Other Conservation" easements are miscellaneous easements that do not fit the characteristics of any of the 12 specific types. Each easement type is described in detail below.

Army Compatible Use Buffer (ACUB) Easements

The Army Compatible Use Buffer Program was established by section 2811(a) of the National Defense Authorization Act for Fiscal Year 2003, now codified at 10 U.S.C. sec. 2684a. This law authorizes the Secretary of Defense or Secretary of a military department to enter into agreements with states and other eligible entities to address land use and development in the vicinity of a military installation. The agreements are for the purposes of:

(1) Limiting any development or use of the property that would be incompatible with the mission of the installation; or
(2) Preserving habitat on the property in a manner that—
    (A) Is compatible with environmental requirements; and
    (B) May eliminate or relieve current or anticipated environmental restrictions that would or might otherwise restrict, impede, or otherwise interfere, whether directly or indirectly, with current or anticipated military training, testing, or operations on the installation.

10 U.S.C.A. sec. 2684a(a).

Camp Ripley, in Central Minnesota, is home of the Minnesota Army National Guard and the primary winter military training site in the United States. On May 3, 2004, a three-mile zone around the camp, located in portions of Morrison, Crow Wing and Cass Counties, was approved as an Army Compatible Use Buffer.

The Minnesota National Guard has entered into a Cooperative Agreement with the DNR to protect lands within the Camp Ripley ACUB focus area. Under the Cooperative Agreement and in accordance with 10 U.S.C. sec. 2684a, the DNR acquires interests in land within the focus area from willing sellers. The acquisitions may be either in fee title or conservation easements. The military funds 75% of the acquisition costs. A 25% match, which may be in the form of funds, donations of land or in-kind services, is provided by the state, other entities or private parties. Legislation passed in 2009, codified as Minn. Stat. sec. 84.0277, provides that the payment for ACUB easements is based on a percentage of the most recent assessed market value of the land as determined by the county assessor.

DNR acquired its first ACUB easement in August 2005 and continues to actively pursue acquisition of ACUB easements.

Aquatic Management Area (AMA) Easements

The Outdoor Recreation Act of 1975, codified as Minnesota Statutes sections 86A.01 through 86A.11, established Minnesota's Outdoor Recreation System. In 1992, the Outdoor Recreation Act was amended to add aquatic management areas (AMA's) as one of the units that

Eagle Creek AMA Easement, Scott County

comprise the system. An AMA may be established "to protect, develop, and manage lakes, rivers, streams, and adjacent wetlands and lands that are critical for fish and other aquatic life, for water quality, and for their intrinsic biological value, public fishing, or other compatible outdoor recreational uses." Minn. Stat. sec. 86A.05, subd. 14.

Minnesota Statutes section 97C.02 requires the Commissioner to acquire lands that are "critical for fish and other aquatic life and that meet the criteria described for aquatic management areas in section 86A.05, subd. 14" and provides that such land "may be acquired by gift, lease, easement, or purchase." The Commissioner is required to designate land acquired under Minn. Stat. sec. 97.02 as aquatic management areas for purposes of the Outdoor Recreation System. State-owned lands or interests in lands that were acquired before Aug. 1, 2000 and administered by the Commissioner for fish management purposes were also designated as aquatic management areas in accordance with Minn. Stat. sec. 86A.05, subd. 14(e). Nearly all designated AMA's, including those held in easement, provide public angling access.

Ten of DNR's existing AMA easements are conservation easements. Three of these are on recreational camps owned by non-profit organizations, one was assigned to DNR by a non-profit land conservation organization and several others were donated to DNR. One of the easements uses boilerplate language nearly identical to that used for DNR's Trout Stream easements (see below) but is on a lake instead of on a stream.

The Fisheries Section of the Division of Fish and Wildlife administers all AMA easements. DNR continues to acquire conservation easements of this type, but will likely limit its future acquisitions to large tracts of land along lakeshore.

Cave (Parks) Easements

Cave easements are for the purpose of surface and subterranean land protection.

DNR currently holds two Cave easements. Both are located in Fillmore County adjacent to and within the Forestville Mystery Cave State Park Statutory Boundary. The easements protect Forestville Mystery Cave and land over the cave. The express purposes of these easements are: (1) to "[p]reserve, conserve and protect Mystery Cave for aesthetic, scientific, and natural and educational purposes;" and (2) to "[p]ermit the subterranean exploration, development and protection of all underground caverns that may exist" within

Forestville Mystery Cave Easement
Fillmore County

the lands described in the easements.

The Forestville Mystery Cave easements were acquired in 1996 and 1999. DNR does not presently have plans to acquire additional Cave easements.

Working Forest Easements: Forest Legacy (FL) and Minnesota Forests for the Future (MFF)

DNR protects working forests with two types of conservation easements, Forest Legacy and Minnesota Forests for the Future. The Minnesota Forests for the Future Program is the overarching Minnesota program for identifying and protecting private, working forests using conservation easements, fee title and other tools.

Sugar Hills Forest Legacy Easement
Itasca County

The Forest Legacy Program is a federal program created by Congress in 1990 as part of the Farm Bill. The purpose of the program is to prevent conversion of environmentally important forest areas to nonforest uses. The federal program partners with states and acquires interests in land only from willing landowners. Minnesota joined the federal Forest Legacy Program in 2000 and acquired its first Forest Legacy easement in March 2001. This program guided the early successes with forest conservation easements in Minnesota, continues to serve as a funding source for the Minnesota Forests for the Future Program and is an important partner in Minnesota's private forest conservation efforts.

Forest Legacy projects are funded primarily through federal Forest Legacy grants. The federal funding share is restricted to 75% of total project costs. The required 25% match may be provided by organizations, states, local units of government, corporations or private parties and may consist of funds, donations, land or interests in land, in-kind contributions or direct or indirect costs. DNR classifies all conservation easements acquired with federal Forest Legacy grant funding as "Forest Legacy" easements.

The Minnesota Forests for the Future Program was established by Minnesota Laws 2008, ch. 357, codified as Minn. Stat. sec. 84.66. The purpose of the Minnesota Forests for the Future Program is to identify and protect "private, working forest lands for their timber, scenic, recreational, fish and wildlife habitat, threatened and endangered species, and other cultural and environmental values." Minn. Stat. sec. 84.66, subd. 1. Minnesota's first Forests for the Future easement was acquired in July 2010 with an appropriation from the Outdoor Heritage Fund.

Upper Mississippi Forest MFF Easement
Itasca County

Minnesota Forests for the Future is a state-

The Forest Capital Partners Project, Phase II

In December 2010, the Minnesota DNR and Forest Capital Partners (FCP) closed on a multi-year project to protect 76,000 acres of private forestland in Koochiching County with conservation easements. The terms of the conservation easements provide for sustainable forest management, conservation of wildlife habitat and public access to the land for outdoor recreation, hunting and fishing in perpetuity. This project illustrates how the federal Forest Legacy and Minnesota Forests for the Future Programs work together to protect Minnesota's private forestland while preserving potential benefits from mining on portions of the land.

Protection of FCP's land was accomplished through the use of both Forest Legacy and Minnesota Forests for the Future easements. The Forest Legacy easements were funded through a grant from the USDA Forest Service Forest Legacy Program. The Minnesota Forests for the Future easements used in the project were funded with an appropriation from the Minnesota Legislature. Decisions about which portions of land to place in which type of easement were based on the land's potential for mineral development and state ownership of severed mineral rights. Forest Legacy easements, which adhere to the restrictive federal requirements on mining, were used for portions of FCP's land with low mineral potential and no state ownership of severed mineral rights. Portions of FCP's land with state ownership of severed mineral rights were protected with Minnesota Forests for the Future easements. These easements permit exploration and mining of both state- and grantor-owned minerals. If the areas that are mined cannot be re-contoured and re-vegetated for forest use, the easements require that suitable lands be substituted.

level program similar to the federal Forest Legacy Program. The program was developed to address Minnesota's specific protection goals for working forests and to enable DNR to pursue forest protection opportunities beyond what can be acquired with limited federal Forest Legacy funding. The state and federal programs have similar goals, with an important distinction between the two programs being the handling of mineral interests. The federal Forest Legacy Program severely restricts mining on lands acquired under the program and requires mineral interests with potential for extensive surface disturbance to be extinguished on easements acquired with Forest Legacy funds. The state holds severed minerals rights on one million acres of private land in northern Minnesota, with rental and royalty income from these rights going to the Permanent School Fund, the Permanent University Fund, local taxing districts and the general fund. Because of federal Forest Legacy mining restrictions, placement of Forest Legacy easements on such lands could conflict with DNR's fiduciary responsibility to maximize the long-term economic return to the funds. The Minnesota Forests for the Future Program allows for greater flexibility in how mineral interests are addressed. Thus, DNR can protect areas of private forestland with high mineral potential with conservation easements while still meeting its fiduciary obligations.

DNR classifies all working forest easements acquired under Minnesota Statutes section 84.66 for which no federal Forest Legacy grant funding was used as "Minnesota Forests for the Future" easements.

Metro Greenways (MGW) Easements

In 1996, the Legislative Commission on Minnesota Resources recommended an appropriation to the Commissioner of Natural Resources from the Future Resources Fund to develop a strategy to protect and manage greenway corridors and natural areas in the seven-county metropolitan area. The Legislature appropriated $50,000 for this purpose. Minn. Laws 1996, ch. 407, sec. 8, subd. 4. As a result, the Greenways and Natural Areas Collaborative, comprised of representatives from the public, private and non-profit sectors and academia, issued a

December 1997 report entitled *Metro Greenprint: Planning for nature in the face of urban growth*. The report recommended the creation of a Metro Greenways and Natural Areas Program with an advisory committee appointed by the Commissioner of Natural Resources in collaboration with the chair of the Metropolitan Council.

Camp Kingswood Metro Greenways Easement
Hennepin County

In 1998, the Legislature began appropriating funding for metro greenways and natural areas, but did not enact legislation to establish a Metro Greenways and Natural Areas Program. Over the next eight years, the Legislature appropriated both bonding and Environment and Natural Resources Trust Fund (ENRTF) funding to DNR for metro greenways and natural areas and authorized the purchase of land in fee title and conservation easements with the funding.

Between 2001 and 2007, DNR acquired 16 Metro Greenways easements with the bonding and ENRTF appropriations. These easements, which protect a total of 669 acres, are located in Washington, Ramsey, Dakota, Hennepin and Anoka Counties. Nine are on parcels owned in fee title by counties, cities or other governmental entities. Five are on parcels owned by nonprofit organizations and the remaining two Metro Greenways easements are on private property.

Native Prairie Bank (NPB) Easements

The state once had over 18 million acres of prairie. Less than 1% remains today. The Minnesota Legislature established the Native Prairie Bank Program in 1987 to help protect remaining parcels of privately owned native prairie with conservation easements. Minn. Laws 1987, ch. 357, sec. 19 (codified as Minn. Stat. sec. 84.96).

Moulton 19-1 Native Prairie Bank Easement
Murray County

Under the Native Prairie Bank Program, the Commissioner of Natural Resources may acquire conservation easements on "native prairie," defined as "land that has never been plowed, with less than ten percent tree cover and with predominately native prairie." Minn. Stat. sec. 84.96, subd. 3. The Native Prairie Bank law requires all easements acquired through the Program to include specific provisions designed to protect the native prairie. For example, the owner must agree "not to alter the native prairie by plowing, heavy grazing, seeding to nonnative grasses or legumes, spraying with large amounts of herbicides, or otherwise destroying the native prairie character of the easement area." Minn. Stat. sec. 84.96, subd. 4(2). In addition to imposing limitations on how the land may be used, Native Prairie Bank easements expressly authorize the DNR to undertake management activities such as prescribed burns on

the prairies.

The Native Prairie Bank Program is administered by DNR's Division of Ecological and Water Resources as part of the Scientific and Natural Areas Program. Land eligible for inclusion in the Native Prairie Bank often meets the criteria for designation as a state scientific and natural area. Native Prairie Bank easements typically contain a provision authorizing the Commissioner to designate and post the land subject to the easement as a scientific and natural area. To date, however, this has only occurred on lands subject to Native Prairie Bank easements that the DNR later acquired in fee title.

Moulton 10-1 Native Prairie Bank Easement
Murray County

DNR acquired its first Native Prairie Bank easement in 1988. Since that time, it has acquired over 100 Native Prairie Bank easements and continues to actively protect privately-owned native prairie with this land protection tool.

Northern Pike Spawning (NPS) Easements

Northern Pike Spawning easements are a type of flowage easement. They authorize DNR to flow and reflow specified areas with water and to otherwise conduct activities required for the operation of Northern Pike Spawning areas.

DNR holds a total of 38 Northern Pike Spawning easements. Ten of DNR's Northern Pike Spawning easements meet the statutory definition of "conservation easement." In addition to permitting DNR to flow and reflow the specified areas with water, these easements prohibit erecting structures or buildings and activities such as excavation, filling, dumping and tree cutting in order to protect the fish spawning habitat.

DNR's Fisheries Section does not intend to acquire additional Northern Pike Spawning easements that meet the definition of "conservation easement."

Scientific and Natural Area (SNA-Conservation) Easements

State scientific and natural areas are one of the units that comprise Minnesota's Outdoor Recreation System. The purpose of a scientific and natural area is "to protect and perpetuate in an undisturbed natural state those natural features which possess exceptional scientific or educational value." Minn. Stat. sec. 86A.05, subd. 5. The Commissioner of Natural Resources may designate as a scientific and natural area lands that satisfy specific criteria set forth in the Outdoor Recreation Act by written order published in the State Register.

Minnesota Statutes section 84.033, subd. 1 authorizes the Commissioner to acquire "by gift, lease, easement, or purchase" lands that are "suitable and desirable for establishing and maintaining scientific and natural areas." While most of Minnesota's scientific and natural areas are on lands that the DNR has acquired in fee title, a number of them are on lands owned

by others that have either been leased to DNR or on which DNR holds conservation easements.

For purposes of DNR's easement inventory, any conservation easement (except Native Prairie Bank easements) that references the state's intent to establish and designate the property as a scientific and natural area is considered an "SNA-Conservation" easement.

DNR will likely acquire additional SNA-Conservation easements in the future.

Trout Stream Easements

The Minnesota Department of Conservation, predecessor of the Minnesota DNR, began acquiring Trout Stream easements as early as 1940. These early easements were for the purposes of providing angler access and authorizing staff to conduct habitat improvement work on the sites. They did not expressly limit how land subject to the easements could be used. Many of the Department's early Trout Stream easements were for 25-year terms, but others were permanent.

Hay Creek Trout Stream Easement
Goodhue County

In the late 1960's and early 1970's, the Department began acquiring permanent Trout Stream easements that not only provide angler access and authorize staff to improve habitat on the sites, but also impose limitations on land use. These easements prohibit new structures and require the landowner to cooperate in the maintenance and enhancement of fishing in the easement area by doing no excavating, filling, dumping, tree cutting, burning or changing the stream course. Some Trout Stream easements, particularly those on streams in Southeastern Minnesota and in other agricultural areas, also prohibit new tillage within a specified distance from the stream. Most provide that the easement area is 66' from the centerline of the stream on the side or sides of the stream subject to the easement. These Trout Stream easements impose limitations on how the land may be used and thus meet the definition of "conservation easement" in Minn. Stat. sec. 84C.01(1).

DNR purchases many of its Trout Stream easements. Since 2002, the purchase price has been determined by a formula set forth in Minn. Stat. sec. 84.0272, subd. 2 rather than by appraisal. Other Trout Stream easements are acquired by gift or are conveyed to DNR by the Commissioner of Revenue upon the sale of tax-forfeited land in accordance with Minn. Stat. sec. 282.37.

All of DNR's existing Trout Stream easements that meet the definition of "conservation easement" are on designated trout streams under Minn. Stat. sec. 97C.005. Most are located in the driftless area of Southeastern Minnesota and in the Lake Superior Watershed.

The Fisheries Section of the Division of Fish and Wildlife administers all of DNR's Trout Stream easements. DNR continues to acquire Trout Stream easements, primarily through purchase and sales

of tax-forfeited land.

Water Bank Easements

DNR's Water Bank Program was established in 1976 as part of the public waters inventory. Minn. Laws 1976, ch. 83, sec. 9. Its purpose was to compensate certain landowners who were no longer allowed to drain wetlands on their properties. Landowners were entitled to compensation under the Water Bank Program if drainage of a wetland on their property was "lawful, feasible, and practical" and, if drained, the wetland "would provide high quality cropland." Minn. Laws 1976, ch. 83, sec. 9, subd. 2.

Initially, the Water Bank law authorized DNR to offer term-limited agreements to landowners in lieu of granting drainage permits. Under the agreements, landowners received annual payments. In 1990, the Legislature amended and recodified the Water Bank Program statute and substituted conservation easements for the term-limited agreements. Minn. Laws 1990, ch. 391, sec. 76 (codified as Minn. Stat. sec. 103F.601). The easements had to be for a minimum of 20 years, but could be permanent. Landowners received a one-time payment for granting the state a Water Bank easement.

In accordance with the authorizing statute, Water Bank easements prohibit draining, burning, filling, other destruction the wetland character of the areas, or use of them for agricultural purposes. Most of the easements negotiated by DNR under the Water Bank Program were for 20-year terms. All but five of the term-limited easements have expired and the remaining ones will all expire over the next two years. Twenty-one of DNR's Water Bank easements are permanent.

Aside from DNR's ongoing stewardship of existing Water Bank easements, the Water Bank Program is now defunct. The DNR has not acquired any Water Bank easements since 1992.

Wild and Scenic River (WSR) Easements

The Minnesota Wild and Scenic Rivers Act and the Lower St. Croix Wild and Scenic River Act became law in 1973. These laws are now codified as Minn. Stat. secs. 103F.301 – 103F.345 and 103F.351, respectively.

S12 Wild & Scenic River Easement
Sherburne County

The Minnesota Wild and Scenic Rivers Act is a state corollary to the federal Wild and Scenic Rivers Act of 1968. It was designed to create a system under which certain Minnesota rivers would be designated as wild, scenic or recreational in order to retain their "outstanding scenic, recreational, natural, historical, scientific and similar values." Minn. Stat. sec. 103F.305.

By enactment of the Lower St. Croix Wild and Scenic River Act, the state recognized and concurred with 1972 federal designation of the Lower St. Croix as a Wild and Scenic River, provided legal authority for the state's joint management of the river with the

United States Department of the Interior and the State of Wisconsin and provided for protection of the river's scenic and recreational qualities through zoning and other means.

Both the Minnesota Wild and Scenic Rivers Act and the Lower St. Croix Wild and Scenic River Act authorize the Commissioner of Natural Resources to acquire scenic easements, which are defined in Minn. Stat. sec. 103F311, subd. 6 as "an interest in land, less than fee title, that limits the use of the land to protect the scenic, recreational, or natural characteristics of a wild, scenic, or recreational river area." Under the Minnesota Wild and Scenic Rivers Act, the Commissioner may acquire these easements "by purchase, grant, gift, devise, exchange . . . or other lawful means" in order to implement the Wild and Scenic Rivers system. The Lower St. Croix Wild and Scenic Rivers Act authorizes the Commissioner to acquire scenic easements by "gift, purchase, or other lawful means" and also by eminent domain. Minn. Stat. sec. 103F.351, subd. 3.

Portions of six rivers have been designated under the Minnesota Wild and Scenic Rivers Act: the Cannon, the North Fork of the Crow, the Minnesota, the Mississippi, the Kettle and the Rum. The DNR has acquired one or more scenic easements on each of these rivers and also holds scenic easements on the federally designated Lower St. Croix River. All of DNR's scenic easements were acquired between 1976 and 1988, with the exception of a donated easement on the Mississippi, which the DNR accepted in 2002. None of the easements authorize public access. DNR classifies the scenic easements it holds on designated wild and scenic rivers as "Wild and Scenic River" easements.

What is the difference between a "scenic easement" and a "conservation easement"?

The Minnesota Wild and Scenic Rivers Act and the Lower St. Croix Wild and Scenic River Act were enacted 12 years before Minnesota's conservation easement law, Minn. Stat. ch. 84C. The definition of "conservation easement" in section 84C.01(1) of the conservation easement law includes interests in land that limit how the land may be used in order to protect natural or scenic values of real property. Scenic easements acquired under the Minnesota Wild and Scenic Rivers Act and Lower St. Croix Wild and Scenic River Act are for the purpose of protecting natural and scenic values of the wild and scenic river areas. These easements therefore clearly meet the definition of and are a type of "conservation easement."

There is one important difference between scenic easements and conservation easements authorized under Minnesota's conservation easement law. The conservation easement law restricts the right to enforce an easement to the easement holder or to a person having a third-party right of enforcement. Minn. Stat. sec. 84C.03(2) & (3). The Minnesota Wild and Scenic Rivers Act grants more expansive enforcement rights for scenic easements. Unless the scenic easement otherwise provides, the Wild and Scenic Rivers Act provides that a scenic easement is enforceable "by its holder *or any beneficiary*." In a Washington County court case against a scenic easement landowner, the court determined that this means a member of the public has the authority to enforce a scenic easement.

The Wild and Scenic Rivers Program has been administered by various DNR divisions and units since its inception, including the Division of Parks and Recreation, Office of Planning, Bureau of Real Estate Management, Division of Waters and Division of Trails and Waterways. The Scenic Easements Program is currently administered by the Division of Parks and Trails. The DNR does not have an active acquisition program for Wild and Scenic River easements.

Other Conservation

DNR holds 48 miscellaneous conservation easements that do not meet the definition of any of the 12 specific types described above. The easements have been classified and coded in DNR's land records system as "Other Conservation." Four DNR divisions administer these easements: (1) Ecological and Water Resources; (2) Fish and Wildlife; (3) Forestry; and (4) Parks and Trails. In addition, DNR's Northwest Regional Operations administers one easement classified as "Other Conservation."

Division of Ecological and Water Resources

Non-Game Wildlife Program

The DNR's Non-Game Wildlife Program administers four "Other Conservation" easements. These easements were all donated to the DNR in 1992 and were for the purpose of protecting a bat hibernaculum in the St. Cloud storm sewer system. The newspaper clipping below shows a portion of the hibernaculum. Prof. Harry Goering, a former St. Cloud State University professor who studied the bat population in the hibernaculum for decades, is pictured.

Harry Goehring (left) furnishes light inside the storm sewer while a St. Cloud faculty associate, Dr. Max Partch, pries a bat from between granite blocks. Partch was one of 12 persons, including children of faculty members, who helped Goehring with his bat project during the past year. Authorities around the world—even behind the Iron Curtain—are interested in Goehring's bat study.

SNA Program-Administered "Other Conservation" Easement, Goodhue County

SNA Program-Administered Easements

In addition to the SNA-Conservation easements described above, the Scientific and Natural Areas Program administers four "Other Conservation" easements. These easements are adjacent to designated scientific and natural areas and buffer and protect the conservation values of the SNA's. One of the "Other Conservation" easements is on land that was previously owned by the state and conveyed in a land exchange to a nonprofit organization to build and maintain an interpretive center next to the scientific and natural area. Another was conveyed to the DNR in the same instrument that conveyed a separate SNA-Conservation easement over a distinct parcel of land. Unlike the SNA-Conservation easements, the four "Other Conservation" easements administered by the SNA Program do not contain language indicating that the state intends to establish scientific and natural areas on these lands.

Division of Fish and Wildlife

Fisheries Section-Administered Easements

The Fisheries Section administers five "Other Conservation" easements. All of these easements protect shoreland but are not within designated aquatic management areas. One of the easements protects 78.8 acres of land along the Mississippi River. Three of the easements, all in Douglas County, were donated to the DNR in connection with permitting for lakeshore developments and were intended to protect aquatic habitat. None of the "Other Conservation" easements administered by the Fisheries Section provide public access.

DNR does not currently have plans to acquire additional conservation easements of this type.

Wildlife Section-Administered Easements

Most DNR easements classified as "Other Conservation" are administered by the Wildlife Section of DNR's Division of Fish and Wildlife. These easements have various origins, which include acquisition for non-game wildlife protection, acquisition for designation and use as wildlife management areas, retention in land exchanges and land sales and acquisition to improve and protect wildlife habitat.

The Wildlife Section is not actively pursuing acquisition of conservation easements at this time, but may acquire them to meet future conservation goals.

Wildlife Section-Administered "Other Conservation" Easement," Becker County

Division of Forestry

The Division of Forestry administers two easements classified as "Other Conservation." Both of the easements were acquired in the 1990's before Minnesota joined the federal Forest Legacy Program. One easement was assigned to DNR by a non-profit organization. The other was donated to DNR.

Division of Parks and Trails

The Division of Parks and Trails holds three conservation easements classified as "Other Conservation." Two are within state park boundaries. The other easement is on land adjacent to a state park.

The Division of Parks and Trails does not currently have plans to acquire additional miscellaneous conservation easements.

Northwest Regional Operations

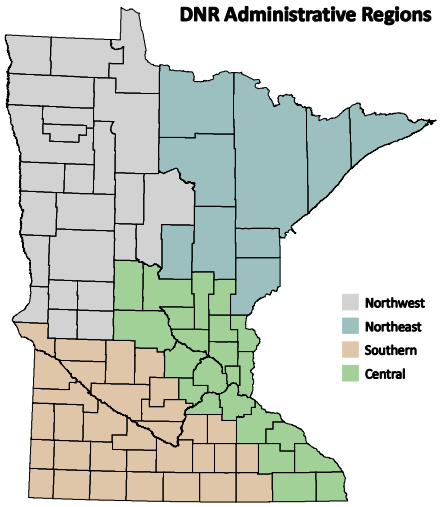
Northwest Regional Operations is the designated administrator of one conservation easement classified as "Other Conservation." DNR retained this conservation easement in a private sale of surplus land authorized by Minn. Laws 2007, ch. 131, art. 2, sec. 14.

Easement Inventory Results

The results of this project's easement inventory are summarized in the tables below. The results include DNR's conservation easement acquisitions through February 25, 2011.

STATEWIDE INVENTORY RESULTS

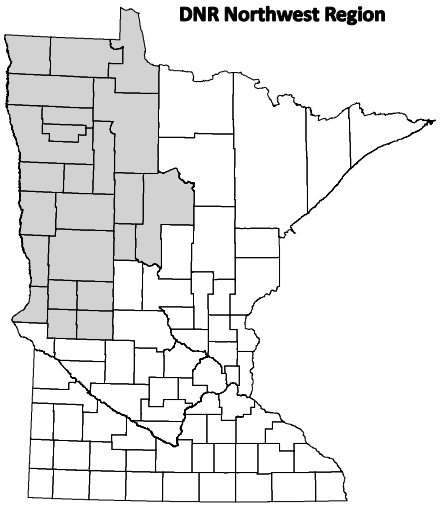
CONSERVATION EASEMENTS STATEWIDE BY TYPE		
EASEMENT TYPE	**NUMBER OF EASEMENTS**	**ACRES**
ACUB (Fisheries)	1	57.2
ACUB (Forestry)	1	42.82
ACUB (Wildlife)	3	548.84
Aquatic Management	10	263.13
Cave (Parks)	2	218.5
Other Cons. (Administrator not designated)	5	46.29
Other Cons. (Eco/Waters)	8	108.68
Other Cons. (Fisheries)	5	87.2
Other Cons. (Forestry)	2	607.54
Other Cons. (NW Regional Ops)	1	31.61
Other Cons. (Parks & Trails)	3	188.64
Other Cons. (Wildlife)	22	1964.21
Forest Legacy	32	135937.35
Forests for the Future	3	195952.42
Metro Greenways	16	668.57
Northern Pike Spawning	10	109.21
Native Prairie Bank	96	7719.09
SNA	18	1409.24
Trout Stream	576	4395.79
Water Bank	26	1427.99
Wild & Scenic River	134	3838.26
Total	**974***	**355622.58**



CONSERVATION EASEMENTS STATEWIDE BY REGION		
DNR REGION	**NUMBER OF EASEMENTS**	**TOTAL ACRES**
Northwest	119	6796.62
Northeast	237	329877.12
Central	462	10357.76
Southern	156	8591.08
Total	**974***	**355622.58**

* Seven conservation easements on properties that DNR subsequently acquired in fee title are presumed to have merged with the fee title and been extinguished. (See Part II.B below.) These conservation easements are excluded from the final inventory results.

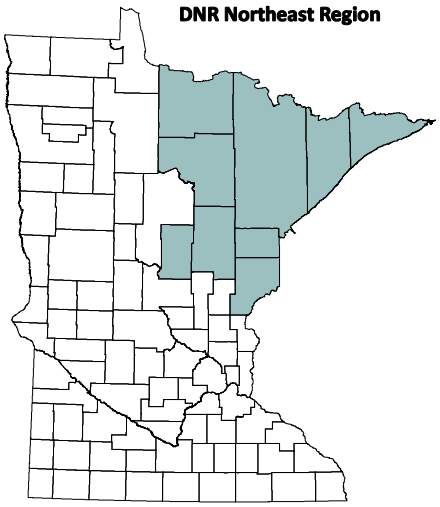
NORTHWEST REGION INVENTORY RESULTS



CONSERVATION EASEMENTS BY TYPE		
TYPE	**NUMBER**	**ACRES**
Aquatic Management	1	6
Other Cons. (Fisheries)	4	8.4
Other Cons. (NW Regional Ops)	1	31.61
Other Cons. (Wildlife)	7	678.72
Forest Legacy	1	1634.7
Forests for the Future	partial	800
Northern Pike Spawning	1	6.3
Native Prairie Bank	21	2874.91
SNA	1	160
Trout Stream	79	471.59
Water Bank	3	124.39
Total	**119**	**6796.62**

CONSERVATION EASEMENTS BY COUNTY		
COUNTY	**NUMBER**	**ACRES**
Becker	13	296.23
Beltrami	10	737.17
Cass	11	1813.61
Clay	5	998.23
Clearwater	7	192.76
Douglas	6	606.66
Grant	4	320.47
Hubbard	38	238.48
Marshall	1	470
Norman	1	34.5
Otter Tail	4	356.19
Pennington	2	116.09
Pope	2	87.5
Red Lake	1	49.1
Traverse	4	221.1
Wadena	6	39.93
Wilkin	4	218.6
Total	**119**	**6796.62**

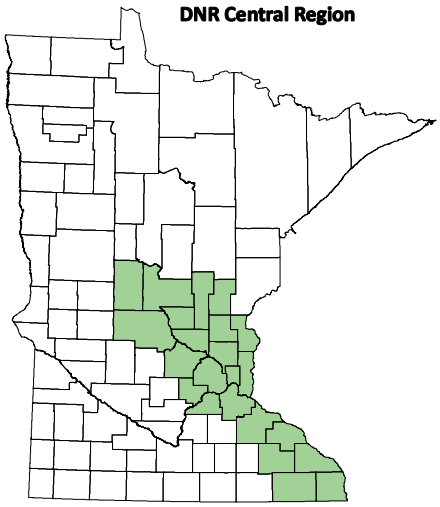
NORTHEAST REGION INVENTORY RESULTS



CONSERVATION EASEMENTS BY TYPE		
TYPE	**NUMBER**	**ACRES**
ACUB (Fisheries)	1	57.2
ACUB (Wildlife)	2	233.84
AMA	7	250.55
Other Cons. (EWR)	1	27.5
Other Cons. (Fisheries)	1	78.8
Other Cons. (Forestry)	1	473.16
Other Cons. (Administrator not designated)	5	46.29
Other Cons. (Wildlife)	3	262.27
Forest Legacy	9	131268.09
Forests for the Future	3	195152.42
SNA	2	242
Trout Stream	171	938.44
Wild & Scenic River	31	846.56
Total	**237**	**329877.12**

CONSERVATION EASEMENTS BY COUNTY		
COUNTY	**NUMBER**	**ACRES**
Aitkin	11	5013.95
Carlton	10	58.92
Cook	13	416.4
Crow Wing	18	3757.19
Itasca	7	168374.30
Koochiching	4	120559.33
Lake	32	6501.51
Pine	42	933.31
St. Louis	100	24262.21
Total	**237**	**329877.12**

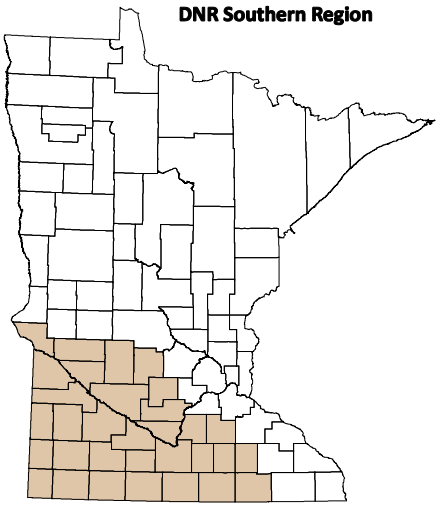
CENTRAL REGION INVENTORY RESULTS



CONSERVATION EASEMENTS BY TYPE		
TYPE	NUMBER	ACRES
ACUB (Forestry)	1	42.82
ACUB (Wildlife)	1	315
AMA	2	6.58
Cave (Parks)	2	218.5
Other Cons. (EWR)	6	17.27
Other Cons. (Forestry)	1	134.38
Other Cons. (PAT)	2	51.44
Other Cons. (Wildlife)	6	819
Forest Legacy	5	1907.45
Metro Greenways	16	668.57
Native Prairie Bank	4	146.48
North. Pike Spawning	2	28.2
SNA	14	767.94
Trout Stream	311	2895.4
Water Bank	10	667.4
Wild & Scenic River	79	1671.33
Total	**462**	**10357.76**

CONSERVATION EASEMENTS BY COUNTY		
COUNTY	NUMBER	ACRES
Anoka	5	274.78
Benton	3	48.65
Carver	2	227.37
Dakota	1	25
Fillmore	119	1388.28
Goodhue	26	810.72
Hennepin	6	238.82
Houston	55	485.03
Isanti	44	1058.76
Mille Lacs	9	101.19
Morrison	5	684.82
Olmsted	14	203.56
Ramsey	4	221.4
Scott	8	256.54
Sherburne	4	194.18
Stearns	27	447.83
Wabasha	27	2143.39
Washington	29	727.49
Winona	70	722.13
Wright	4	97.82
Total	**462**	**10357.76**

SOUTHERN REGION INVENTORY RESULTS



EASEMENTS BY TYPE		
TYPE	**NUMBER**	**ACRES**
Other Cons. (EWR)	1	63.91
Other Cons. (PAT)	1	137.2
Other Cons. (Wildlife)	6	204.22
Forest Legacy	17	1127.11
NPS	7	74.71
NPB	71	4697.70
SNA	1	239.3
Trout Stream	15	90.36
Water Bank	13	636.2
WSR	24	1320.37
Total	**156**	**8591.08**

EASEMENTS BY COUNTY		
COUNTY	**NUMBER**	**ACRES**
Big Stone	7	770.08
Blue Earth	4	46.06
Brown	12	326.97
Cottonwood	10	415.41
Faribault	1	25.9
Freeborn	1	17.5
Jackson	7	415.55
Kandiyohi	2	81.81
Lac Qui Parle	7	593.21
LeSueur	5	592.61
Lyon	3	218.41
McLeod	2	27.7
Meeker	34	1403.49
Murray	10	909.33
Nicollet	2	165.5
Nobles	1	18.7
Pipestone	2	400.96
Redwood	9	207.31
Renville	1	29.7
Rice	22	1294.18
Swift	3	93.6
Waseca	2	88.82
Watowan	2	90.6
Yellow Medicine	7	357.68
Total	**156**	**8591.08**

The Inventory Process

Background. DNR's Division of Lands and Minerals is the repository for documentation of DNR -administered real property interests held by the State of Minnesota. Lands and Minerals maintains paper copies of deeds and easements in DNR's Central Office in St. Paul. (Original real property records are filed with recorders' offices in the counties where the real property is located.) DNR's copies of the deeds and easements are filed by county. The records for each county are organized in alphabetical folders, which include folders for specific programs or project types.

In the 1980's, a land records system (computer database) was developed to track DNR-administered land and mineral interests. A decision was made not to enter data about easement interests when the system was first implemented because of the system's limited data storage capabilities. When data storage capacity was added to the system, Lands and Minerals staff began entering data for newly acquired easements. As funding and staffing allowed, Lands and Minerals later began efforts to capture easement data for older easement records but was not able to complete this process with existing resources.

When LCCMR funded this project, data for older easements in more than half of Minnesota's counties had not been entered into the land records system, and the easement data already entered had never been systematically reviewed for accuracy. Moreover, DNR had not yet developed a comprehensive conservation easement coding schema at the time some easement data had been entered. Accordingly, many conservation easements were coded in the system simply as "conservation easement" but not by specific type (e.g., Native Prairie Bank). The incomplete conservation easement dataset and lack of precise coding made it impossible for DNR to use the land records system as a source for accurate information or reports about its conservation easements. To ensure that DNR's land records system contained complete and accurate data about every conservation easement, project staff needed to review every deed and easement housed in the Division of Lands and Minerals, to compare the document with previous entries into the system, and to update the system with any missing information or corrections.

Coding. The first step (and one of the deliverables) of this project was to develop a conservation easement coding schema for DNR's land records system. The purpose of the coding schema is to accurately track conservation easement data in the system, to enable users to query the system and to produce reports about DNR's conservation easements. Lands and Minerals staff already had a fairly detailed conservation easement coding schema in place before this project began. Project staff further developed the coding schema by refining criteria for application of specific codes, by adding new codes for two types of easements (Army Compatible Use Buffer and Minnesota Forests for the Future easements) and by changing the existing code "Conservation" to "Other Conservation."

Project staff also worked with Lands and Minerals information technology staff to re-program the land records system to add a new field (called the "84C field") that flags all of DNR's easements that meet the definition of "conservation easement" in Minn. Stat. sec. 84C.01(1). This was necessary, as DNR historically used three easement type codes (Aquatic Management Area (AMA), Northern Pike Spawning (NPS) and Trout Stream) for both conservation easements and other easements that are for similar purposes but do not meet the definition of "conservation easement." The 84C field enables DNR staff to limit queries of the system about AMA, NPS and Trout Stream easements to only AMA, NPS and Trout Stream easements that are conservation easements.

Records review and data entry. Two project analysts hired for this project systematically read every deed and easement maintained by the Division of Lands and Minerals (totaling about 17,000 documents), collected information from those that conveyed or retained an easement interest and entered the information into the land records system. Pertinent data that were entered included: easement type, DNR administrator, project code, acreage, means of acquisition, document type, DNR document numbers, recorded county document numbers and geocodes. Project analysts also entered data about DNR's lands held in fee title that are subject to conservation easements, conservation restrictions, reserved rights or reversionary interests held by others.

What is a geocode?

A geocode identifies the geographic location of real property in terms of the Public Land Survey (PLS). The PLS identifies a location by the Township, Range, Section, Forty and/or Government Lot identified in the legal description. A "Forty" is the smallest unit used in the PLS and also in DNR's land records system. The "Forty" is also the standard unit used in county records tracking systems. The project analysts entered data for each easement document according to the geocodes to the "Forty" level. DNR's land records system requires creation of a data "record" for each Forty-level interest in land. Accordingly, depending on the number of Forties conveyed by a particular instrument, the project analysts were required to create one or more records.

Acreage Calculations. As part of DNR's current land acquisition process, the Survey Unit of the Division of Lands and Minerals creates "geocode sheets" based on legal descriptions of lands or easements that DNR acquires. These geocode sheets list the Public Land Survey (PLS) parcels and associated acreages for each Forty or Government Lot as derived from the legal description. Lands and Minerals staff enter the data on the geocode sheets into the land records system.

The geocode-sheet procedure was not in place when DNR acquired many of its conservation easements. Accordingly, project analysts either entered acreages from conveyance documents, calculated acreages for easements where the acreages were not specified in conveyance documents or, in the case of complex legal descriptions, worked with the Survey Unit to determine the acreages. For some Trout Stream easements, a placeholder acreage of 0.01 was entered into the land records system instead of an actual acreage calculation. This was necessary because stream courses change over time and legal descriptions for some of DNR's Trout Stream easements convey an easement interest in a stream corridor in a PLS Forty or Government Lot where the stream does not currently flow. The placeholder acreage in the land records system indicates that the state has an interest in those particular parcels although the acreage is not known.

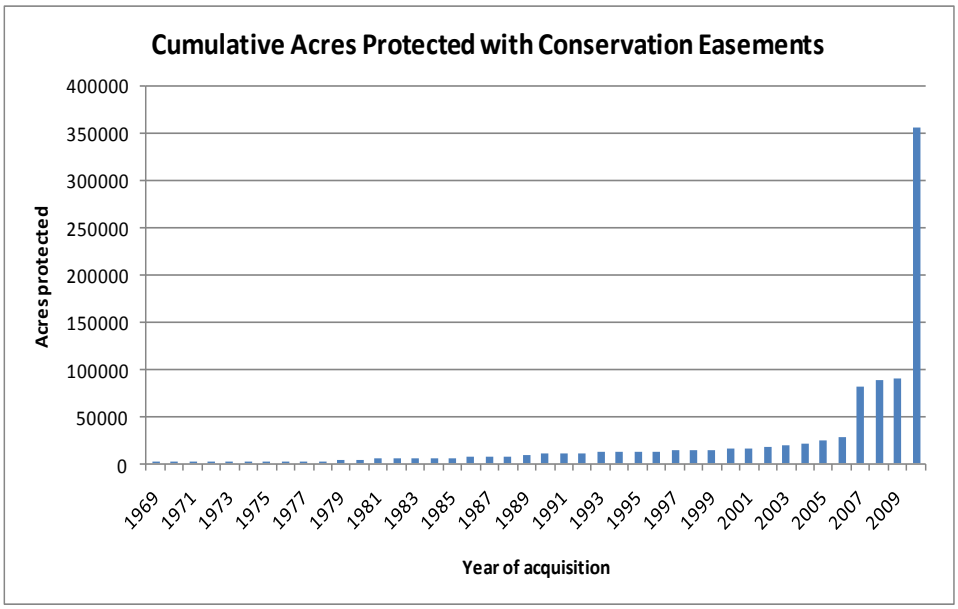
Quality control. After the project analysts reviewed all records for a county and updated the land records system, they used validation procedures to check data entry accuracy. In addition, following completion of documents review and data entry for an entire DNR region, the project analysts checked each other's work to make sure every easement interest in that particular region had been captured.

Project staff reconciled the Division of Lands and Minerals data with paper records, Access or GIS databases or Excel spreadsheets of conservation easements maintained by other DNR divisions and programs. Project staff also distributed spreadsheets of the inventory results to DNR's regional managers for accuracy review.

Uses of the Conservation Easement Dataset

Reporting. The easement data entered into the land records system in this project produced a comprehensive dataset that can be used to answer numerous questions about state-owned, DNR-administered conservation easements. DNR staff can consult this dataset to view the attributes (such as easement type, DNR administrator, location, acreage) of specific conservation easements or to create reports that aggregate easement data by one or more attributes.

Graphs. Data from the system also enables DNR to produce graphs that illustrate facts about DNR's conservation easements. The graph below was developed from conservation easement acquisition data from the system to show how the acreages of conservation easements held by DNR have increased over time.



Mapping. In collaboration with Division of Lands and Minerals Geographic Information Systems (GIS) staff, the project analysts produced a map layer within DNR's GIS system that allows mapping of conservation easement data to the PLS Forty/Gov't Lot level. The layer, entitled "State Conservation Easements—MS Chapter 84C," includes all easements that have been determined to meet the statutory definition of conservation easement under Minnesota Statutes chapter 84C. The conservation easement layer is available for all DNR staff who are ArcGIS users and can be used to access information about DNR's conservation easements or to create maps. The information in the map layer is regularly updated as new information is entered into the land records system. Sample maps that were created from the layer are found on pages 1-6 of the Appendix to this report. These maps depict conservation easements in three Minnesota counties by type and by administrator.

The general public can gain access to the map layer through the DNR's Data Deli. However, the layer currently exists in shapefile format for use in ESRI GIS applications such as ArcView or ArcGIS. It is recommended that users be sufficiently familiar with this data format and basic navigation in ESRI software to view and use the data. In the future, DNR intends to create a web-based application that will allow any Internet user to access the conservation easement layer.

PART II: CONSERVATION EASEMENT STEWARDSHIP PLAN

A. Integration of Conservation Easement Stewardship Plan with DNR's New Land Records System

In May 2009, DNR entered into a contract with International Land Systems (ILS) to design and build a new land records system (LRS). The new system will replace the current land records system, the mineral rights information system, and related systems to better support real property management processes and strategic resource planning and management. By integrating workflow and document management technology, geographic information system technology, data exploration technology, and other tools, the new system will enable DNR employees agency-wide to easily access reliable and current information and enable the DNR to provide the general public greater access to information about DNR's land records.

An integral part of DNR's Conservation Easement Stewardship Plan is the incorporation of an application that ILS is building for the new LRS for administering and monitoring conservation easements. This application, in conjunction with the other components of the new LRS, will provide DNR with state-of-the art technological tools to support conservation easement stewardship agency-wide. Its record-keeping functions will ensure that key documents and data relating to DNR's conservation easements will be maintained in a centralized location and be easily accessible to staff statewide. Its data exploration technology will enable DNR to easily track its conservation easement stewardship, to measure results and to generate reports about easement stewardship outcomes.

Key components and uses of the new LRS and conservation easement application for conservation easement stewardship are described below.

Conservation Easement Acquisition and Drafting. As part of the new LRS's acquisition workflow, information about a conservation easement being acquired will be entered into the system. Such information will include legal description, associated geocodes, grantor's name and contact information and terms and conditions of the easement. Information entered into the system will populate a template for drafting the conservation easement conveyance document by which the easement is acquired. The information will also be used to populate other system-generated documents described below.

The system will also be used with existing conservation easements. Much of the relevant data for these easements has been entered into DNR's existing land records system and will be migrated to the new system. Other data relating to existing easements (e.g., current landowner names and contact information and easement terms) will be collected and entered into the new LRS.

Baseline Property Reports. The preparation of baseline property reports for new conservation easements will be built into the acquisition workflow. The system will use acquisition data entered about the proposed conservation easement to partially populate a baseline property report template. (Prototypes of two baseline property report templates (one for Trout Stream easements, the other for use with other easement types), which were created as part of this project, are included on pages 8-26 of the Appendix to this report.) The acquisition coordinator and other program staff will gather the appropriate baseline data for the conservation easement and will complete the report. As part of the process, DNR's Survey Unit will prepare a shapefile (either from a survey or from the legal description if

no survey takes place), which will be used for baseline property report maps and stored in the system for monitoring and other future uses. Upon completion of the acquisition process, the baseline property report will be signed by both the DNR and the landowner. A scanned copy of the signed baseline property report will be stored in the LRS using the system's electronic documents management function and will be easily accessible to future easement monitors and other DNR staff.

The system will also be used to prepare baseline property reports for DNR's existing conservation easements that are lacking baselines. Baseline property reports that have already been completed will be scanned and stored in the LRS.

Conservation Easement Monitoring Application. The monitoring application within the LRS is designed to both generate easement-specific monitoring forms that are pre-populated with information stored in the system and to allow staff to record the results of monitoring.

A periodic monitoring schedule will be established for the conservation easement by the administering division or unit and will be incorporated into the LRS's calendaring function. The LRS will notify the monitor (and any monitoring coordinator) in a timely manner so the monitoring event can be scheduled into the appropriate field season planning cycle. Information supplied to the system from both the acquisition process and the baseline report will be pre-populated on a monitoring form template for the monitor to use during the monitoring event. Two monitoring form templates, created as part of this project, have been included in the system, one specific to the unique needs of Trout Stream easement monitoring and one more generic form to be used to monitor other conservation easements. (Examples of these forms are included on pages 27-33 of the Appendix to this report.) Forms will contain the terms and conditions of the specific easement to ensure that monitors evaluate all relevant terms for compliance.

The new system will allow information collected during the monitoring event to be directly entered into the LRS by the monitor, including a summary and the result (i.e., in compliance or not in compliance). A workflow process incorporated into the LRS provides for supervisory approvals of the completed monitoring form. Should the results of a monitoring event show that there are compliance issues, the workflow process has procedures for directing resolution either on system or off system. Resolution and enforcement actions accomplished off system will have associated documents such as correspondence, notices, e-mails, or copies of court orders scanned and attached to the specific easement through the LRS's electronic documents management function.

Electronic Documents Management. The electronic documents management function of the new land records system will facilitate the preparation, storage and retrieval of documents relevant to each conservation easement. Staff will be able to scan and associate correspondence, maps, photos, complaints and landowner contacts and other information for storage in the system. This function will also facilitate the production of routine forms, letters and documents such as periodic letters to landowners by pre-populating templates with information (e.g., landowner name and address) from the system.

B. Agency-Wide Conservation Easement Stewardship Plan

Stewardship Goals. The ultimate responsibility of the DNR's conservation easement stewardship program is to preserve the conservation values associated with each property protected by an

easement. DNR's conservation easement stewardship goals are to:

- Encourage voluntary compliance with the terms of DNR's conservation easements.
- Establish and maintain good relationships with landowners.
- Provide professional, timely responses and service to landowners. DNR cannot be successful without working in cooperation with the many landowners dedicated to protecting their lands through conservation easements. DNR respects the commitment made by these landowners and subsequent owners and is dedicated to working with them in a respectful and professional manner.
- Document the condition of lands protected by each easement at the time the easement is acquired and monitor that condition over time.
- Maintain accurate records.
- Be efficient and effective with the use of funds in supporting our stewardship activities.

Baseline property reports. Over the past two decades, it has become the industry standard for a conservation easement holder to a prepare baseline property report for each conservation easement. DNR currently has a significant baseline property report backlog. This is due to several factors: (1) DNR acquired many of its conservation easements before preparation of baseline practice became a standard practice for easement holders; (2) Trout Stream easements, which comprise the largest number of DNR's conservation easements, have been considered primarily as angler access easements in the past and the Fisheries Section did not start preparing Trout Stream easement baselines until 2009; and (3) although DNR has prepared baseline property reports for many of its conservation easements acquired in the past decade, this has not been an agency-wide practice.

What is a baseline property report?

A baseline property report documents, in text, photographs and maps, the conservation values and conditions of a property subject to a conservation easement in relation to an easement's terms. For example, if an easement term prohibits new structures, the baseline property report would document all existing structures on the property. A baseline property report typically includes maps showing the easement's location within a geographic area, the easement's boundary, any reserved building sites and locations of important features of the property. Photographs documenting the property's condition are keyed to photo points on one of the maps included in the report. A baseline property report provides objective information that is used by a monitor to assess compliance with the easement's terms. Accordingly, having a baseline property report for each conservation easement is an integral component of any stewardship program.

Collecting field data for DNR baseline property reports

The following chart shows the DNR's current baseline report backlog by easement type:

Easement Type	Number of Permanent Conservation Easements	Baselines Completed	Baselines Partially Completed
ACUB	5	5	
AMA	10	8	
Cave (Parks)	2	2	
Other Conservation (admin. not designated)*	5	0	
Other Cons. (Eco/Waters)	8	0	
Other Cons. (Fisheries)	5	0	
Other Cons. (Forestry)	2 (1 held in fee by DNR)	1	
Other Cons. (NW Reg. Ops.)	1	0	
Other Cons. (Parks & Trails)	3 (1 held in fee by DNR)	1	
Other Cons. (Wildlife)	19 (1 and part of another are held in fee by DNR)	3	
Forest Legacy	32	32	
Minn. Forests for the Future	3	3	
Metro Greenways	16	8	
NPS	10	0	
Native Prairie Bank	96	17	
SNA	18 (4 held in fee by DNR)	1	
Trout Stream	576	9	6
Water Bank	21	0	
Wild & Scenic River	134	2	38
Total	**966**	**92**	**44**

* These easements will be assigned to one of DNR's existing easement administrators.

Monitoring. Conservation easement monitoring by an easement holder is essential to ensure that the landowner and others are complying with the easement's terms and, ultimately, to ensure that the conservation values of the easement site continue to be protected.

It is the goal of the DNR to monitor all of its conservation easements on a regular basis. The specific monitoring schedule will depend on the easement type and other factors, but will typically include an on-the-ground visit to the conservation easement site every 1–3 years.

Monitoring methods will vary by easement type. For smaller easements, a monitoring visit will usually include a walk-through of the easement site. For larger easements, the on-site visit may include a walk-through of a selected portion of the easement (which will be documented in monitoring records) plus a review of satellite imagery or aerial photography.

Where feasible, landowners will be invited to accompany the monitor on the monitoring visit. However, due to the large number of easements held by DNR and the multiple subdivisions of the lands subject to the easements, it will not always be possible to coordinate monitoring visits with landowners.

Records will be prepared for each monitoring visit. Documentation of suspected violations, including photographs, will be prepared.

Landowner relations. DNR's goal is to assign one staff member to be the primary landowner contact for each conservation easement. The assigned staff member will usually be either the program's monitoring coordinator or the easement monitor.

DNR will contact all easement landowners on at least an annual basis, either by letter, telephone, e-mail or personal visit. The staff member who initiates the contact will typically be the staff member assigned as the primary landowner contact. The contact will be documented and documentation maintained in the new land records system.

DNR will maintain up-to-date records about landowners. Currently, many easement landowners (particularly the Trout Stream easement landowners) are unknown. This project will begin collecting current landowner data from county parcel data between now and June 30, 2011, and this data collection will continue in FY 2012 if the program is funded for FY 2012-13. Once all landowner data are in the land records system, DNR will develop a process for regular updates to the data. This may include a combination of procedures, including annual letters to landowners requesting notice of any updates in ownership or contact information, or linking DNR's new land records system with county parcel data to automatically generate notices of updates.

Record keeping. DNR will maintain key records on each of its conservation easements. These include:

- Conservation easement and any amendments to the easement
- Baseline property report
- Landowner names (current and historic) and contact information
- Management plans
- Records of communications with landowners (letters, telephone calls, e-mails)
- DNR approvals under the easement's terms
- Complaints
- Monitoring records and reports
- Photographs
- Results of enforcement actions

Records will be stored either as electronic data or scanned images in the DNR's new land records system. Some enforcement data (e.g., court filings) may be maintained off system. The final results of any enforcement proceedings and pertinent final records (e.g., court orders) will be documented, scanned and stored in the land records system.

Staffing. DNR will assign staff to perform conservation easement stewardship duties. These duties will be part of staff position descriptions. Regional/area staff will perform easement monitoring to the extent feasible in order to minimize travel.

Each program that administers conservation easements will assign an easement stewardship coordinator, who will be primarily responsible for ensuring that easement monitoring is completed on a timely basis, for handling administrative tasks associated with conservation easements and for addressing any easement violations.

DNR's goal is to provide training to all staff involved in conservation easement stewardship.

The training will cover all aspects of conservation easement stewardship, including preparing baseline property reports, monitoring, landowner relations, record keeping and use of DNR's new land records system for conservation easement stewardship.

Easement enforcement. DNR must be prepared to address violations of its conservation easements. Whenever possible, the DNR will work with the landowner or third party responsible for the violation to have the landowner or third party correct the situation without further action by the DNR.

DNR's goal is develop agency-wide protocols for conservation easement enforcement. These protocols will ensure that violations are handled promptly and fairly and that consistent enforcement standards are maintained across programs and divisions. The protocols will provide guidance to staff who monitor conservation easements or supervise easement monitoring about:

- Documenting violations
- Communicating with landowners about suspected violations
- Reporting suspected violations to management
- Negotiating with landowners
- Preparing agreements to resolve violations
- Follow-up procedures to ensure that violations are resolved

Under existing law, conservation easement violations that cannot be resolved can only be addressed through civil legal actions filed in the district court in the county where the conservation easement is located. Any legal action to enforce a conservation easement requires approval by both the Commissioner of Natural Resources and the Attorney General's Office.

Funding. DNR's goal is to seek adequate funding to be able to meet its conservation easement stewardship obligations. Potential funding sources are discussed in Part III.

Lands Acquired in Fee Title Subject to Conservation Easements. DNR holds 14 conservation easements on properties that it also holds in fee title. These easements fall into two categories: (1) easements that are presumed merged with the fee title and extinguished; and (2) easements that are presumed not to have merged. There are seven easements in each of these categories.

Conservation Easements Presumed Merged: Seven of the easements where the land was subsequently acquired by DNR in fee title are presumed merged with the fee title (and extinguished) according to advice from the Attorney General's Office. Neither the easements nor deeds express the grantors' intent that the conservation easements not merge upon DNR's acquisition of the properties in fee title. Under the doctrine of merger, a conservation easement merges into fee title upon acquisition by the conservation easement holder unless the grantor expresses the intent that merger not occur. These easements presumed merged are not included in the inventory results in Part I.

Conservation Easements Presumed Not Merged: DNR also holds both conservation easements on and fee title to six properties where the grantors have expressed their intent (either in the easement, the deed, or both) that the conservation easements not merge into the fee titles. The Attorney General's Office has advised DNR to consider such conservation easements not to have merged. By a court order distributing an estate, DNR was also granted fee title to a property in Beltrami County subject to conservation restrictions. These conservation restrictions are also presumed to remain in ef-

fect.

DNR will not monitor these for easement compliance so long as it remains fee holder of the properties. However, it will incorporate the easement's terms into its management plan for each of the sites to ensure ongoing compliance with the terms.

The SNA Program's pending request for Environment and Natural Resources Trust Fund funding (discussed below), if approved, would pay for baseline property reports for four of these easements. DNR will not prepare baseline property reports for the other easements at this time. However, if fee title to those properties is ever transferred, DNR will prepare a baseline property report at the time of the transfer and, following the transfer, will monitor the easement in accordance with its stewardship plan for other conservation easements.

Evaluation of conservation easements for possible extinguishment. DNR holds several conservation easements that may provide very limited natural resource protection value or benefit to the public in relation to their potential administrative costs. Most of these easements were either retained in land sales or exchanges (some under laws no longer in effect) or were donated to DNR by developers as a condition of obtaining permits to develop adjacent land. (Since these easements were acquired, DNR has become much more selective in accepting donated conservation easements. It is unlikely that the easements in question would be accepted by DNR under current selection standards.) In connection with initial monitoring visits, DNR will carefully evaluate these easements to determine whether they should be extinguished. DNR will take the following considerations into account:

- Conservation values, including whether any rare resources are protected by the easement
- Public benefit of the easement (e.g., recreational access)
- Administrative/monitoring costs in relation to the property's conservation values
- Risk to conservation values if the easement were extinguished
- Location in relation to other natural resources lands
- Size of the parcel protected by the easement
- Original funding, if any, for DNR to obtain the easement
- If donated, the grantor's intent
- Legal requirements that must be met to extinguish the easement

C. Individual Conservation Easement Stewardship Plans by Administrator or Type

There are four DNR divisions that are each responsible for administering conservation easements of various types. In addition, DNR's Northwest Regional Operations is the administrator for one conservation easement. Three separate divisions administer DNR's ACUB easements and another division is responsible for monitoring these easements. DNR's Metro Greenways easements are administered by the Central Region, but no staff are currently assigned.

Stewardship Plans are organized by administrator and subdivided by easement type. Because of the unique situation of DNR's ACUB and Metro

Greenways easements, separate stewardship plans have been developed for them. Key components of each plan are summarized in the table at the end of Part II.

1. Stewardship Plan: Division of Ecological and Water Resources-Administered Easements

The Division of Ecological and Water Resources (EWR) is the designated administrator for all SNA-Conservation, Native Prairie Bank and Water Bank easements. In addition, the Scientific and Natural Areas Program administers four easements coded as "Other Conservation" and EWR administers DNR's four "Other Conservation" easements that were donated to protect a bat hibernaculum. The total number of existing easements that EWR administers as of the date of this report is 148. The Scientific and Natural Areas Program administers most (117). The Water Bank Program (part of EWR's Conservation Assistance and Regulation Unit) administers 26. The Non-Game Wildlife Program administers DNR's four bat hibernaculum conservation easements.

a. Scientific and Natural Areas Program Plan

The Scientific and Natural Areas Program has a goal of completing baseline property reports for all existing SNA-Conservation, Other Conservation and Native Prairie Bank easements by June 30, 2015, conducting regular monitoring of all easements and engaging in other necessary aspects of easement stewardship (e.g., cultivating landowner relations and communication, and enforcing easements) in the future. The SNA Program currently has only limited funding (and only for Native Prairie Bank easements) that can be used to prepare baseline property reports and for conservation easement stewardship. Pending requests for ENRTF appropriations, if approved, would provide some additional temporary funding but will not enable the SNA Program to completely carry out the plan set forth below. The SNA Program's ability to fully implement its conservation easement stewardship plan is contingent on securing additional funding that can be used for this purpose.

(1) SNA-Conservation and "Other Conservation" Easements

Baseline Property Reports. Of the 22 conservation easements administered by the SNA Program, only one has a completed baseline property report. The SNA Program will complete the baseline property reports for all of these easements by June 30, 2013 if a pending funding request is approved.

The SNA Program's pending proposal to LCCMR (101-D) would include funding to complete baselines for approximately 10 SNA sites on which DNR holds conservation easements. There are three scientific and natural areas that have multiple conservation easements per site. Only one baseline report will be created for each of these sites, but each report will address all conservation easements associated with the site. If the proposal is approved by the Legislature, the appropriation will enable the SNA Program to completely address its baseline report backlog.

Either SNA Program staff or contractors would complete the baseline property reports. The completion date for the baseline property reports in DNR's proposal to LCCMR is June 30, 2013.

Monitoring. SNA Program staff conduct regular visits to most of the Program's conservation easements for land management and ecological monitoring, but the Program has not conducted conservation easement monitoring in the past. The SNA Program will begin regular monitoring of the con-

servation easements in FY 2012.

In order to increase landowner-program relations and for continuity in easement management oversight, the primary easement monitors will be the SNA regional staff who conduct or supervise management activity on the sites. To increase efficiency, easement monitoring by SNA staff will be conducted in conjunction with management visits when feasible. Once regular conservation easement monitoring is established, the SNA Program may enlist volunteer site stewards to assist with monitoring at some SNA sites.

The SNA Program plans to conduct easement monitoring and complete a monitoring form at least once every three years but will contact all landowners at least once annually. If there are issues of concern (e.g., actual or potential violations) on any conservation easement, the SNA Program will monitor the easement more frequently than once every three years until the concerns are fully addressed.

Funding. The SNA Program's pending request for ENRTF funding includes funding to monitor conservation easements at approximately 10 SNA sites. Under the SNA Program's proposal to LCCMR, the monitoring would be conducted by June 30, 2013.

(2) Native Prairie Bank Easements

Baseline Property Reports. The Native Prairie Bank Program began preparing baseline property reports for all newly acquired Native Prairie Bank easements in January 2008. To date, baselines have been completed for a total of 17 Native Prairie Bank easements. Seventy-eight existing Native Prairie Bank easements lack baseline property reports.

In 2010, the Minnesota Legislature appropriated $1,750,000 from the ENRTF to the Scientific and Natural Areas Program. Minn. Laws 2010, ch. 362, sec. 2, subd. 4b. The LCCMR Work Program for this appropriation budgets $47,200 for Native Prairie Bank easement baseline property reports and initial monitoring. The funding will pay for baseline property reports for approximately 13 existing easements acquired with ENRTF funding and for one new Native Prairie Bank easement acquisition. The Native Prairie Bank Program will hire contractors to prepare these baseline property reports. In accordance with the Work Program, these reports must be completed by June 30, 2013.

The Native Prairie Bank Program has a pending request to LCCMR for ENRTF for Native Prairie Stewardship for FY 2012-13, which would include funding to complete baseline property reports for an additional 17 existing Native Prairie Bank easements.

The DNR's proposal to LCCMR requires completion of these reports by June 30, 2013. These baselines would be completed either by Native Prairie Bank Program staff or by contractors. If the Legislature approves this appropriation and no other sources of funds are used for Native Prairie Bank easement baselines, the baseline report backlog for the Native Prairie Bank Program will be reduced to 48 by the end of FY 2013.

Monitoring. Native Prairie Bank Program staff regularly visit most Native Prairie Bank easement sites to conduct prairie management activities. Although Native Prairie Bank Program staff have identified and addressed some easement violations as a result of these management visits, the Program has not formally monitored its easements in the past. The Native Prairie Bank Program will begin regular monitoring of the easements in FY 2012.

The primary easement monitors will be Native Prairie Bank Program regional staff who conduct or supervise prairie management activity on the sites. This will enable the Program to better establish relations with landowners and provide for better management oversight.

The Native Prairie Bank Program will monitor and complete a monitoring form for each easement at least once every three years but will contact the landowners at least once per year. If there are issues of concern (e.g., actual or potential violations) on any NPB easement, the Program will monitor the easement more frequently than once every three years until the concerns are fully addressed.

Funding. As discussed above, the ENRTF appropriation authorized by Minn. Laws 2010, ch. 362, sec. 2, subd. 4b provides funding for the Native Prairie Bank Program to monitor 14 Native Prairie Bank easements by June 30, 2013. The Native Prairie Bank's pending proposal to LCCMR, if approved, would provide funding to monitor approximately 22 Native Prairie Bank easements, including up to 17 existing easements.

Potential sources of additional funding for long-term stewardship of all easements administered by the SNA Program are discussed in Part III of this report.

b. Water Bank Program Plan

DNR currently holds 26 Water Bank easements. Five are 20-year easements, which will all expire in 2011 and 2012. The Division of Ecological and Water Resources administers the Water Bank easements, but has delegated monitoring responsibilities to the Wildlife Section of the Division of Fish and Wildlife.

Baseline Property Reports. None of the Water Bank easements have completed baseline property reports. DNR will complete them for the 21 permanent Water Bank easements, but not for the temporary easements. The Division of Ecological and Water Resources will begin working on the baseline property reports in FY 2012. The Wildlife Section's easement monitors will collect baseline data (e.g., photographs and photo locations) for the reports during annual monitoring visits. The Public

Waters Hydrologist who coordinates administration of the Water Bank easements and other Ecological and Water Resources staff will complete the baseline property reports. The Division of Ecological and Water Resources expects to complete all 21 reports no later than June 30, 2015.

Monitoring. DNR has monitored its Water Bank easements annually for a number of years. Both the Division of Ecological and Water Resources and the Wildlife Section of the Division of Fish and Wildlife participate in coordinating the monitoring. The Public Waters Hydrologist sends an annual letter to each landowner, advising the landowner of the approximate time-period during which an annual monitoring visit will take place. The Wildlife Program Coordinator notifies area wildlife managers to conduct the annual visits. The area wildlife managers, or staff working under their supervision, conduct walk-through monitoring at the easement sites, complete monitoring reports and return them to the Wildlife Program Coordinator. If a violation is detected, the Wildlife Program Coordinator, Area Hydrologist, and the Public Waters Hydrologist participate in addressing the violation.

The Division of Ecological and Water Resources and the Wildlife Section will continue to collaborate in Water Bank easement stewardship and will continue monitoring the Water Bank easements on an annual basis.

Funding. The cost of administering and monitoring DNR's Water Bank easements is shared by the Division of Ecological and Water Resources and the Division of Fish and Wildlife. The Division of Ecological and Water Resources' administrative costs for Water Bank stewardship are part of its operating budget, which is funded largely through appropriations from the general fund. Monitoring expenses and administrative costs incurred by the Wildlife Section are paid out of the game and fish fund as part of the Division of Fish and Wildlife's operating budget. These funding sources will continue to be used for stewardship of DNR's Water Bank easements. General fund and Game and Fish funding will also be used to prepare the baseline property reports.

d. Plan for Bat Hibernaculum Easements

For several decades in the 20th Century, a significant population of bats used a portion of the St. Cloud storm sewer as a hibernaculum. The storm sewer includes a section built from mortar-laid granite blocks that originally served as culverts for streets built over a ravine close to the Mississippi River. This section of the storm sewer contained the hibernaculum. The bats entered the storm sewer from the ravine and hibernated in mortar-free joints and other cracks within the structure. St. Cloud State University professors studied and monitored the hibernaculum for several decades.

In 1992, the DNR acquired as gifts four conservation easements at places along the storm sewer critical to protecting the bat hibernaculum. Unfortunately, not long after the easements were acquired, work performed on the storm sewer damaged the habitat. Some of the crevasses were apparently grouted and part of the sewer that had been used by the bats was walled off. A change to the airflow affected the temperature. After the work on the storm sewer, very few bats were observed in the locations covered by the conservation easements.

The DNR did not pursue any action under the conservation easements at the time the damage to the hibernaculum was discovered. No monitoring of the bat population or of the portions of the storm sewer covered by the easement took place for many years.

DNR's Division of Ecological and Water Resources (EWR) is conducting surveillance of Minnesota bat hibernacula this winter in order to obtain information about white-nose syndrome. EWR staff visited the St. Cloud storm sewer hibernaculum this month to conduct surveillance and observed only two bats hibernating in the site.

EWR staff will review photographs and other information collected during the February 2011 site visit, and will determine whether changes to the site to restore the hibernaculum are feasible. If so, EWR will initiate discussions with the appropriate parties to determine how best to resolve the matter. If restoration occurs, EWR will develop a plan to regularly monitor conservation easements.

If restoration is not feasible, DNR will likely pursue extinguishment of the easements.

2. Stewardship Plan: Division of Fish and Wildlife

a. Fisheries Section-Administered Conservation Easements

The Fisheries Section of DNR's Division of Fish and Wildlife administers four types of conservation easements: Aquatic Management Area, Northern Pike Spawning, "Other Conservation" and Trout Stream. Its stewardship plan is tailored to easement type.

(1) Plan for Aquatic Management Area Easements

The Fisheries Section has monitored some, but not all, of DNR's 10 AMA easements in the past. Baseline property reports have been completed for eight of these easements.

Beginning in FY 2012, the Fisheries Section will monitor all AMA easements on an annual basis. Monitors will be area Fisheries staff. Monitoring will include walk-throughs and, for some easements, observation from the water. All landowners will be contacted at least annually. No later than June 30, 2015, the Fisheries Section will prepare baseline property reports for the AMA easements that do not have completed baselines.

All of the costs for monitoring, landowner contact and other stewardship activities and the costs to prepare the two baseline reports will paid from the Fisheries Section's general operating budget, which is funded mainly by the game and fish fund.

(2) Plan for Northern Pike Spawning Easements

DNR's 10 Northern Pike Spawning easements, which were determined to be conservation easements during the course of this project, were intended primarily as flowage easements for fish spawning purposes. The limitations on uses of the land were of secondary importance, and the Fisheries Section did not consider the NPS easements to be conservation easements. Accordingly, the Fisheries Section has not monitored these easements for compliance with their terms in the past or prepared baseline property reports for the easements.

Beginning in FY 2012, the Fisheries Section will monitor all Northern Pike Spawning easements at least once every three years and will contact the landowners annually. Monitoring will be performed by area Fisheries staff and will include an on-site visit to each easement. Fisheries staff will also collect baseline data and will prepare a baseline property report for each easement, using an abbreviated format similar to the baseline property report format that will be used for DNR's Trout Stream easements. (See Appendix, pp. 8-11 (Trout Stream Easement Baseline Form)). Fisheries staff will complete baseline property reports for all 10 Northern Pike Spawning easements by June 30, 2015.

Costs incurred in the preparation of baseline property reports, monitoring, landowner contacts and other easement stewardship activities will be paid from the Fisheries Section's general operating budget.

(3) Plan for "Other Conservation" Easements

Most of DNR's five Fisheries Section-administered "Other Conservation" easements have been monitored in the past, but not on a regular basis. Baseline property reports have not been completed for any of the five easements. One of the easements, adjacent to a development on a Douglas County lake, was the subject of an enforcement action to address the removal of vegetation in violation of the easement's terms. The matter was ultimately settled after DNR filed a civil action in district court.

Beginning in FY 2012, the Fisheries Section will monitor its five "Other Conservation" easements annually. Landowners will be contacted annually. Area Fisheries staff will conduct the monitoring visits, which will include walk-throughs and, in some instances, observations from water. The Fisheries Section will prepare baseline property reports for all of the "Other Conservation" easements no later than June 30, 2015.

The cost of baseline report preparation, monitoring, landowner contact and other stewardship activities will be paid through the Fisheries Section's general operating budget.

(4) Plan for Trout Stream Easements

DNR holds more Trout Stream easements than any other type of conservation easement. DNR acquires Trout Stream easements primarily to provide angler access and to improve trout habitat on the sites. The limitations on land use that are included in these easement—i.e., the aspects of the easements that make them "conservation easements" under Minn. Stat. sec. 84C.01(1)—are secondary reasons for acquisition. Accordingly, the Fisheries Section considers Trout Stream easements to be more of an angler access easement than a type of conservation easement. With the exception of a few area Fisheries offices, the Fisheries Section has not systematically monitored Trout Stream ease-

ments for compliance in the past. However, the Fisheries Section has addressed violations reported by members of the public or observed during easement site visits for habitat work or other reasons. Baseline property reports have not been completed for the vast majority of DNR's Trout Stream easements.

Baseline Property Reports. In 2009, the Fisheries Section began preparing baseline property reports for some of its newly acquired Trout Stream easements. To date, nine baseline property reports have been completed and six others, which have been partially completed, will be finalized this spring. The following chart shows DNR's baseline report backlog for existing Trout Stream easements by region.

Region	Number of easements	Baseline backlog
Northwest	79	79
Northeast	171	171
Central	311	293
Southern	15	15

The Fisheries Section's goal is to complete baseline property reports for all existing Trout Stream easements by June 30, 2015, but its ability to do so is contingent on obtaining additional funding.

The following two existing funding sources will enable DNR to address about 25% of the backlog by June 30, 2015:

1. *Operating budget:* A few area offices that administer a limited number of Trout Stream easements (e.g., Hinckley Area Office, all Southern Region Area Offices and a few of the Northwest Region Area Offices) will be able to complete baseline property reports for all of their Trout Stream easements without additional resources. The Fisheries Section expects to be able to address approximately 10% of the statewide baseline backlog statewide by June 30, 2015 in this manner.

2. *Federal grant:* DNR has a federal grant for the Lake Superior Watershed, which is available through Dec. 31, 2012. The grant will enable the Fisheries Section to hire two temporary employees to conduct work on designated trout streams along the North Shore. A portion of their time will be spent collecting baseline data and preparing baseline property reports for existing easements on these streams. The Fisheries Section expects to address about 50% of the Northeast Region's baseline backlog with this funding.

If Phase II of the Conservation Easement Stewardship Program is funded (see Appendix, pp. 34-35 (Phase II proposal)), a primary focus of that project would be to begin addressing the baseline report backlog for Trout Stream easements in Southeastern Minnesota. The funding would be used to

hire temporary field staff in the Lanesboro Area Fisheries Office to work exclusively on Trout Stream easement stewardship, including preparing baseline property reports for existing easements. This funding would enable the Fisheries Section to address about 1/3 of the Central Region's baseline backlog. In combination with the two existing funding sources, this funding would enable the Fisheries Section to address about 43% of the Trout Stream easement baseline report backlog statewide.

In order to fully address the backlog of baseline reports for its Trout Stream easements, DNR will seek additional sources of revenue that can be used for Trout Stream easement stewardship. Potential sources of funding are discussed in Part III of this report.

Monitoring. The Fisheries Section's goal is to regularly monitor all of its existing Trout Stream easements, but its ability to do so without causing a substantial adverse impact on other Fisheries Section work is contingent on securing additional funding. The following plan will be carried out to the extent that funding permits.

Plan flexibility to account for various conditions statewide. There are substantial regional and other differences in DNR's Trout Stream easements. For example, a Trout Stream easement adjacent to a cultivated field or a residential development generally requires more frequent monitoring than an easement on a stream in a wilderness area. The Fisheries Section will take regional and other differences into account when developing its easement-specific monitoring plans.

Monitoring frequency. The Fisheries Section's goal is to monitor all of its existing Trout Stream easements on average once every three years. Some easements should be monitored with site visits every year. Others are at such low risk for violations that a site visit every few years would be sufficient to protect the conservation values and the state's interests in the easement. When setting specific monitoring schedules, the Fisheries Section will consider factors such as:

- Location of the easement (higher monitoring frequency in developed or agricultural areas than in remote areas)
- Landowner (higher monitoring frequency for new landowner or landowner who has violated easement in the past)
- Uses/ownership of adjacent lands

Monitoring methods. The Fisheries Section will use a combination of monitoring methods, including walk-through visits and remote sensing, to monitor its easements. The particular method(s) used will depend on the land type and uses as well as accessibility to the site.

Monitors. Area Fisheries staff will monitor most of DNR's Trout Stream easements. If the Fisheries Section is able to secure additional funding for conservation easement stewardship, one or more stewardship coordinator positions will be created. The coordinator(s) would

conduct some of the easement monitoring along with other Fisheries staff and perform other easement stewardship work.

Coordination with other Fisheries Section work. The Fisheries Section will conduct Trout Stream easement monitoring in conjunction with its stream surveys to the extent feasible. These surveys are conducted on many of Minnesota's designated trout streams every three years and adding easement compliance monitoring to this work would be more efficient than visiting the sites solely for routine compliance monitoring. The ability to download monitoring forms from the new computer application onto the ruggedized laptops that the Fisheries Section already uses for stream surveys and to enter the monitoring data in the field would facilitate record keeping for easement monitoring.

Landowner contact. The Fisheries Section does not currently know the names or have contact information for a majority of the fee owners of lands subject to DNR's Trout Stream easements, although a few area Fisheries offices either maintain such data or have easy access to it through county databases. DNR's Trout Stream easements do not restrict subdivision of the property subject to the easements, so it is likely that many of the easement sites now have multiple owners.

Once landowner information is acquired, the Fisheries Section will contact landowners annually. Due to the extensive number of easements and landowners, the Fisheries Section will not be able to routinely meet with landowners. However, annual contact (either in writing or by telephone) will remind landowners of the easements and inform them of DNR's stewardship activities. In addition to regular landowner contact, the Fisheries Section will notify Landowners of violations or other issues with the easements that need to be addressed.

Funding. At current funding and staffing levels, only a few area Fisheries offices that administer a limited number of Trout Stream easements can meet the goal of easement monitoring an average of every three years. The Fisheries Section estimates that this would account for monitoring of about 10% of its existing Trout Stream easements. The federal Lake Superior Watershed grant will provide funding to monitor about 50% of Northeast Region's easements one time between now and Dec. 31, 2012. If Phase II of the Conservation Easement Stewardship Program is funded, the Fisheries Section could also monitor about one-third of the Central Region's Trout Stream easements one time between now and June 30, 2013. In combination, these funding sources provide only a partial, temporary solution to the Trout Stream easement stewardship issue and additional sources of revenue are needed. Potential funding sources are discussed in Part III of this report.

b. Wildlife Section-Administered Conservation Easements

As outlined in Part I (Inventory Results), the Wildlife Section has been assigned as the administrator for 22 conservation easements, all of which are coded "Other Conservation." Of these, 20 and a portion of a 21st will be monitored. The one easement and portion of another that will not be monitored are on lands that DNR holds in fee title. They are being managed in accordance with the easement terms. (See Part II.B (Lands Acquired in Fee Title Subject to Conservation Easements) above).

Baseline Property Reports. DNR has completed baseline property reports for three of the 21 conservation easements administered by the Wildlife Section that will be monitored. Three Wildlife

Section-administered easements are temporary, and DNR will monitor but not prepare baseline property reports for those. The Wildlife Section expects to complete baseline property reports for the remaining 15 conservation easements by June 30, 2013.

Monitoring. At the time this project began, the Wildlife Section had been regularly monitoring nine conservation easements for several years. Three additional conservation easements administered by the Wildlife Section were acquired in 2009. During this project's inventory process, DNR determined that there were eight additional Wildlife Section-administered conservation easements, most of which had been retained in land sales or exchanges, that needed to be monitored. The Wildlife Section also agreed to take on the responsibility of administering and monitoring one conservation easement that previously had no assigned administrator within the DNR. Beginning in FY 2012, the Wildlife Section will monitor all 21 of these conservation easements annually.

The Wildlife Section's Program Coordinator administers the Section's easement monitoring program. This includes sending monitors reminders to complete monitoring, maintaining monitoring records and working with monitors and managers to address any violations or other issues. The Program Coordinator will continue to coordinate the Section's conservation easement monitoring.

The Wildlife Section has assigned primary responsibility for conservation easement monitoring to area wildlife managers. They, or Wildlife Section staff working under their supervision, conduct the monitoring visits. Non-Game Wildlife Program staff, who work in DNR's Division of Ecological and Water Resources, are the assigned monitors for four of the Wildlife Section-administered conservation easements. Monitoring visits typically include walk-throughs of the easement sites and meetings with landowners.

Funding. The Wildlife Section pays for most conservation easement administration and monitoring from the game and fish fund, as part of its operating costs. The only exception is for the Wildlife Section-administered conservation easement monitored by Non-Game Wildlife staff. Their time and expenses for conservation easement monitoring are paid from the non-game wildlife fund. The DNR will continue to use these two funding sources to cover monitoring costs for the Wildlife Section-administered conservation easements. These funding sources will also pay for the baseline property reports that still need to be completed for existing Wildlife Section-administered conservation easements.

3. Stewardship Plan: Division of Forestry

The Division of Forestry administers all working forest easements (Forest Legacy and Minnesota Forests for the Future easements) through its Minnesota Forests for the Future Program. The Division also administers two miscellaneous conservation easements (coded as "Other Conservation") that were acquired in the early 1990's before Minnesota joined the federal Forest Legacy Program.

a. Minnesota Forests for the Future Program

The Division of Forestry's Minnesota Forests for the Future (MFF) Program has had a stewardship plan in place for its working forest easements for many years. The plan incorporates requirements of the federal Forest Legacy Program and comports with many conservation easement stewardship standards developed by the Land Trust Alliance. DNR's agency-wide conservation easement steward-

ship plan, set forth above, is modeled after the MFF stewardship plan.

The MFF Program is staffed by a full-time Statewide Forest Legacy Coordinator. The Forest Legacy Coordinator is responsible for all aspects of the Program, including easement acquisitions, preparation of baseline property reports, easement administration, landowner contacts, monitoring, record keeping, and funding requests. The Forest Legacy Coordinator also handles enforcement issues by working with landowners to address minor easement violations. (To date, there have been no violations of Forest Legacy or MFF easements that have required legal action.) As the number of Forest Legacy/MFF easements increases, the Program will add staff to ensure that all of its easement stewardship obligations can be met.

Baseline property reports. A baseline property report is created for every Forest Legacy and Minnesota Forests for the Future easement held by the DNR, and all existing Forest Legacy and MFF easements have completed baseline property reports. The MFF Program's policy is to complete the baseline property prior to the time the easement acquisition is completed.

Monitoring. The federal Forest Legacy Program requires annual monitoring and it is the goal of DNR's Forest Legacy/MFF Program to monitor each easement property annually. The Forest Legacy Coordinator is currently the Program's primary easement monitor. Monitoring methods for smaller easements typically incorporate a landowner face-to-face meeting and an on-the-ground field visit. For larger-scale easements, an annual meeting is held with the landowner or landowner's representative to review the past year's activities and planned activities. A field visit of selected sites is typical as is a review of recent aerial photography. Satellite imagery and other technologies may supplement other more traditional monitoring methods, especially on the large easements.

Record keeping. The Forest Legacy Coordinator maintains the following records for Forest Legacy/MFF easements:

- Application for program
- Baseline property report
- Conservation easement
- Landowner information (historic and current, including name, address and telephone number)
- Forest Management Plan
- Monitoring records
- Landowner correspondence
- Photographs
- Other miscellaneous materials such as press releases and newspaper clippings

Funding. The MFF Program estimates that on-the-ground monitoring of all of its existing conservation easements (333,000 acres and 37 projects) requires approximately a 0.4 FTE. This estimate is

based on the following assumptions:

Project Size	Small Projects <500 acres	Med. Projects 501-5,000 acres:	Large Projects 5,000 –50,000 acres	Very Large projects: Greater than 50,000 acres
Project numbers and estimated annual hours	27 Projects 430 hours annually.	4 Projects 90 hours annually	4 Projects 120 hours annually	2 Projects 160 hours annually

Additional stewardship expenses (not included in the 0.4 FTE estimate) are: staff time to conduct pre-monitoring activities and post-monitoring office work; staff time to respond to requests for information, formal approvals from landowner; travel (per diem, lodging, fleet, possible fixed wing flights); remote sensing (fixed wing and satellite imagery); GIS applications including mapping; office overhead including phone, etc.

Soon after the establishment of the Forest Legacy Program in 1999, program responsibilities for the Minnesota Forest Legacy Program were assigned to the Area Forester in Faribault. In 2005, the Forest Legacy Coordinator position was established as a full-time position with funding provided by federal Forest Legacy Program grants and with additional funding provided by the state's general fund. Both general funds and federal Forest Legacy funds have supported the Division's monitoring and easement stewardship efforts to date, which have largely been carried out by the Forest Legacy Coordinator. The Division plans to continue the use of both general fund support and federal fund support for future monitoring. In addition, the Division plans to use those additional monitoring funds provided through the Outdoor Heritage Fund appropriations or other monitoring contributions as discussed below.

The Minnesota Forests for the Future law requires the Commissioner to "establish a long-term program for monitoring and enforcing Minnesota [F]orests for the [F]uture easements." Minn. Stat. sec. 84.66, subd. 11. The law also states: "The program must require that a financial contribution be made for each easement to cover the cost of managing, monitoring, and enforcing the easement."

In connection with DNR's first MFF conservation easement (Upper Mississippi Forest Project), the Program requested that $750,000 of the acquisition appropriation from the Outdoor Heritage Fund (Minn. Laws 2009, ch. 172, art. 1, sec. 2, subd. 3) be set aside to fund long-term stewardship. This set-aside was approved as part of the LSOHC Accomplishment Plan. DNR's ability to use these funds for stewardship, however, depends on legislation this session to establish a Forests for the Future Stewardship Account and to authorize the transfer of these funds into this account. The account would be an interest-bearing account in the natural resources fund, and the amounts in the fund would be annually appropriated to the Commissioner to pay for Forests for the Future easement stewardship. If such legislation is passed, the $750,000 deposited in the Forests for the Future Stewardship Account will fund stewardship of the Upper Mississippi Forest Project and may also be used for stewardship of other conservation easements acquired with Outdoor Heritage funding.

b. "Other Conservation" Easements

The Forestry Division administers two "Other Conservation" easements, neither as part of the Forest Legacy/Minnesota Forests for the Future Program.

A non-profit organization assigned one easement, which protects open space in the Richard J. Dorer Memorial Hardwood Forest in Goodhue County, to DNR in 1993. The Area Forester monitors this easement annually and submits monitoring reports to the non-profit organization. The Area Forester will continue to monitor the conservation easement annually. The easement does not have a baseline property report. The Area Forester or other Forestry Division staff will prepare one by June 30, 2013.

The other easement, on property in St. Louis County, was donated to the DNR in 1992. The donors prepared a baseline property report. This easement has not been monitored in the past. The Forestry Division will begin monitoring the easement annually in FY 2012. The Area Forester will be assigned as the primary easement monitor.

The Forestry Division's general operating budget will cover the ongoing costs of administering and monitoring both of these conservation easements.

4. Stewardship Plan: Division of Parks and Trails

The Division of Parks and Trails administers all of DNR's Wild and Scenic Rivers (WSR) easements (134) as well as two Cave easements and three miscellaneous "Other Conservation" easements adjacent to or within state park statutory boundaries.

a. Wild and Scenic Rivers Scenic Easement Program

DNR started acquiring Wild and Scenic River (WSR) easements in the mid-1970's. Between that time and 2008, there was never an ongoing effort to monitor these easements. No baseline property report work was done and, over time, the locations of many easements were forgotten. In 1990, DNR staff conducted an aerial analysis of WSR easements on the Rum and Kettle Rivers, but there was no budget for pursuing eight suspected easement violations. Between 2000 and 2003, a temporary worker conducted an inventory of county records for WSR easements, established a hard-copy filing system, and visited some easements.

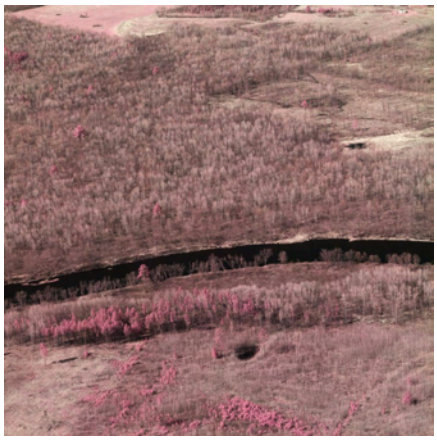
In the late 1990's, DNR became aware that it held a scenic easement on the Lower St. Croix River that was the subject of serious violations. DNR filed a civil enforcement action (DNR v. Dow, No. C9-00-1101) in Washington County District Court against the landowner and was successful in obtaining a court order that required the landowner to restore the property.

In 2008, DNR created a Scenic Easements Coordinator position in the Division of Trails and Waterways (now part of Parks and Trails) to coordinate the

development and implementation of a statewide monitoring and enforcement program for scenic easements on wild and scenic rivers. The position was set up to inventory division files, develop data systems that serve program objectives (working in coordination with the land records system project), provide technical assistance to landowners and local units of government, resolve easement violations, and establish protocols for a sustainable easement stewardship and enforcement program. Although a temporary worker was assigned to the WSR Scenic Easements Program between 2000 and 2003, this was the first classified, full-time DNR position responsible for scenic (WSR) easement administration since the WSR Program began in the early 1970s.

The Scenic Easements Coordinator position was filled in the fall of 2008. When the coordinator began, there had been no easement monitoring since 2003, and the locations of many easements were unknown. There was no up-to-date contact database for landowners, and individual landowner parcel ownership under easements was unknown. Files were only available in hard-copy format and it was unknown if all files were at DNR. The status of on-the-ground conditions for WSR easements was unknown and existence of violations was uncertain.

Since 2008, the new WSR Scenic Easements Program has completed the following:



Oblique aerial photograph
Kettle River

- **Aerial Photography.** Conducted high resolution "oblique aerial photography" of both banks of all Wild and Scenic Rivers. This high resolution imagery (which is available on the Internet) assists easement monitoring, baseline property report creation, and is an asset to other DNR staff and the general public.

- **CCM Pilot Program and Baseline Fieldwork.** Conducted a pilot project utilizing Conservation Corps Minnesota (CCM) field crews to collect baseline field data for scenic easements. Crews and the Scenic Easements Coordinator conducted site visits on 35 properties. That field data will be the foundation to create baseline property reports on those easement lands. The division also has a CCM AmeriCorps corps member who assists statewide Parks and Trails water recreation programs. This position assisted in the completion of the first two WSR baseline property reports and with CCM crew coordination.

- **Data Systems, Digital Records, and GIS data.** The Program entered into service level agreements with the DNR Survey Unit and the Forest Resource Assessment Office to create digitized GIS parcel maps of scenic easement boundaries. Scenic Easement Program staff created digitized GIS parcel boundary information for landowner-specific ownership within DNR scenic easement boundaries based on county records. Initial contact information based on county tax parcel records was collected for all parcels within easement areas. An access database that links landowner contact information to GIS and digitized records is set up for program use. All scenic easement file records are now digitized.

Land and Water Conservation (LAWCON) Funds. Parks and Trails (PAT) and the Office of Management and Budget (OMB) both have a responsibility to monitor Minnesota Wild and Scenic River

scenic easements acquired utilizing federal LAWCON funding. PAT was allocated $20,000 from OMB in FY 2011 to fund an easement monitoring training for staff and is enabling site visits/landowner outreach for easements on the Rum and Kettle Rivers. The LAWCON funding is enabling the use of DNR staff (who are less than full time) for landowner outreach and site visit coordination on WSR easements.

Baseline Property Reports. Field data have been collected for 40 WSR easements, and two reports are in final draft form and awaiting landowner signatures. PAT's goal is to complete baseline property reports for all WSR easements by June 30, 2015. However, its ability to do so is contingent on securing additional funding. At current staffing and funding levels, it is estimated that baseline property reports for all easements will take approximately eight years to complete. Part of the difficulty in creating these reports is that many easements are over 30 years old and there has been either no or only limited communication with landowners since they were acquired. There are existing violations on a number of the easements, and addressing these may cause further reduction in staff time available for field work and report creation.

Monitoring. It is PAT's goal to conduct on-site monitoring for WSR easements every other year and to contact landowners every year. PAT's ability to carry out this monitoring plan is contingent on securing additional funding, as current staffing and funding levels are not adequate.

Scenic easement monitoring should occur in the following manner:

Year 1: Site visit (abbreviated, not full-site walk through) /landowner visit
Year 2: Landowner letter and/or phone call
Year 3: Walk-though site visit / landowner visit
Year 4: Landowner letter or phone call
Repeat…

Funding. The Scenic Easements Coordinator position was authorized and funded out of a general fund appropriation during the 2008/2009 biennium. There was no program budget setup for field-based project work or other budget items besides the coordinator's salary. After filling the position in November 2008, the position was reduced to 50% within the first year due to general fund budget cuts.

The Division plans to continue using general fund support for the half-time Scenic Easements Coordinator position. It is unlikely that there will be an adequate general fund budget to restore this position to full time in the near future.

The Division also plans to request continued support for LAWCON funding if those funds remain available. Currently, there are no other sources of funding utilized for Scenic Easement Program operations. The Division is exploring other funding opportunities and will seek other applicable funding sources once identified.

b. Cave and "Other Conservation" Easements

DNR's two Cave easements and two of its three "Other Conservation" easements that are within or adjacent to state park statutory boundaries were historically administered by DNR's Division of Parks and Recreation. During the 2009 integration of the Division of Parks and Recreation with the Division of Trails and Waterways, the Scenic Easements Coordinator took over responsibilities for Cave and "Other Conservation" easements.

The Cave easements and two of the "Other Conservation" easements have been regularly monitored for years. Both Cave and one "Other Conservation" easement have baseline property reports. One "Other Conservation" easement, which is a scenic easement within the Afton State Park statutory boundary, was discovered during the course of this project. A specific plan for the completion of this easement's baseline property report will be developed after an inquiry into the history of that acquisition and a meeting with the landowner, but the Division expects to have the report completed by June 30, 2013. The third "Other Conservation" easement is on a property owned by DNR in fee title.

Currently, Cave and "Other Conservation" easements administered by Parks and Trails have a division staff member (either a state park manager or assistant manager) assigned as the primary monitor. They will monitor the easements every other year.

Funding for stewardship of these easements is through general funds that pay for park managers and scenic easements program coordinator salaries. The general fund will continue to pay for stewardship of these easements.

5. Stewardship Plan: Northwest Regional Operations

Northwest Regional Operations administers one DNR conservation easement, which was retained upon conveyance of surplus land on Bear Island in Leech Lake to the Leech Lake Band of Ojibwe Indians in 2007. The band acquired and is managing the land subject to this easement for purposes of fish, wildlife, plant management, habitat and tribal cultural resource protection.

The DNR has not yet prepared a baseline property report for this easement, but the easement was monitored in 2010. Northwest Regional Operations staff will monitor the easement at least once every three years. This will be an on-site visit with access to the island by boat. Monitoring will be by walk-through and by observing portions of the easement from the water. Northwest Regional Operations staff will maintain annual contact with the Leech Lake Band of Ojibwe and any subsequent landowners. At the next regular monitoring visit, NW Regional Operations staff will collect baseline data on the easement and will complete a baseline property report no later than Dec. 31, 2013.

Funding for monitoring of this easement, preparation of the baseline report and other administrative costs are borne by the Northwest Regional Operations budget. No additional funding sources are needed.

6. Stewardship Plan: ACUB Easements

The ACUB easement acquisition process is currently coordinated by a community assistance

specialist based in the Division of Ecological and Water Resources. As part of the acquisition process, one of DNR's divisions or sections must agree to administer the ACUB easement. The Division of Fish and Wildlife administers four of DNR's existing ACUB easements. Of these, the Wildlife Section administers three and the Fisheries Section one. The Division of Forestry administers the other existing ACUB easement. Baseline property reports have been completed for all existing ACUB easements.

The administrators' role in stewardship of the ACUB easements does not include monitoring or record keeping. Those functions are performed by the ACUB acquisition coordinator and a Non-Game Wildlife Program staff member who is based at Camp Ripley. The ACUB easements are monitored annually either by an on-site walk-through visit or by fly-overs. The monitors contact landowners on an annual basis as well.

DNR's plan for existing ACUB easements is for the ACUB acquisition coordinator and Non-Game Wildlife staff member to continue annual monitoring and landowner contact for at least some of the easements. If any violations occur, the division or section that is the assigned administrator will participate in actions to address the violations.

The federal ACUB Program provides no stewardship funding for the easements, and, in fact, pays no indirect acquisition expenses or administrative costs of the acquisition program. Monitoring costs for existing ACUB easements are paid from the general fund and the non-game wildlife fund, which pay for the salaries of the ACUB acquisition coordinator and Non-Game Wildlife staff member who conduct the easement monitoring. Funding through these sources has been adequate to complete annual monitoring of existing easements to date, although not in an optimal manner. Other job duties and priorities for both the ACUB acquisition coordinator and Non-Game Wildlife staff make annual monitoring difficult. To the extent that the assigned administrators participate in stewardship of these easements, their costs will be paid through their operating budgets.

7. Stewardship Plan: Metro Greenways Easements

DNR's Central Region is the administrator for the Metro Greenways easements, but no DNR staff are currently assigned to administer or monitor the easements. All metro greenways funding expires at the end of fiscal year 2011.

DNR has baseline property reports for eight of the 16 Metro Greenways easements.

There has been some monitoring of the Metro Greenways easements since they were acquired, but monitoring has not occurred at regular intervals. Between 2008 and 2010, DNR monitored eight Metro Greenways easements and determined that all were in compliance. (Seven of the monitoring visits were part of test monitoring conducted in connection with the Conservation Easement Stewardship and Enforcement Program Plan.)

DNR's current plan is for the Central Regional Director to assign stewardship responsibility for

the 16 Metro Greenways easements to Central Region staff based in various divisions and for assigned staff to being regular easement monitoring in FY 2012. The assigned staff would monitor the easements at least once every three years and would complete baseline property reports for the eight Metro Greenways easements that do not have baselines. Staff would obtain baseline data for these reports at the next regularly-scheduled monitoring visit and complete the reports no later than June 30, 2015. The operating budgets of the assigned divisions would be used to pay the stewardship costs for the Metro Greenways easements.

Key Components of Monitoring Plans by Easement Type: Existing DNR Conservation Easements					
Easement Type	**Administrator**	**Primary monitor**	**Monitoring type(s)**	**Monitoring frequency**	**Additional staffing needed?**
ACUB	Multiple	Area EWR Staff	Walk-through, fly-over	Annual	**Yes**
AMA	Fisheries Section	Area Fisheries staff	Walk-through, boat-by	Annual	No
Cave	Parks & Trails	Park Manager	Walk-through	Every other year	No
Forest Legacy	Forestry	Forest Legacy Coordinator	Walk-through, remote sensing, records review	Annual	No
MFF	Forestry	Forest Legacy Coordinator/Forestry staff	Walk-through, remote sensing, fly-over, records review	Annual	No
MGW	Being reassigned	Being reassigned	Walk-through	Every 3 years	**Yes**
NPS	Fisheries Section	Area Fisheries staff	Walk-through	Every 3 years	No
NPB	EWR (SNA Program)	SNA Program regional staff	Walk-through	Every 3 years	**Yes**
Other Conservation	Fisheries Section	Area Fisheries staff	Walk-through, boat-by	Annual	No
Other Conservation	Forestry	Area Foresters	Walk-through	Annual	No
Other Conservation	NW Regional Operations	NW Regional Operations staff	Walk-through, boat-by	Annual	No
Other Conservation	Parks & Trails	Park Managers	Walk-through	Every other year	No
Other Conservation	Wildlife Section	Area Wildlife Managers	Walk-through	Annual	No
SNA-Administered	EWR (SNA Program)	SNA Program regional staff	Walk-through	Every 3 years	**Yes**
Trout Stream	Fisheries Section	Area Fisheries staff	Walk-through	Average of every 3 yrs	**Yes**
Water Bank	EWR	Area Wildlife Managers	Walk-through	Annual	No
WSR	Parks & Trails	Scenic Easements Coordinator, Area Parks & Trails staff	Walk-through or abbreviated site visit	Every other year	**Yes**

PART III: Options for Long-Term Conservation Easement Stewardship Funding

A. Existing Legal Requirements

Much of DNR's progress in improving stewardship of its conservation easements over the past decade has been in response to evolving standards for both public and private entities that hold conservation easements. Stewardship standards of both the federal Forest Legacy Program and the Land Trust Alliance, a non-profit umbrella organization for entities with land conservation missions, have driven many recent changes in DNR's practices. In addition, DNR recognizes the need to protect the substantial public investment in its conservation easements through ongoing monitoring and enforcement.

Minnesota Statutes chapter 84C does not mandate that an easement holder either monitor its easements or secure any funding for conservation easement stewardship. In fact, until 2008, there were no requirements in Minnesota law that DNR establish stewardship programs or fund the management, monitoring and enforcement of any type of easement. The first such law was the Minnesota Forests for the Future statute, Minn. Stat. sec. 84.66, subd. 11(a), enacted in 2008, which provides:

> The commissioner shall establish a long-term program for monitoring and enforcing Minnesota forests for the future easements. The program must require that a financial contribution be made for each easement to cover the costs of managing, monitoring, and enforcing the easement.

In 2008, appropriations for conservation easement acquisitions from the Environment and Natural Resources Trust Fund were conditioned on the inclusion of a long-term stewardship plan and funding for monitoring and enforcing the easement agreement. Minn. Laws 2008, ch. 367, sec. 2, subd. 10(a)(4)(v).

In 2009, appropriations for conservation easement acquisitions from both the Environment and Natural Resources Trust Fund and the Outdoor Heritage Fund included requirements for stewardship plans and funding:

> As a condition of accepting an appropriation in this section, any agency or entity receiving an appropriation must, for any project funded in whole or in part with funds from the appropriation[,] . . . provide that all conservation easements . . . include a long-term stewardship plan and funding for monitoring and enforcing the easement agreement.

Minn. Laws 2009, ch. 143, sec. 2, subd. 11(a) (ENRTF appropriation); Minn. Laws 2009, ch. 172, art. 1, sec. 2, subd. 10 (Outdoor Heritage Fund appropriation).

The 2010 Environment and Natural Resources Trust Fund appropriation, Minn. Laws 2010, ch. 362, sec. 2, subd. 11, contains the same requirements for conservation easements as the 2009 ENRTF and Outdoor Heritage Fund appropriations. The 2010 Outdoor Heritage Fund appropriation also requires a long-term stewardship plan as a condition of accepting funding for a conservation easement acquisition. In addition, this appropriation requires that sources and amounts of funding for monitor-

ing and enforcing the easements be identified. Minn. Laws 2010, ch. 361, art. 1, sec. 2, subd. 9.

To date, the Minnesota Forests for the Future law, the 2008, 2009 and 2010 ENRTF appropriations and the 2009 and 2010 Outdoor Heritage Fund appropriations remain the only Minnesota legislative mandates relating to DNR's conservation easement stewardship and stewardship funding.

B. Conservation Easement Stewardship Plan Cost Estimates

As discussed in Part II of this report, DNR needs to either secure additional funding to fully implement its plans for long-term stewardship or adjust its use of current funding. Long-term stewardship of any new conservation easements will also be needed.

Project staff developed the following cost estimates from test monitoring and from easement program coordinator and program staff estimates. In order to track actual conservation easement stewardship costs and to accurately estimate future funding needs for conservation easement stewardship, DNR staff engaged in conservation easement stewardship activities will begin cost-coding all time spent on such activities in FY 2012. (Implementation of the new land records system and completion of baseline property reports will decrease the time needed to prepare for monitoring and to complete monitoring reports. In addition, regular monitoring of all conservation easements should reduce violations and eventually reduce DNR's overall stewardship costs.)

Unless otherwise noted in the Comments field, stewardship cost estimates assume:

- A staff rate of $45/hr. (This rate is based on the mid-range annual salary of a Natural Resources Program Coordinator ($57,285). Additional fringe benefits and other staff costs were calculated with DNR's fiscal note worksheet for estimating the cost of new positions. In addition to salary, the calculation includes fringe benefits (FICA, Medicare & retirement), insurance, and DNR's average cost per FTE for space rent, telephone, travel, supplies, and equipment such as personal computers.)
- Preparation time for monitoring (file review, prepare easement-specific monitoring form, create maps for easements without baseline property reports).
- Annual communications with landowner.
- Site visits per the monitoring schedule, with annual visits for 20% of easements that have two- or three-year monitoring schedules due to possible violations, new landowners, or other issues.
- Landowner meetings in conjunction with site visits for all easement types except Trout Stream.
- Monitoring report preparation/records maintenance.
- Subdivisions of Wild and Scenic River and Trout Stream easement properties will increase staff time needed for stewardship.

Estimated Stewardship Plan Costs for Existing Conservation Easements		
Easement Type	**Annualized Cost**	**Comments**
ACUB	$10,000	ACUB coordinator's estimate of annual monitoring (walk-through) plus all ordinary stewardship costs. Approximately 40% of this cost can be covered through existing funding sources.
AMA	$3,600	Funding covered by existing sources. Assumes 8 hrs of staff time per easement annually.
Forest Legacy/ Forests for the Future	$60,000	Funding covered by existing sources. Forest Legacy Coordinator's estimate. Approximately 40-50% of this funding is anticipated from the Outdoor Heritage Fund; the balance will be from federal Forest Legacy Program grants when available, and from Division general fund support.
Forestry-Administered "Other Conservation"	$720	Funding covered by existing sources. Assumes 8 hrs of staff time per easement annually.
Metro Greenways	$4,128	Assumes 10 hours of staff time per easement in monitoring visit years and 2 hrs per easement in other years.
Native Prairie Bank	$28,500	Assumes 12 hrs of staff time per easement in monitoring visit years and 2 hrs per easement in other years. Existing funding will cover monitoring for about 15% of the easements through June 30, 2013.
North. Pike Spawning	$2160	Funding covered by existing sources. Assumes 8 hrs of staff time in site visit years and 2 hrs per easement in other years. Assumes no violations requiring additional monitoring.
NW Reg. Operations-Administered "Other Conservation"	$180	Funding covered by existing sources. Assumes 8 hrs of staff time for the easement in monitoring years and 2 hrs in other years. Assumes no violations requiring additional monitoring.
Parks & Trails-Administered "Other Conservation" & Cave	$900	Funding covered by existing sources. Assumes 8 hrs of staff time per easement in site visit years and 2 hrs in other years. Assumes no violations requiring additional monitoring.
SNA-Conservation & SNA Program-Administered "Other Conservation"	$3,024	Assumes 8 hours of staff time per easement in monitoring visit years and 2 hrs per easement in other years. DNR also owns four of 18 SNA-administered easements in fee title. These easements are not included in this cost calculation.
Trout Stream	$130,644	Assumes 8 hours of staff time per easement in site visit years and 2.5 hrs per easement in other years. Approximately 10% of this cost can be covered through existing funding sources.
Water Bank	$7,560	Funding covered by existing sources. Assumes 8 hrs of staff time per easement per year. Only the 21 permanent easements are included in the calculation, as the temporary easements will all expire before 2013.
Wild & Scenic River	$57,888	Assumes 16 hours of staff time per easement in full site visit years; 12 in partial site visit years; 2.5 in other years. A portion of this cost will be funded through the Parks & Trails Division's 50%-time scenic easement coordinator position.
Fish & Wildlife Division-Administered "Other Conservation"	$7,560	Funding covered by existing sources. Assumes 8 hrs of staff time per easement per year. One easement, which is also held in fee title, is not included in the calculation.

The following additional costs need to be included in conservation easement stewardship budget estimates:

Issue resolution costs. Based on test monitoring visits and on information from DNR's easement coordinators, 15-20% of DNR's conservation easements are expected to have some type of violation or other issue that requires additional staff time to resolve. Examples of such issues (from test monitoring visits and recent experiences by DNR conservation easement administrators) are:

- Relatively minor violations (e.g., unauthorized mowing)
- Moderate violations, for example:
  - Noncompliance with tillage setback requirements in Trout Stream easements
  - Vegetation removal
  - Unauthorized food plots within easement boundary
  - Unauthorized ATV use
  - Unauthorized structures (e.g., swing set, gazebo, stairs)
- New landowner with questions/concerns about easement
- Boundary location questions/erroneous legal descriptions (easements not surveyed at time of acquisition)

Costs associated with resolution of these types of issues are difficult to estimate but could potentially increase program stewardship costs by 100% or more above the costs for routine monitoring and landowner contact estimated in the table above. In some cases, minor or moderate violations may be resolved quickly and simply through negotiations with landowners and documentation memorializing the agreed-upon resolution. Other issues will require substantial staff time and other expenses to resolve. For example, three existing DNR conservation easements (one Native Prairie Bank, one Trout Stream and one Wild and Scenic River) are known to have errors in legal descriptions, and all will need to be amended. Resolution will involve staff time to negotiate amendments, survey costs, real estate transaction costs and legal fees.

Legal fees for enforcement. Under existing laws, violations of DNR-held conservation easements that cannot be resolved through negotiation must be addressed through civil enforcement actions in district court. In such cases, the Attorney General's Office provides legal representation to DNR and makes the final decision about whether an action will be filed.

The Attorney General's Office has pursued legal action for DNR in two conservation easement violations in cases. The cost of legal services provided to DNR by the Attorney General's Office was documented, but because DNR staff time in the matters was not separately tracked, there is no record of DNR's total enforcement expenses in the cases. One case, which involved violations of a Fisheries-administered "Other Conservation" easement, was settled after the complaint was filed in district court. The total cost of legal services provided to DNR by the Attorney General's Office was $8,687.70. The other matter arose out of a landowner's violation of a Wild and Scenic River easement. That case went to trial in district court, but there was no appeal. The total cost of legal services provided to DNR by the Attorney General's Office in that case was $44,003.50.

Of 38 conservation easements visited by project staff, one has serious violations (cattle holding pen encroaching in easement, large quantities of junk dumped in the easement) that will likely require legal action to address. The sample of easements test monitored was too small to predict the percentage of easements that will need enforcement action. However, given the large number of conservation easements held by DNR and lack of regular monitoring in the past, it is expected that several ease-

ments have violations that will require legal action to resolve.

Baseline property report costs. The following estimated costs for preparing baseline property reports to address DNR's baseline backlog for existing easements assume:

- Projected numbers of baselines that can be completed with existing funding sources referenced in the stewardship plan in Part II are accurate.
- The pending SNA Program funding request to LCCMR (101-D) will be approved by the Legislature.
- The pending Native Prairie Bank Program funding request to LCCMR (102-D) will be approved by the Legislature.
- The pending request to LCCMR by the Lands and Minerals Division for Phase II funding for this project (066-C1+2) will be approved by the Legislature. (This funding would pay for preparation of at least 180 baseline property reports, primarily for Trout Stream, Wild and Scenic River and Native Prairie Bank easements.)

Estimated Cost of Completing Baseline Property Reports for Existing Conservation Easements				
Easement Type	**No. of Existing Conservation Easements Needing Baselines**	**Estimated Staff Time Per Easement (including field time, report writing, mapping)**	**Estimated Total Staff Time**	**Estimated Cost @ $45/hr.**
Metro Greenways	8	40 hrs.	320 hrs	14,400
Native Prairie Bank	23	56 hrs.	1288 hrs	57,960
Trout Stream	309	20 hrs.	6180 hrs	276,600
Wild & Scenic River	80	56 hrs.	4480 hrs	201,600
			Total estimated cost =	**$550,560**

Based on the foregoing estimates and assumptions about conservation easement stewardship costs, it is recommended that DNR seek the following staffing increases. Alternatively, work could be re-assigned with existing staff.

1. **SNA/Native Prairie Bank Program:** Add 1 FTE for conservation easement stewardship. The need for staffing at this level should be reviewed after all baseline property reports for existing Native Prairie Bank easements are complete and all easements have been monitored.

2. **Fisheries Section (Trout Stream):** Add 2+ FTE's. One FTE should be located in an area office DNR's Central Region (e.g., Lanesboro Area Fisheries Office). One FTE should be located in an area office in DNR's Northeastern Region (e.g., Duluth Area Fisheries Office). A partial FTE should be located in DNR's Northwestern Region. It is likely that stewardship staffing at this level will need to be permanent even after the existing baseline property report backlog is addressed because of the large number of Trout Stream easements and ongoing acquisitions.

3. **Wild and Scenic River Program:** Add 1 FTE to existing Wild and Scenic Rivers Program staff-

ing levels. The need for staffing at this level should be reviewed after all baseline property reports for existing Wild and Scenic River easements are complete and all easements have been monitored.

4. **ACUB/Metro Greenways:** In order not to displace work in other programs, the ACUB and Metro Greenways programs need to either add part-time conservation easement stewardship staff (less than 0.1 FTE for each program to monitor existing easements) or need funding that will enable other stewardship options to be considered (e.g., contracting for stewardship services, or managing volunteers to conduct stewardship activities).

5. **Forest Legacy/MFF:** It will be necessary to commit a part-time (0.4) FTE to enable the ongoing monitoring that is needed for the program. Options include continuing the monitoring duties with the Forest Legacy Program Coordinator, reassign those duties to existing staff in the regions/areas, add staff or some combination of these.

C. Options for Stewardship Funding

1. Stewardship funding for new conservation easement acquisitions

In accordance with the requirement in Minn. Stat. sec. 84.66, subd. 11(a) for a "financial contribution . . . for each easement to cover the costs of managing, monitoring, and enforcing the easement," the Minnesota Forests for the Future Program asked the Lessard-Sams Outdoor Heritage Council to authorize the use of $750,000 of a $36 million conservation easement acquisition appropriation under Minn. Laws 2009, ch. 172, art. 1, sec. 2, subd. 3 for conservation easement stewardship. LSOHC approved this request, and it is part of the Minnesota Forests for the Future Program's LSOHC accomplishment plan for the appropriation. For DNR to use the $750,000 for long-term stewardship, an interest-bearing account needs to be created in the natural resources fund, and the appropriation needs to be amended to transfer the $750,000 into that account. Legislation to authorize transfer of the funds is in the 2011 Outdoor Heritage bill (HF471), and a proposal to create a Minnesota Forests for the Future easement account in the natural resources fund is in the Governor's recommended budget (Natural Resources Department, p. 29). Interest earned on the account (calculated to be approximately $30,000 annually) would be appropriated to the Commissioner for Minnesota Forests for the Future conservation easement monitoring, landowner contacts, record keeping, processing landowner notices, requests for approval or amendments and other easement management related activities. This funding model is similar to the endowments that non-profit land trusts successfully use for long-term funding of conservation easement stewardship.

A similar interest-bearing account could be created in the natural resources fund for stewardship of other types of DNR-held conservation easements, with appropriations from the fund used exclusively for conservation easement stewardship and enforcement. Sub-accounts could be created in this fund so that conservation easement stewardship expenses could be tracked by DNR program.

Advantages:

- Funds for long-term stewardship of a conservation easement could be secured at the time of the acquisition through an appropriation from the acquisition funding source (e.g., Outdoor Heritage Fund) or from another funding source, ensuring that DNR has adequate funding to manage the easement in the future.

- DNR would be able to require a one-time stewardship donation as a condition of accepting a conservation easement as a gift (whereas it currently has no interest-bearing account in which to place such donations).
- Use of the funds would be limited by law to conservation easement stewardship and enforcement.

Disadvantages:

- A large corpus is required to fully fund stewardship through interest earned on the account in today's marketplace.
- Smaller conservation easements (e.g., Trout Stream) may require a funding amount that would constitute a substantial percentage of the purchase price.
- Some types of funds placed in the account (e.g., general fund) could be redirected for other uses by future Legislatures. Constitutionally-dedicated funding could be redirected from conservation easement monitoring to other constitutionally-allowable projects.

2. Stewardship funding for existing easements

There are a number of options that DNR could pursue to adequately fund its stewardship of existing conservation easements:

a. Seek increases in user fees as a source of new revenue (e.g., increase trout and salmon stamp validation fee to fund stewardship of Trout Stream easements).

Advantages:

- Parties who would benefit the most from stewardship of certain types of conservation easements, rather than the general public, would bear the cost.

Disadvantages:

- Raising user fees may be controversial.
- Increases in fees may reduce the number of users.

b. Seek legislation to authorize the use of existing natural resources fund accounts for conservation easement stewardship (e.g., expand authorized uses of water recreation account to include stewardship of Wild and Scenic River easements).

Advantages:

- Expanding authorized uses of natural resources fund accounts could reduce DNR's reliance on the general fund for conservation easement stewardship funding and provide more stable sources of revenue.

Disadvantages:

- Without user fee increases, adding conservation easement stewardship to authorized uses of existing natural resources fund accounts would reduce funds for other DNR programs (e.g., decrease funds for management of fee interests).

c. Seek ongoing appropriations from the general fund and other operating budget funding sources for conservation easement stewardship.

Advantages:

- These sources have been used to fund stewardship of some conservation easement types (e.g., ACUB, Wild and Scenic River, Water Bank) in the past and no statutory amendments would be required to use funds from these sources.

Disadvantages:

- Funding levels, particularly from the general fund, are unpredictable.

d. Seek ongoing appropriations for conservation easement stewardship from constitutionally-dedicated funds.

Advantages:

- Conservation easement stewardship has received funding from both the ENRTF and the Outdoor Heritage Fund in the past, so it is possible future appropriations could be secured.

Disadvantages:

- The DNR would have to ensure that dedicated fund use did not supplant traditional funds used in the past. Further, funding from both the ENRTF and the Outdoor Heritage Fund is appropriated on a competitive application process; there is no guarantee that the DNR would receive funds for the monitoring program.

e. Seek legislation for an interest-bearing account in the natural resources fund and use appropriations from the account for stewardship of existing conservation easements as well as for stewardship of new acquisitions. Another alternative for consideration would be to use a private foundation as the repository of a conservation easement stewardship endowment.

Advantages:

- If funded sufficiently to generate enough income to support stewardship of all DNR conservation easements, an interest-bearing account could provide a permanent, stable source of funding.
- Using a private foundation as the repository of a stewardship endowment could protect the corpus of the fund from being redirected to other uses.

Disadvantages:

- This would require large one-time appropriations in order to generate sufficient interest to fund stewardship of DNR's existing easements. Statutory and constitutional amendments may be necessary for the state to use a private foundation to manage a stewardship endowment. Fund security may also be a concern.

D. Other Legislative Changes to Improve Conservation Easement Stewardship

The Legislature could consider the following to implement long-term stewardship of all conservation easements:

1. An amendment to Minn. Stat. ch. 84C that would require any entity holding conservation easements in Minnesota to have a program for stewardship (i.e., management, monitoring and enforcement) of all of its conservation easements.

2. A statutory requirement that any entity acquiring a conservation easement (either through purchase or gift) obtain and place in an interest-bearing account or endowment fund at the time of the acquisition funding to cover long-term stewardship of the easement. Funding amounts should be calculated to generate sufficient interest to pay the average estimated annual cost of stewardship of the easement.

Conservation Easement Stewardship and Enforcement Program Plan – DNR

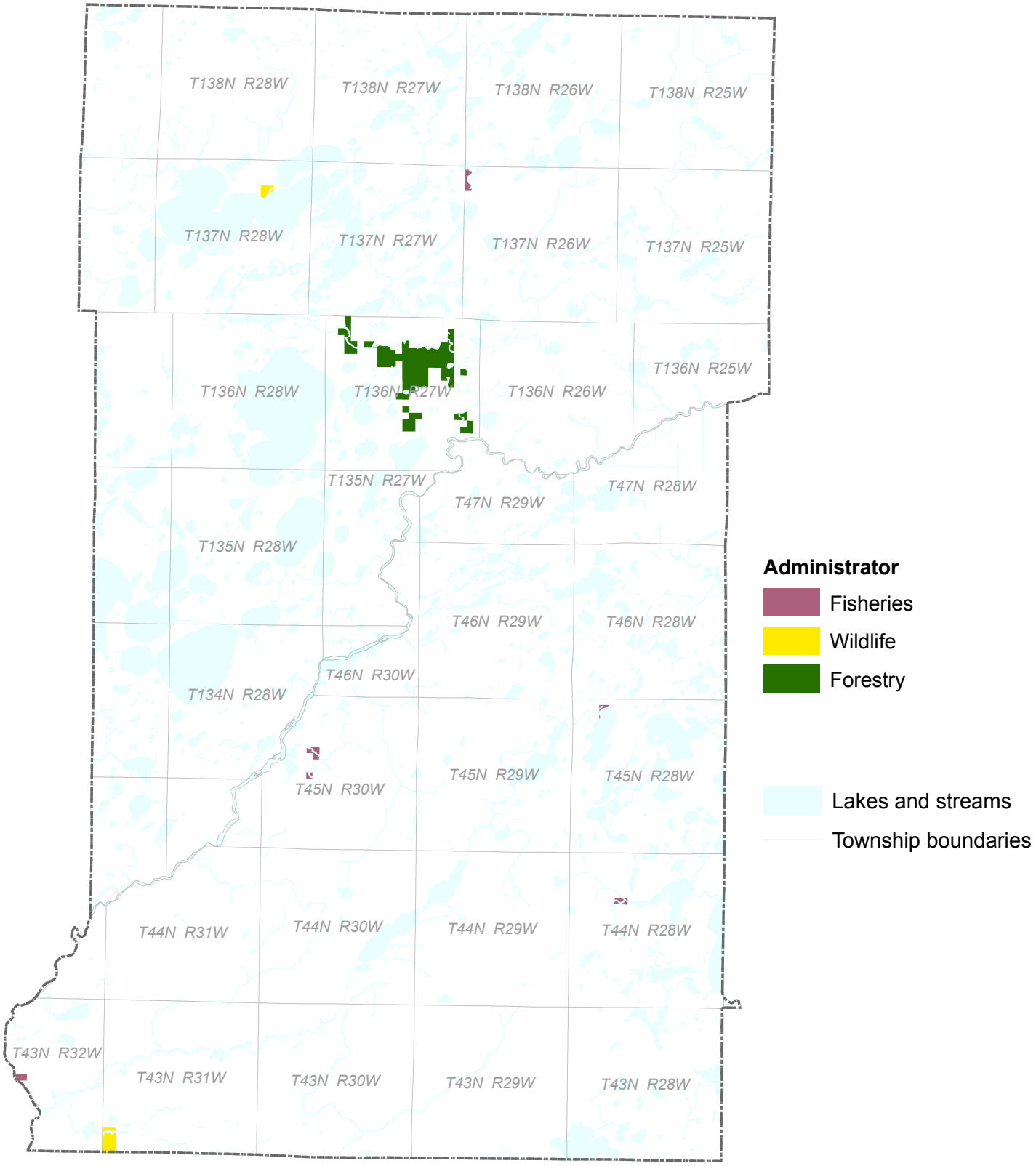
Final Report, Feb. 28, 2011

APPENDIX

State-owned DNR-administered Conservation Easements

Conservation Easements by Administrator

Crow Wing County



0 2.5 5 Miles

N

Note: This map shows the approximate relative location of easements and other features but was not prepared by a professional land surveyor. This map is provided for informational purposes only and may not be sufficient or appropriate for legal, engineering, or surveying purposes.

These data are obtained from DNR Land Records as of 2/2011. Easements are mapped to the Quarter-Quarter Section or government lot of the Public Land Survey and are not necessarily portrayed with their true boundaries. Easements that comprise less acreage than this unit of land are represented as an entire Quarter-Quarter Section or government lot.

Data sources follow the final map in this map series.

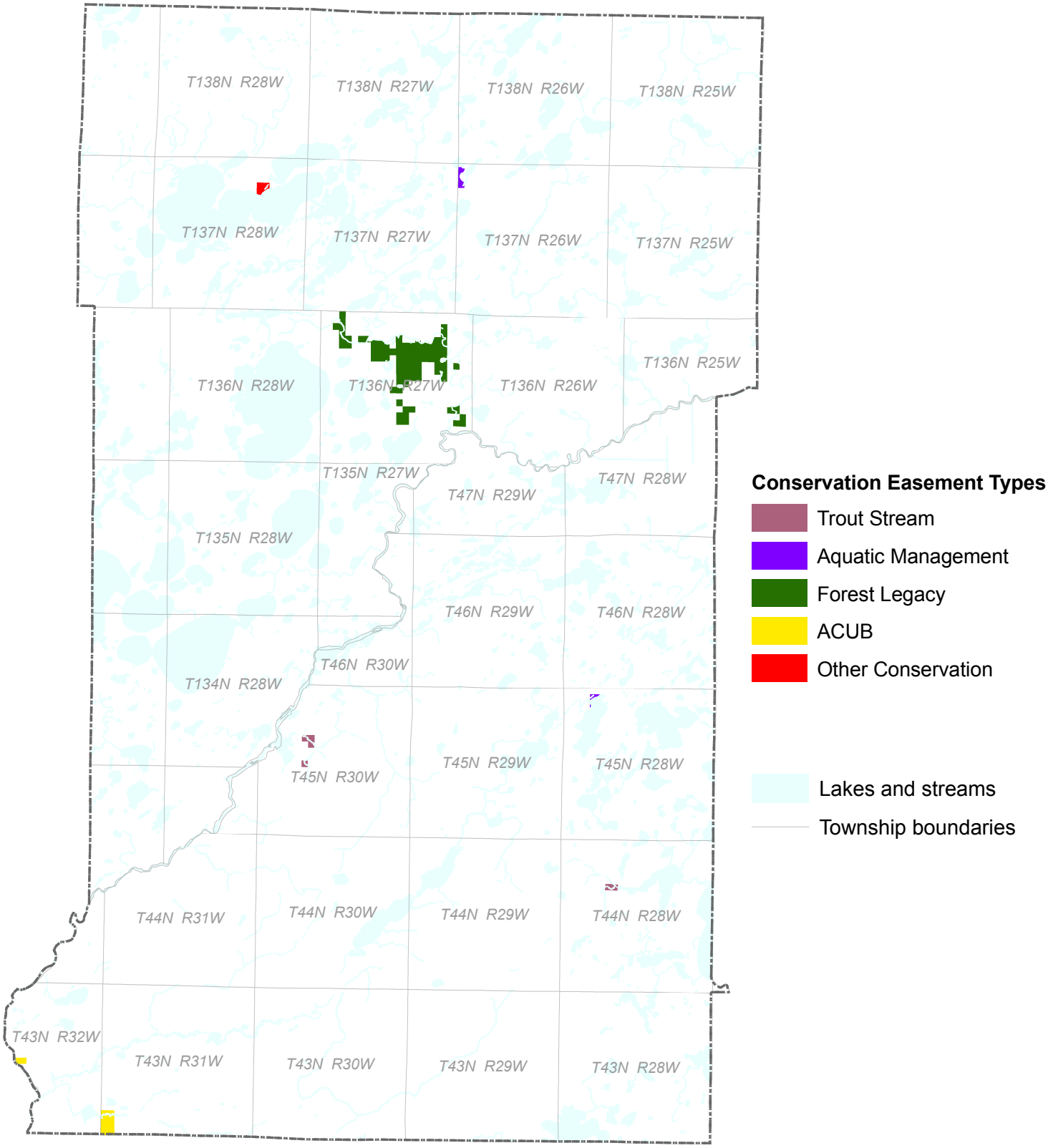
Map prepared February 2011.

© 2011, State of Minnesota, Department of Natural Resources.

State-owned DNR-administered Conservation Easements

Conservation Easements by Type

Crow Wing County



0 2.5 5 Miles

N

Data sources follow the final map in this map series.

Map prepared February 2011.

© 2011, State of Minnesota, Department of Natural Resources.

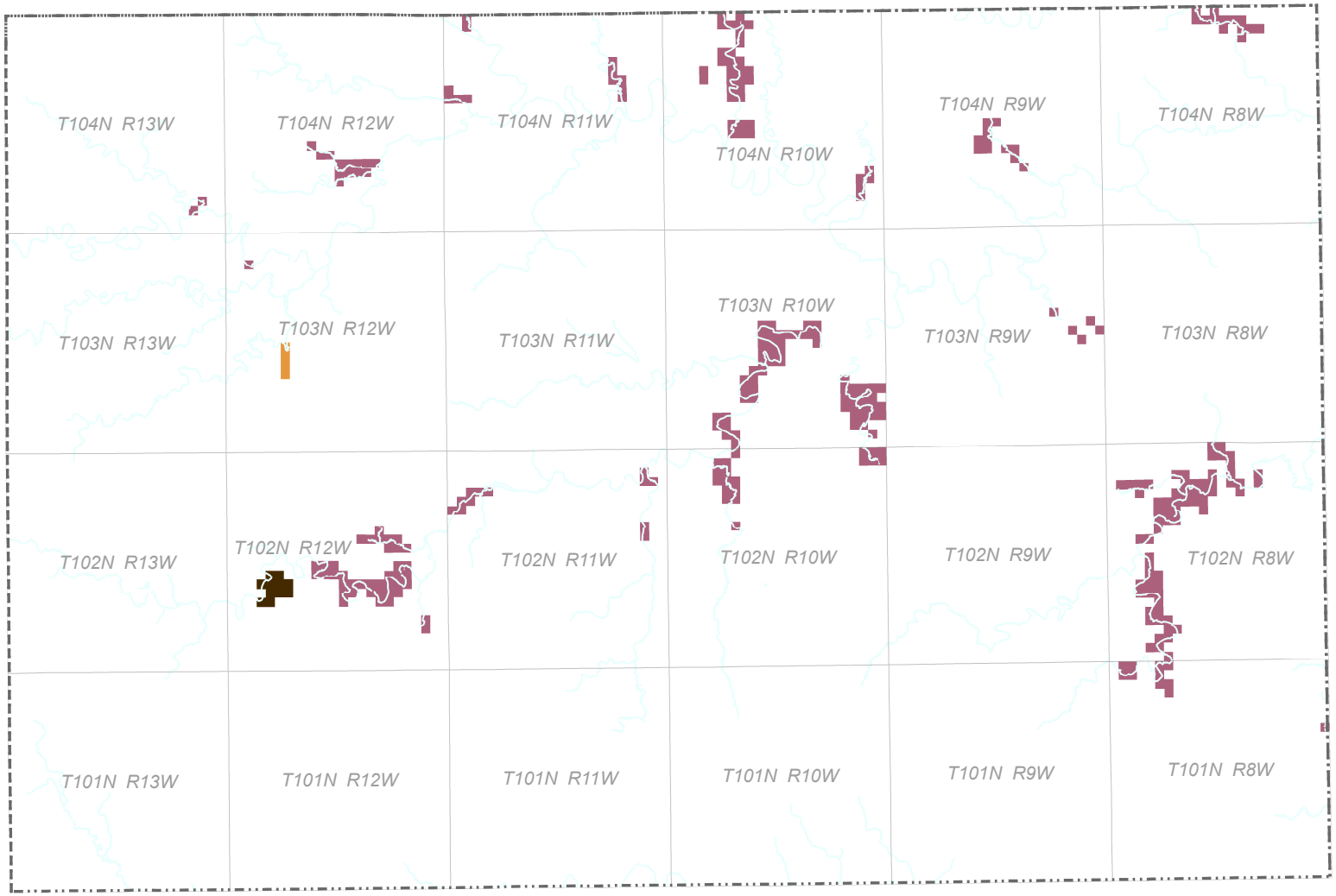
Note: This map shows the approximate relative location of easements and other features but was not prepared by a professional land surveyor. This map is provided for informational purposes only and may not be sufficient or appropriate for legal, engineering, or surveying purposes.

These data are obtained from DNR Land Records as of 2/2011. Easements are mapped to the Quarter-Quarter Section or government lot of the Public Land Survey and are not necessarily portrayed with their true boundaries. Easements that comprise less acreage than this unit of land are represented as an entire Quarter-Quarter Section or government lot.

State-owned DNR-administered Conservation Easements

Conservation Easements by Administrator

Fillmore County



Administrator

- Fisheries
- Parks
- Ecological Resources

- Lakes and streams
- Township boundaries

0 2.5 5 Miles

N

Data sources follow the final map in this map series.

Map prepared February 2011.

© 2011, State of Minnesota, Department of Natural Resources.

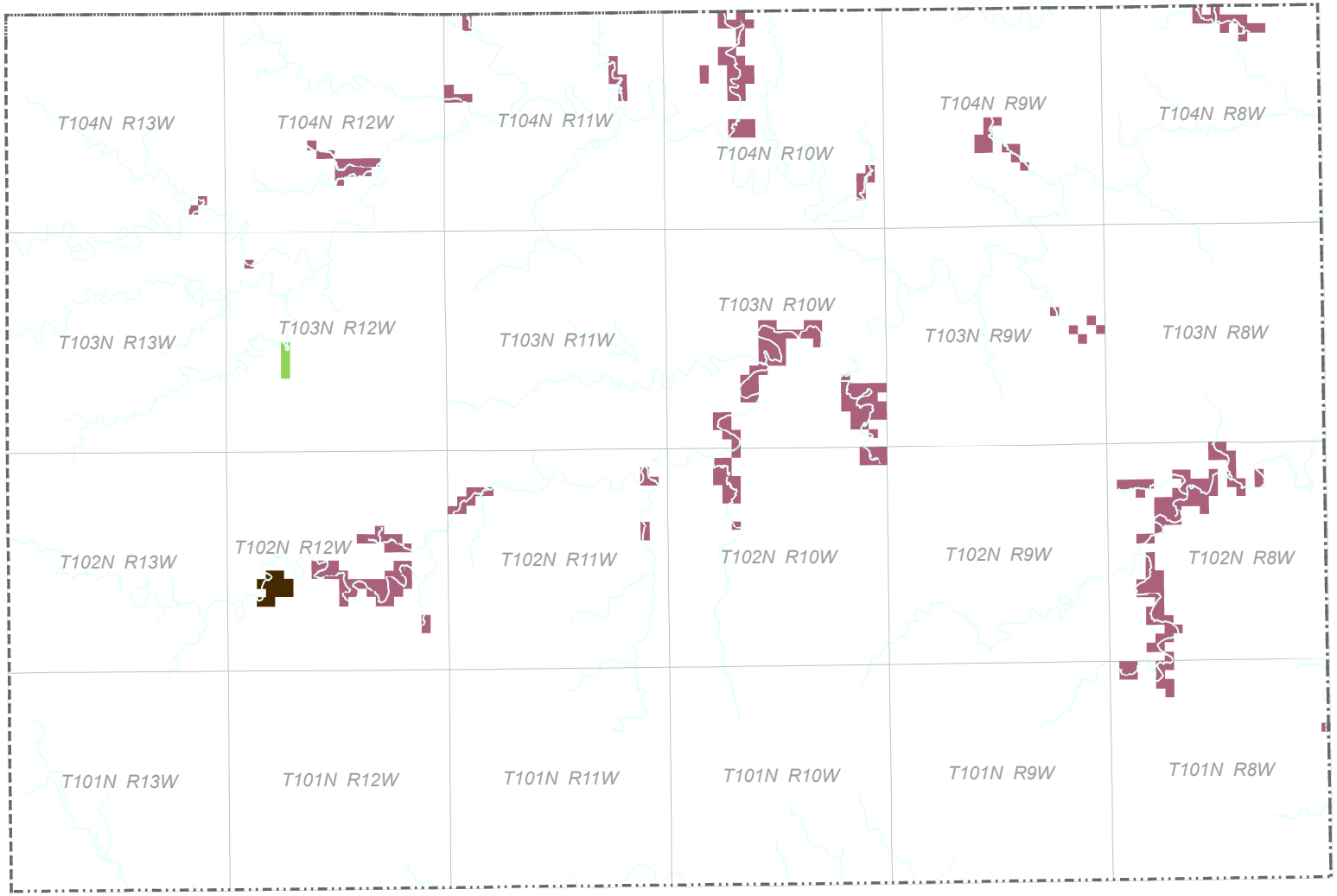
Note: This map shows the approximate relative location of easements and other features but was not prepared by a professional land surveyor. This map is provided for informational purposes only and may not be sufficient or appropriate for legal, engineering, or surveying purposes.

These data are obtained from DNR Land Records as of 2/2011. Easements are mapped to the Quarter-Quarter Section or government lot of the Public Land Survey and are not necessarily portrayed with their true boundaries. Easements that comprise less acreage than this unit of land are represented as an entire Quarter-Quarter Section or government lot.

State-owned DNR-administered Conservation Easements

Conservation Easements by Type

Fillmore County



Conservation Easement Types

- Trout Stream
- Cave
- SNA

- Lakes and streams
- Township boundaries

0 2.5 5 Miles

N

Data sources follow the final map in this map series.

Map prepared February 2011.

© 2011, State of Minnesota, Department of Natural Resources.

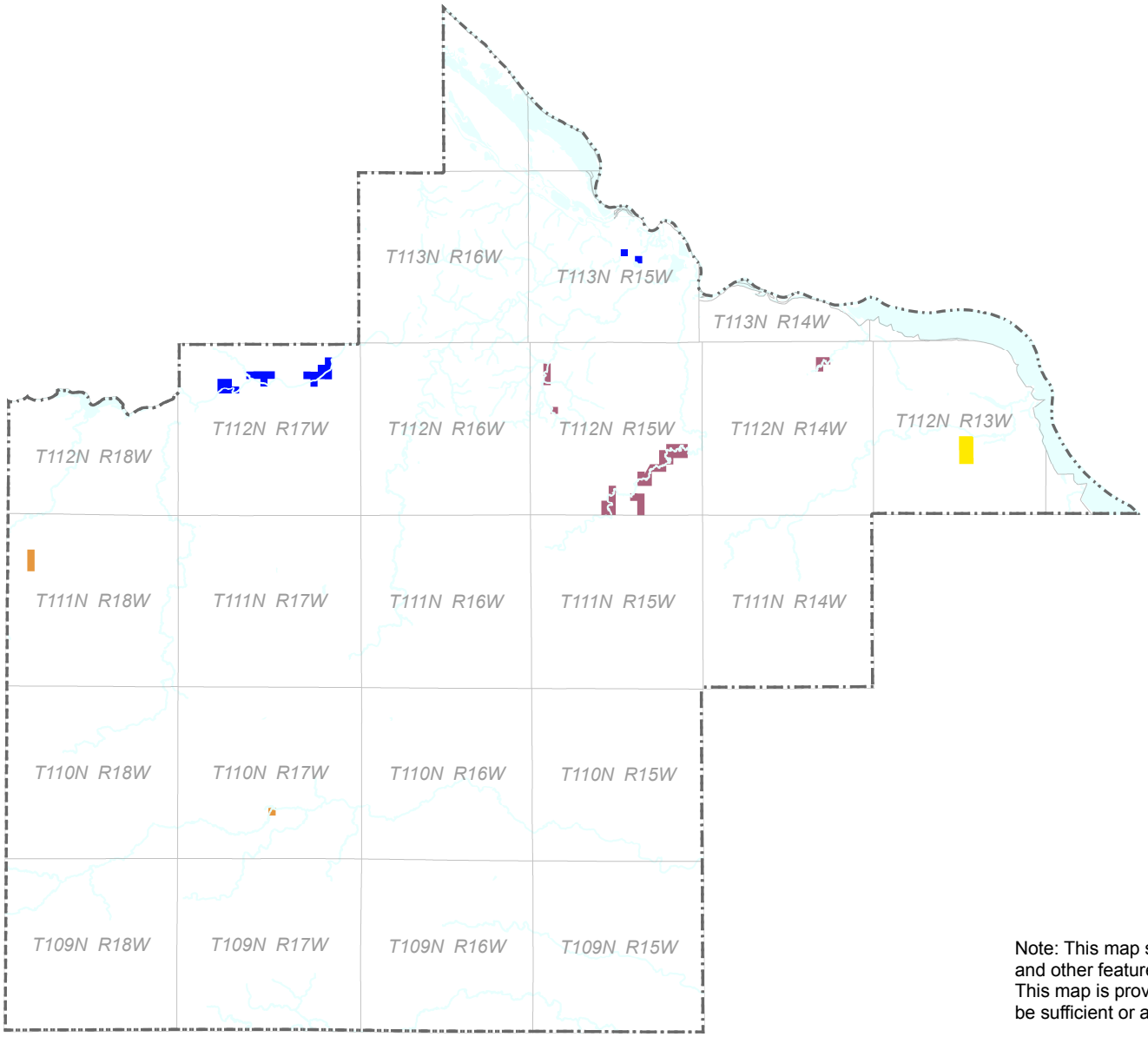
Note: This map shows the approximate relative location of easements and other features but was not prepared by a professional land surveyor. This map is provided for informational purposes only and may not be sufficient or appropriate for legal, engineering, or surveying purposes.

These data are obtained from DNR Land Records as of 2/2011. Easements are mapped to the Quarter-Quarter Section or government lot of the Public Land Survey and are not necessarily portrayed with their true boundaries. Easements that comprise less acreage than this unit of land are represented as an entire Quarter-Quarter Section or government lot.

State-owned DNR-administered Conservation Easements

Conservation Easements by Administrator

Goodhue County



Administrator

- Fisheries
- Ecological Resources
- Trails and Waterways
- Wildlife

- Lakes and streams
- Township boundaries

Note: This map shows the approximate relative location of easements and other features but was not prepared by a professional land surveyor. This map is provided for informational purposes only and may not be sufficient or appropriate for legal, engineering, or surveying purposes.

Data sources follow the final map in this map series.

Map prepared February 2011.

© 2011, State of Minnesota, Department of Natural Resources.

N

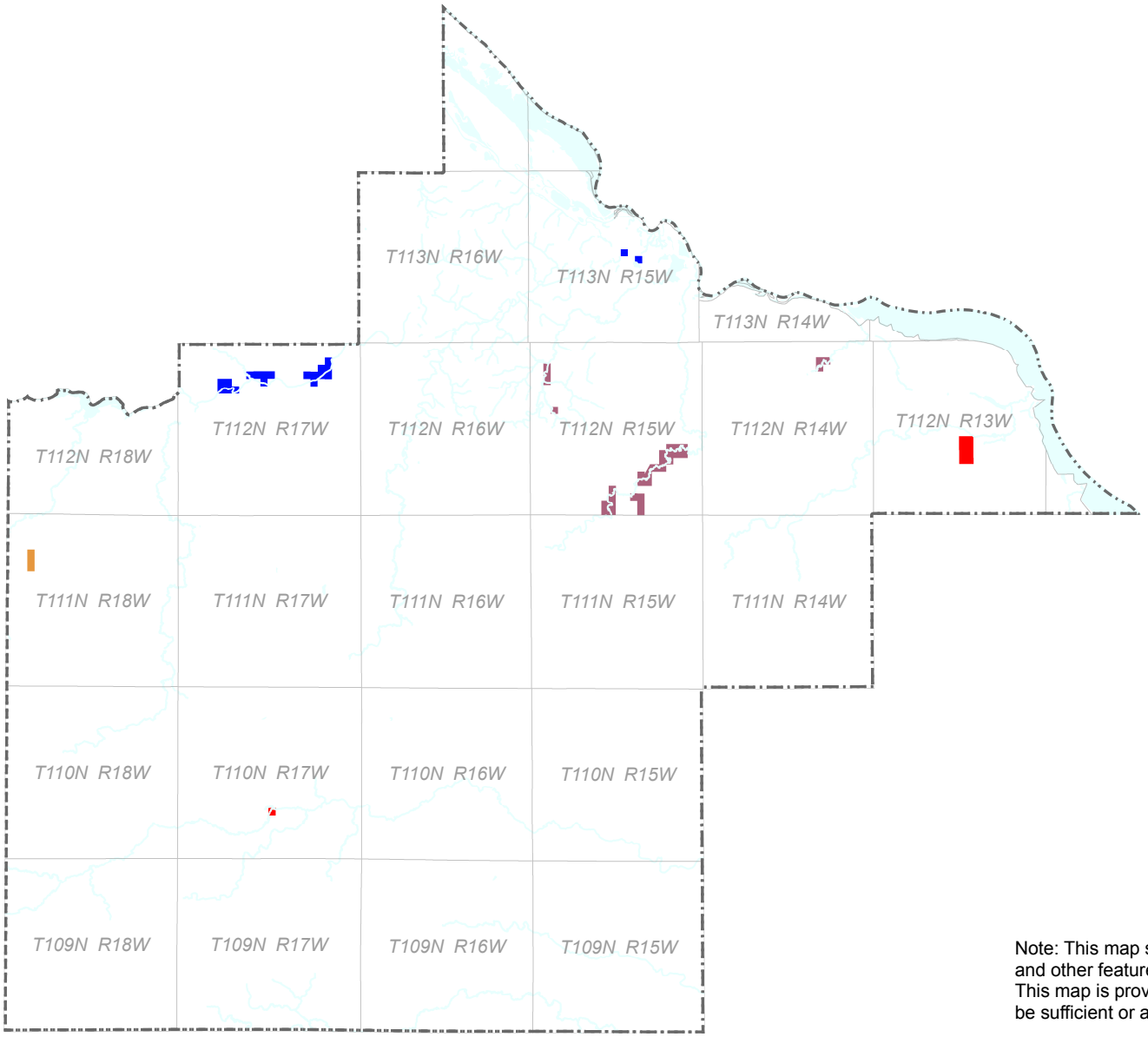
0 2.5 5 Miles

These data are obtained from DNR Land Records as of 2/2011. Easements are mapped to the Quarter-Quarter Section or government lot of the Public Land Survey and are not necessarily portrayed with their true boundaries. Easements that comprise less acreage than this unit of land are represented as an entire Quarter-Quarter Section or government lot.

State-owned DNR-administered Conservation Easements

Conservation Easements by Type

Goodhue County



Conservation Easements Types

- Trout Stream
- Native Prairie Bank
- Wild and Scenic River
- Other Conservation

- Lakes and streams
- Township boundaries

Note: This map shows the approximate relative location of easements and other features but was not prepared by a professional land surveyor. This map is provided for informational purposes only and may not be sufficient or appropriate for legal, engineering, or surveying purposes.

Data sources follow the final map in this map series.

Map prepared February 2011.

© 2011, State of Minnesota, Department of Natural Resources.

N

0 2.5 5 Miles

These data are obtained from DNR Land Records as of 2/2011. Easements are mapped to the Quarter-Quarter Section or government lot of the Public Land Survey and are not necessarily portrayed with their true boundaries. Easements that comprise less acreage than this unit of land are represented as an entire Quarter-Quarter Section or government lot.

State-owned DNR-administered Conservation Easements
Map data sources for sample maps created with conservation easement data layers

Conservation Easement data:

State Conservation Easements–MS Chapter 84C—Minnesota DNR, Division of Lands & Minerals, 2010. Scale 1:24000. Last updated 2/18/2011.

State Conservation Easements–MS Chapter 84C (no matches mapped to section)—Minnesota DNR, Division of Lands & Minerals, 2010. Scale 1:24000. Last updated 2/18/2011.

Contextual data:

DNR 24K Perennial Streams—Minnesota DNR, MIS Bureau, 2004. Scale 1:24000.

DNR 100K Lakes and Rivers—DNR Division of Fish & Wildlife, Fisheries Unit, 2002. Scale 1:100000.

Minnesota County Boundaries—Minnesota DNR, Minerals Division/Section of Wildlife, 2003. Scale 1:24000.

National Wetlands Inventory Geodatabase—Minnesota DNR, Division of Waters, 2009. Scale 1:24000.

Public Land Survey (PLS40) Geodatabase—Minnesota DNR, Division of Lands & Minerals, 2010. Scale 1:24000.

BASELINE PROPERTY REPORT
AMA (Trout Stream) Easement
DNR Managing Fisheries Office: _____

Stream Name	County	Tributary Number	Parcel Number	Acquisition Date		Acquisition Number	
Stream Feet	**One-sided Feet**	**Acreage**	**Width from Centerline**	**UTM Upstream**		**UTM Downstream**	
				Easting	Northing	Easting	Northing

Geocode					DNR Document No.	County Document No.	PID
Twp	Section	Range	Forty	Govt' Lot			

Current Landowner	Address	Contact Number	Date	Comments
Original Landowner	**Address**	**Contact Number**	**Date**	**Comments**

Date of Report	Completed By	Site Visit By	Date of Site Visit	Photos Taken By

Easement Terms and Description of Current Conditions

Paragraph No.	Term [Insert terms of the easement that is the subject of the report]	Current Condition [Describe the current property conditions, as they relate to the easement term]	Reference
	THE PURPOSE AND INTENT OF THIS EASEMENT IS TO:		
1	Permit the development of fish habitat in the above described area, including tree planting, fencing, erosion control, installation of instream structures, posting of signs and other improvements as are deemed necessary.		
2	Permit angling by the public in the above described area		
	FURTHER COVENANTING, THE GRANTOR, FOR ITSELF, ITS HEIRS, SUCCESSORS AND ASSIGNS:		
A	Shall not place or erect any structure or building in the easement area without prior written approval of the Grantee.		
B	Agree to cooperate in the maintenance and enhancement of fishing in the above described area by doing no excavating, filling, dumping, tree cutting, burning or changing of the stream course, without prior written approval of the Grantee		
C	Agree that existing tillage be set back in accordance with the County Shoreland Standards for agriculture lands along water bodies designated by the Commissioner of Natural Resources as trout waters and that no new tillage be initiated within the above described set back corridor **County Shoreland Setback is: _____**		

MAPS

Map 1: Location Map [Shapefile of this easement showing its location on stream; location of other DNR lands, easements on stream, within area]

Map 2: Photopoint Map [Documenting location where photographer was standing]

Photographs [Photos should be saved/stored in original .jpg format, but also inserted in to the Word template for the report]

PHOTOGRAPHS

Photographs need to be identified with the following information:

1. Date taken (This can be identified once for the entire set if all were taken on the same day.)
2. Photographer (This can be identified once for the entire set if all were taken by the same photographer.)
3. Unique identifier for each photo
4. Acquisition number (this may only need to be in the metadata, since the text part of the baseline will already identify the acquisition number)
5. Location (latitude/longitude or UTM coordinates)
6. Direction (this can be upstream or downstream)
7. Description (if necessary)

ACKNOWLEDGEMENT OF PROPERTY CONDITION

AMA (Trout Stream) Easement
Acquisition No. ____
[Name], Original Landowner

This Baseline Property Report accurately represents the current condition of the property.

Current landowner's signature:	Signature and title of DNR representative:
Current landowner's name (please print):	DNR representative's name, title (please print):
This instrument was acknowledged before me on (date):	This instrument was acknowledged before me on (date):
By:	By:
Signature of Notary Public	Signature of Notary Public
Notary Stamp or Seal	Notary Stamp or Seal

About the DNR Baseline Property Report Form and Annotated Instructions

This form is designed to be used for baseline property reports for all DNR conservation easement types except trout stream easements. The section headings identify the information that will generally be included in all reports. Some sections may not be applicable to a particular DNR conservation easement, and sections may need to be added for conservation easements on properties with unusual features. Remove or add sections as needed for a particular project.

What is a baseline property report and what is its purpose?

A baseline property report documents, in text, photos and maps, the conditions of the Protected Property as they relate to each of the easement's terms. For example, if an easement term prohibits "new structures," the baseline would document the location and size of all existing structures on the Protected Property. The baseline report also documents the Protected Property's conservation values, i.e., the aspects of the property that make it worth protecting such as its native plant communities, geologic, hydrologic or scenic features. The content of a baseline report should be specific and measurable. The report should:

- *Serve as an information resource for future DNR staff and future owners of the Protected Property;*
- *Support future monitoring activities by enabling the monitor to detect changes to the property by comparing current conditions with the conditions documented in the report; and*
- *Allow the easement to be enforced in the event of a violation without reference to external materials, to the extent possible.*

Baseline property reports for new conservation easement acquisitions

Baseline property reports for new conservation easements should be prepared during the acquisition process and signed by the landowner and DNR at the closing. The baseline report should include information sufficient to establish the condition of the property <u>at the time the DNR acquires the conservation easement</u>.

Baseline property reports for existing conservation easements

DNR is in the process of preparing baseline property reports for conservation easements it currently holds, some of which are years or decades old. Baseline reports for these properties should document the <u>current</u> condition of the property, rather than reconstruct conditions that existed at the time the easement was acquired. You may include historical documentation (e.g., old photographs, historical FSA maps, old plant lists) in an appendix, but such materials should be clearly marked as historical.

How do I use this form?
This form provides step-by-step instructions for preparing a baseline property report. In addition to using these instructions, review an example of a completed report for your specific easement type.

Italicized and blue text

*Instructions in the form are written in **italicized** text. Delete all instructions before you complete your report.*

*A few examples are included. They are in **italicized blue** text. Delete and replace these sections with the applicable text of your report.*

Headings

If a heading is not applicable to the easement that is the subject of your report, delete it and re-number other headings accordingly. Add a new heading for each non-standard section that is necessary to document the condition and conservation values of a property.

Tables

For ease of reading the report, format tables so that each table is included on a single page.

Photographs

Photographs should (1) show key and representative features of the property that are protected by the conservation easement; and (2) document conditions relevant to the conservation easement's terms. All photographs should be labeled with the photopoint number or letter, photopoint locations and a description of what is shown in the photograph.

Maps

Maps will be created by the user off system in ArcMap. Templates, tools, and instructions for creating standardized baseline report maps can be found at V:\core\lam\projects\easecapture\BaselineTemplates (in the Central Office) or at \\156.98.35.69\gis\core\lam\projects\easecapture\BaselineTemplates for those not in Central Office. Maps will be exported in PDF format and manually incorporated into the baseline property report.

Appendices

Attach the conservation easement itself as Appendix A. Include additional appendices (Appendix B, C, D, etc.) for historical material such as old photographs, old FSA aerial maps, old plant lists, etc.

Avoid redundancy

Avoid redundancy in the report to the greatest extent possible by stating the information once in the appropriate section then referring to that specific section as necessary in other sections.

Quality Control

Ask a co-worker to proofread your baseline before it is finalized.

Finalizing the Report

Once completed, the text, photos and maps should be converted to PDF documents and put together. It is easiest to put page numbers on the completed report using Adobe Acrobat.

MINNESOTA DEPARTMENT OF NATURAL RESOURCES
BASELINE PROPERTY REPORT

Cover page:

1. *Use the heading at the top;*
2. *Insert the best photo of the site in the center of the page;*
3. *As illustrated below, in the lower left-hand corner of the page:*
    a. *List the name of the easement, followed by the easement type (native praire bank, aquatic management area, forest legacy, etc.) on the top line*
    b. *List the parcel number and, in parentheses, the total number of parcels, on the second line (for example, Parcel 1 (of 3))*
    c. *List all original landowners (i.e., the person or persons who conveyed the easement to the DNR)*
    d. *The bottom line should state: "Original Landowner(s)"*
4. *Include the DNR seal in the lower right corner – see below*

Lakeside 30-1 Native Prairie Bank Easement
Parcel 1 (of 1)
Joyce Christensen,
Donald and Esther Kalash,
Ronald and Monica Maurer,
Alan and Linda Staples,
Kim and Terry Anderson,
Original Landowner(s)

Comment [m1]: Automatic: Easement Name—populate from system

Comment [m2]: Automatic: Easement Type--opulate from system

Comment [m3]: Automatic: Parcel number and number of parcels—Populate from system

Comment [m4]: Automatic: Landowner name(s) --Populate from system

DNR INFORMATION COVER SHEET

COUNTY		*Name of county*		
CONSERVATION EASEMENT TYPE		*(ACUB, AMA, native prarie bank, etc.)*		
CONSERVATION EASEMENT ADMINISTRATOR		*Division or section of the DNR responsible for administering easement after it closes*		
GEOCODE (TRACT 1)				
TWP	**RANGE**	**SECTION**	**FORTY**	**GOV'T LOT**
105N	*35W*	*30*	*NENE, SENE*	
GEOCODE (TRACT 2) *Only necessary if there are two tracts*				
TWP	**RANGE**	**SECTION**	**FORTY**	**GOV'T LOT**
105N	*35W*	*19*	*NENE, SESE, SENE*	
ACQUISITION NO.		*137720 This is the number assigned by the Division of Lands and Minerals when an acquisition fact sheet is submitted.*		
COUNTY DOCUMENT NO.		*253501 This is assigned by the county when the easement is filed. This number will not yet be available for baseline reports prepared during the acquisition process to be signed at closing. For those easements, delete this row.*		
DATE FILED		*The date the document was filed at the county This number will not be available for baseline reports prepared during the acquisition process to be signed at closing. For those easements, delete this row.*		
DNR DOCUMENT NO.		*NPB0000276 This is the number assigned by the Division of Lands and Minerals after finalization. This number will not be available for baseline reports prepared during the acquisition process to be signed at closing. For those easements, delete this row.*		
REPORT COMPLETED BY **DATE**		*List name(s) and job title(s) of person(s) who wrote the baseline property report.* *Date the baseline property report was completed*		
SITE VISIT BY **DATE**		*List name(s) and job title(s) of person(s) who visited the site to gather information to write the report.* *Date(s) of the site visit(s)*		
PHOTOGRAPHS TAKEN BY **DATE**		*List name(s) of person(s) who took the photos included in this baseline property report.* *Date(s) of photos*		

Comment [m5]: Automatic: Populate from system

Comment [m6]: Automatic: Populate from system

Comment [m7]: Automatic: Populate from system

Comment [m8]: Automatic: Populate from system

Comment [m9]: Automatic: Populate from system

Comment [m10]: Automatic: Populate from system

Take out unnecessary Table of Contents headings and add others as necessary. Check back at the end of the writing process to assign page numbers.

TABLE OF CONTENTS

Page No.

Acknowledgement of Property Condition…….....
Definitions……..

I. Protected Property Overview …….…….…….
- A. Protected Property Location and Context….……...
- B. Ownership Information……..…… ……
- C. Legal Description, Acreage, Property Tax ID Numbers ……
  - 1. Legal Description and Acreage……...
  - 2. Property Tax ID Numbers.……..
- D. Directions and Access to the Protected Property ……
- E. Conservation Easement Transaction…….……...
  - 1. History of the Transaction……...
  - 2. Transaction Information……..
- F. Conservation Values ……...
  - 1. Overview of Conservation Values……...
  - 2. Specific Property Attributes…..……..
- G. Conservation Easement Terms and Current Conditions……..
- H. Existing Management or Stewardship Plans ……..
- I. Other *[Change the "Other" title to reflect the type of information added here. Delete this heading if this section is not needed.]*

Sources Used to Compile Protected Property Overview ……

II. Maps ……
- Map 1: *Insert name* County, Minnesota (Locator Map)……
- Map 2: Area State and Conservation Lands ……...
- Map 3: Topography…….
- Map 4: Features of Protected Property ……
- Map 5: Rare Natural Features …….
- Map 6: Native Plant Communities …….
- Map 7: Biodiversity Significance ……..
- Map 8: Photopoints …….

Supplemental Definition of Map Symbols …….
Map Data Sources……

III. Photographs ……

APPENDIX *(The Conservation Easement will be Appendix A. Add other appendices for any historical or other material that documents the conservation values of the protected property and would be helpful to future monitors of the easement. Examples of such information include old plant surveys, animal surveys, etc.)*

A. Conservation Easement……..
B. …….

ACKNOWLEDGEMENT OF PROPERTY CONDITION

Easement name followed by the easement type
Parcel __ (of __)
Acquisition No.
List landowners vertically

The following is a standard signature section including room for a notary signature and stamp. When landowners will be signing the document at the same time (such as a married couple) then add one notary for the two people. If landowner will be signing at separate times, provide a notary space for each signature. Some landowners of existing easements may not be willing to sign an Acknowledgment. In such cases, omit the landowner signature block, but still have the appropriate DNR representative sign.

Copy as many of these sections that are needed for all of the landowners to sign.

This Baseline Property Report accurately represents the current condition of the property.

Landowner signature: _____

Landowner name (please print): _____Date: _____

This instrument was acknowledged before me on (date): _____
By:

_____
Signature of Notary Public Notary Stamp or Seal

The following section is the signature and notary section for DNR staff to sign indicating that they attest that the information contain within this report is true.

Minnesota Department of Natural Resources

By: _____
(Signature and title of DNR representative)

DNR representative's name, title (please print):_____

Date: _____

This instrument was acknowledged before me on (date): _____
By:

_____
Signature of Notary Public Notary Stamp or Seal

Comment [m11]: Automatic: Populate easement name and type from system.

Comment [m12]: Automatic: Populate from system

Comment [m13]: Automatic: Populate from system

This Definitions section can be modified to include specific terms or references that might be helpful to any reader, but especially the landowner and future monitors. Review and modify the list as necessary. Delete definitions that are not relevant to your baseline property report. Define any words used in the baseline property report that have specialized meanings or are unique to the DNR.

Definitions:

Baseline Property Report – A record containing text, maps and photographs that documents the conservation values of the protected property and the conditions of the property in relation to the conservation easement's terms. The baseline property report is signed by the landowner and the easement holder (State of Minnesota) and is used to monitor and enforce the conservation easement.

Conservation Easement – The agreement between the Original Landowner(s) and the State of Minnesota to protect the conservation values of the Protected Property.

Conservation Values – The environmental aspects of the land that make it worth protecting.

Management or Stewardship Plan – A plan that guides how land will be managed to protect its conservation values.

Minnesota County Biological Survey – The Minnesota County Biological Survey (MCBS), which is administered by the DNR's Ecological and Water Resources Division, began in 1987 as a systematic survey of Minnesota's rare biological features. The goal of MCBS is to identify significant natural areas and to collect and interpret data on the distribution and ecology of rare plants, rare animals, and native plant communities.

Original Landowners – *Joyce Christensen, Donald and Esther Kalash, Ronald and Monica Maurer, Alan and Linda Staples, Kim and Terry Anderson*, who granted the Conservation Easement to the State of Minnesota.

Comment [m14]: Automatic: Populate from system

Photopoints – The locations where the photographer was standing when *she* took photographs that are contained in this Report. Photopoints are shown on Map *8* and are referenced in the photograph labels.

Protected Property – The property that is subject to the terms and conditions of the Conservation Easement.

Species in Greatest Conservation Need (SGCN) – Animal species whose populations are rare, declining, or vulnerable in Minnesota and meet one or more of five criteria listed in Tomorrow's Habitat for the Wild and Rare: An Action Plan for Minnesota Wildlife, Comprehensive Wildlife Conservation Strategy. Division of Ecological Services, Minnesota Department of Natural Resources 2006. The criteria can be found at the following web address:

http://files.dnr.state.mn.us/assistance/nrplanning/bigpicture/cwcs/chapters_appendix/appendix_a.pdf

Threatened Species (state definition) – A species is considered **threatened** if the species is likely to become endangered within the foreseeable future throughout all or a significant portion of its range within Minnesota.

Threatened Species (federal definition) – An animal or plant species likely to become endangered within the foreseeable future throughout all or a significant portion of its **range.**

I. PROTECTED PROPERTY OVERVIEW

A. Protected Property Location and Context

This section describes the location and the general layout of the Protected Property. Refer to the appropriate map(s). Information in this section should include:

1. *Location of the easement:*
    a. *Within the county*
    b. *In relation to the nearest town*
    c. *In relation to other significant geographic features such as rivers, etc.*
2. *Configuration:*
    a. *Is there more than one discrete parcel/tract in the easement?*
        i. *If there are multiple parcels/tracts, explain how they will be named in the baseline report.*
    b. *Does the easement permit subdivision of the Protected Property?*
        i. *If so, are there limitations on how it can be subdivided?*
3. *Ownership context:*
    a. *Does owner of the Protected Property own more land (such as a farm) surrounding the easement*
4. *Context of protection:*
    a. *What are the uses of surrounding lands?*
    b. *Are there other protected lands in the vicinity?*
        i. *If so, in what way are they protected (e.g., State Parks, WMA's other conservation easements)*

Refer to the appropriate maps.

B. Ownership Information

If the Protected Property has changed hands since DNR acquired the easement, this section should state who the original landowner was, who owns the property now and when the current owner acquired the property.

Describe how the land is currently owned (contact for deed, fee title, etc.) and by whom.

List each current landowner separately in the table below. Save information about other contacts for the land (e.g., children, siblings, hunting buddies) and history of how DNR came to own an easement on this land for the "History of Transaction" section below.

Landowner(s) *If the original landowner still owns the property the caption should be "Original Landowner." Otherwise, use "Current Landowner."*	**Address, City, State, Zip Code**	**Phone Number**

Comment [m15]: Automatic: This will be system generated for new acquisitions.

C. Legal Description, Acreage, Property Tax ID Number(s)

1. Legal Description and Acreage

Insert the legal description of the property protected by the easement. If the legal description is lengthy, refer to the description in the attached conservation easement (Exhibit A) in order to avoid errors in re-writing the description.

Comment [m16]: Automatic: Populate from system for new acquisitions.

If the legal description was written by a DNR staff member (e.g., member of the Survey Unit), include that person's name, title and date after the description. State how the legal description was derived (i.e., by survey or other means).

Give the acreage of the protected property. Explain whether the acreage is a total of more than one tract. ***Example:*** *The Protected Property consists of two discrete tracts of land containing a total of approximately 39.71 acres, more or less.*

Comment [m17]: Automatic: Populate acreage from system for new acquisitions.

2. Property Tax ID Number(s)

Property tax ID numbers will help DNR track changes in ownership of the Protected Property.

List all Property Tax ID numbers that are encumbered by the conservation easement. Sometimes there will be two or more ID numbers. In other cases, the Protected Property will only comprise a portion of the property that is covered by an ID number.

The following property tax ID numbers are encumbered by the Conservation Easement:

Property Tax ID No.

Comment [m18]: Automatic: Populate Property Tax ID Nos. from system.

D. Directions and Access to the Protected Property

Describe how to get to the site from the nearest town, or from the location most people would come from when they monitor the site and how to reach DNR's legal access, other access points, or both, if applicable.

Legal access: *If DNR acquired an access easement to the Protected Property, describe the access easement, its location in relation to the Conservation Easement and explain how to get to the access easement. Refer to the appropriate map.*

Other access points: *If there are other ways to access the Protected Property that are likely to be used by a monitor (e.g., from a road, from state-owned property, or permissive access through private property) also describe and give directions to the Conservation Easement using such access points. State whether permission from a private landowner is required before using such access. Refer to the appropriate map.*

E. Conservation Easement Transaction

1. History of Transaction

This section explains how the Conservation Easement came into being and gives a timeline of the negotiation process. It can provide nice background for future owners and DNR monitors of the property. Topics covered in this section, if known, should include:

- *Historical uses of the property (e.g, farm land, hunting land)*
- *The landowner's reasons for wanting to protect the property*
- *When and how the negotiations for the easement began*
- *The people involved in the negotiations (including DNR staff)*
- *Any significant issues that affected or were discussed during the negotiations*
- *Any past boundary issues or issues pertaining to neighboring land*

2. Transaction Information

Transaction type	*Purchased, donated, etc.*
Closing date	*Date the CE was closed by the DNR*
Purchase price	*The amount that DNR purchased the easement for*
Easement value	**Amount:** **Determined by:** *This will either be appraisal or formula*
Law(s) Authorizing Acquisition	*This is a citation to the DNR's statutory authority to acquire the easement*
Funding Source(s)	***Example:*** *2006 bonding*
Law(s) Appropriating Funding	*The law(s) that appropriated the funds to DNR for the acquisition*

F. Conservation Values

This section describes the conservation values associated with the property—the reasons the property is being protected. "Conservation values" translate the physical/ecological attributes of the property into public benefits associated with protection.

1. Overview of Conservation Values

This subsection provides the "big picture" of the Protected Property's conservation values. Subsection 2 will flesh this out with specific details. The overview should closely follow the values defined in the easement but may be more expansive. Refer to the easement as necessary.

- *Reference any maps and specific photographs that are included in the report illustrating the conservation value(s).*
- *Avoid redundancy in other sections by referring to this description rather than repeating the same information.*

Examples of the types of conservation values to be described in this subsection are:
Natural area and habitat values

- *What type(s) of ecosystem(s) are found on the Protected Property? (Use the classifications in Field Guide to the Native Plant Communities of Minnesota.)*
- *What species of wildlife inhabit the Protected Property or for what species is this type of property known to provide habitat? Reference any species that are endangered, threatened or of special concern. (Detailed information, such as wildlife lists, will be in subsection 2.)*
- *What native plant communities are found on the Protected Property? Are they rare or threatened?*
- *Are individual plant species found on the Protected Property endangered, threatened or of special concern?*

Scenic or open-space values
Historical, architectural, archeological or cultural values
Public benefits

- *Will the Conservation Easement provide public access for hunting, fishing or other forms of outdoor recreation?*
- *Will protection of the property maintain or enhance air or water quality?*

Economic benefits
Scientific or educational values
Other purposes/benefits of the Conservation Easement

- *Did the Legislature or another governmental entity create a program specifically designed to protect this type of property through the acquisition of conservation easements (e.g., ACUB, the Minnesota Forests for the Future Program, the Prairie Bank Program)? If so, cite the relevant statutory authority, and explain the history, purpose and benefits intended by such a program.*

2. Specific Property Attributes

This subsection should provide details about the broad conservation values described in subsection 1. Add subheadings (e.g., Plants, Wildlife, Geologic Features) where appropriate.

Examples of the types of information that should be included are:

- *Findings from any MCBS or other ecological evaluations. Include the date of the evaluation, professional references and supporting materials to validate the findings.*
- *Land cover types*
- *Natural communities*
- *Significant geologic features*
- *Plant and animal species identified on the Protected Property. If possible, include the dates of observation, common and scientific names and name and job title and/or professional qualifications of the observer. (Plant and animal lists can be inserted into this subsection or attached in the Appendix if they are lengthy or historical.)*
- *Observations made during the site visit conducted for the baseline report, including lists of plants and animals observed on that date*
- *Identify any relevant status of natural communities or species (e.g., endangered, threatened, of special concern, regionally or locally significant habitat, etc. and who/what determines this status).*
- *Note, if appropriate, how the specific make-up of the property may change over time but identify the essential characteristics that will remain.*
- *Refer to maps, photos as necessary*

G. Conservation Easement Terms and Current Conditions			
Term No. *Paragraph nos. of the easement terms to be monitored*	**Easement Term** *Language of the easement term. Only include terms that can be **field-verified** and that involve the **landowner's side** of the agreement (i.e, restrictions on what the landowner can do with the property) .*	**Current Condition** *Describe the current conditions that relate to the specific easement term. This is really the key component of the baseline property report text, as future monitors will be relying on these descriptions to detect changes to these conditions over time. Refer to maps, photos or other portions of the report as necessary to provide a complete and accurate description.*	**Reference(s)** *Refer to relevant maps and/or photos*
1.A.	*The Grantors agree that there shall be "[n]o topographic changes or alteration of the natural landscape within or upon said premises by excavation, cultivation, drainage, filling, or any other means without a written authorization from the Commissioner of Natural Resources."*	***Example:** Both parcels of the Protected Property contain rolling hills with moderate slopes (Maps 3, 4). The northeast corner of Tract 1 contains a northeast-facing slope, and an intermittent stream running almost parallel to the eastern boundary the northernmost third of the tract. A ridge runs east of center through the southern two-thirds of the wider part of Tract 2. The western boundary of Parcel 2 intersects a wetland/marsh.*	***Example:** (Maps 3, 4), Photos 1, 2*
1.B	*The Grantors agree that there shall be "[n]o other structures or devices, whether permanent or temporary, hereafter constructed or placed on the premises without a written authorization from the Commissioner of Natural Resources."*	***Example:** A barbed-wire fence that existed at the time the State of Minnesota acquired the Conservation Easement runs from the southeast corner of Tract 1 in a northwesterly direction through part of the Protected Property. There are no other structures or devices on the Protected Property itself.* *If there are existing structures such as buildings within the Protected Property, give the measurements and square footage of each and describe the location. Structures should be photographed and mapped, and references given to the photos/maps.*	***Example:** Photos 9-12*

Comment [m19]: Automatic: Populate from system

Comment [m20]: Automatic: Populate from system. These will generally be the easement terms from the "Covenants" section.

H. Existing Management or Stewardship Plans

Provide the following information:

- *Does the Conservation Easement require a management or stewardship plan?*
- *Has a management or stewardship plan been prepared? If yes:*
  - *Who prepared it?*
  - *When was it prepared?*
  - *Where is it located?*
- *For existing conservation easements with a management or stewardship plan:*
  - *Explain whether and how the plan has been implemented*

I. Other

List any other important information here (change the caption as necessary) or delete this section.

Sources Used to Compile Protected Property Overview:

List the sources used to compile the information in the baseline property report. Examples of the types of source material to cite:

- *Correspondence*
- *Databases (e.g., Natural Heritage Information System; USDA, NRCS Plants Database)*
- *Field guides (e.g., DNR's Field Guides to Native Plant Communities of Minnesota)*
- *Interviews of landowners, including date and name of person doing the interview*
- *Material from acquisition files (for existing easements)*
- *Websites*

[PREPARE MAPS WITH ArcMAP AND INSERT STARTING ON THE FOLLOWING PAGE]

[INSERT PHOTOGRAPHS AFTER THE MAPS.]
Photo Labels:
Photopoint
Unique Photo ID
Location (UTM Coordinates, Lat./Long. or description from landmarks)
Description & direction: (A description of what is in the photo including the direction the photographer was facing when the photo was taken).
Date of photo (The photo date(s) can be referenced in an introduction, and do not need to be included in each separate label)
Name of photographer (Photographer name(s) can be referenced in an introduction, and do not need to be included in each separate label) For example: All photographs in this report were taken by Melissa Driscoll on 10.15.10.

MONITORING FORM
AMA (Trout Stream) Easement

Managing Fisheries Office: _____

Stream Name	County	Tributary Number	Parcel Number	Acquisition Date	Acquisition Number

Stream Feet	One-sided Feet	Acreage	Width from Centerline	UTM Upstream		UTM Downstream	
				Easting	Northing	Easting	Northing

Geocode					DNR Document No.	County Document No.	PID
Twp	Section	Range	Forty	Gov't Lot			

General Information			Monitor Information			Current Landowner		
Monitoring Date:			Monitor Name:			Name:		
Baseline Report:	☐ Yes	☐ No	Monitor Title:			Address:		
Date of Baseline Report:			Phone:			City:	MN	Zip:
Date of First Monitoring Visit:			Email:			Contact Number:		
Date of Previous Monitoring Visit:			Address:			Date:		
Monitoring Interval:			City:	MN	Zip:	Comments:		

Directions to Property	Location of Access			Monitor's Observations		
				Signs in place?	☐ Yes	☐ No
				Pastured?	☐ Yes	☐ No
				Stiles?	☐ Yes	☐ No
				Was landowner or representative present during the monitoring visit?	☐ Yes	☐ No
	Access Type	☐ Legal	☐ Informal	Comments:		

Compliance with Easement Terms

	Term	Are there any concerns about compliance?	IF YES, EXPLAIN, PHOTOGRAPH AND GIVE LOCATION
	THE PURPOSE AND INTENT OF THIS EASEMENT IS TO:		
1	Permit the development of fish habitat in the above described area, including tree planting, fencing, erosion control, installation of instream structures, posting of signs and other improvements as are deemed necessary.	☐ Yes ☐ No	
2	Permit angling by the public in the above described area	☐ Yes ☐ No	
	FURTHER COVENANTING, THE GRANTOR, FOR ITSELF, ITS HEIRS, SUCCESSORS AND ASSIGNS:		
A	Shall not place or erect any structure or building in the easement area without prior written approval of the Grantee.	☐ Yes ☐ No	
B	Agree to cooperate in the maintenance and enhancement of fishing in the above described area by doing no excavating, filling, dumping, tree cutting, burning or changing of the stream course, without prior written approval of the Grantee	☐ Yes ☐ No	
C	Agree that existing tillage be set back in accordance with the County Shoreland Standards for agriculture lands along water bodies designated by the Commissioner of Natural Resources as trout waters and that no new tillage be initiated within the above described set back corridor **County Setback is: _____**	☐ Yes ☐ No	

Monitor's Summary and Compliance Assessment

Monitoring Date:	**Compliance Assessment**	**Summary of Monitoring Visit**
Monitor Name:	Based on your knowledge of the easement and your observations from monitoring, are the terms of the easement being met? ☐ **Yes** ☐ **Pending** (need additional information) ☐ **No** (possible violations observed)	
Title		
Phone:		
Email:		
Address:		
City:		

Required Next Action(s)-check all that apply	**Notes or Summary of Next Action Items or Enforcement**
☐ Send standard follow-up letter/routine monitoring at next regularly scheduled visit	
☐ Schedule management review for pending/possible violation	
☐ Schedule management visit	
☐ Contact area supervisor	
☐ Prepare corrective action plan	
☐ Other	

Photographs (including the following)	**List of Attachments**	
Photo # or unique identifier Photographer Date taken UTM Coordinates for each photo Direction (can be upstream/downstream) Description If multiple photos are taken, create a photopoint map	List any documents that were collected or prepared in connection with the monitoring visit and are scanned.	
	Monitor Signature:	**Date:**

CONSERVATION EASEMENT MONITORING FORM

GENERAL INFORMATION	MONITOR INFORMATION
Conservation Easement Type:	Monitoring Date:
	Monitor Name:
Project Name:	Title:
Acquisition Number:	Phone:
Acquisition Date:	Email:
DNR Document No:	Address:
County Document Number:	City: State: **MN** Zip:
Baseline Report: ☐ Yes ☐ No	
Date of Baseline Report:	Monitor Name:
Date of First Monitoring Visit:	Title:
Date of Previous Monitoring Visit:	Phone:
Monitoring Visit Interval:	Email:
	Address:
Parcel No(s) & Acreages:	City: State: **MN** Zip:
	COMPLIANCE ASSESSMENT Based on your knowledge of the easement and your observations from monitoring, are the terms of the easement being met ☐ **Yes** ☐ **Pending** (need additional information) ☐ **No** (possible violations observed)

PROPERTY TO BE MONITORED

Has the property been surveyed? ☐ Yes ☐ No
Are the easement boundaries marked by signs? ☐ Yes ☐ No
Is there a management or other plan in place? ☐ Yes ☐ No
Is all land included in the easement to be monitored? ☐ Yes ☐ No

Street Address(es) of Property to be monitored if available (approximate if necessary):

Directions to Property:

Location of Legal Access and Informal Access Points:

GEOCODES and PID's of the property to be monitored:

County	Co PID	Township	Range	Section	Forty	Gov't Lot

CURRENT LANDOWNER(S) & CONTACT INFORMATION		
Full Name:		
Full Address:		
Phone 1:	Ext	Type:
Phone 2:	Ext	Type:
Email Address:		
☐ Landowner	☐ Representative	☐ Primary Contact
Has Landowner/Representative been contacted?	☐ Yes ☐ No	

Did Representative accompany Monitor on site visit?	☐ Yes ☐ No	
If No, how was information provided to Monitor?		
☐ By phone (date:)	☐ In writing (date:)	☐ By email (date:)
☐ Other (describe)		

	QUESTIONS FOR LANDOWNER/REPRESENTATIVE	Answer	Comments
1	What is the current use of the protected property?		
2	Are there any plans to make changes in how the property is used?	☐ Yes ☐ No	
3	Have there been any natural alterations to the land (e.g., fire flood, erosion, wind, invasive species, etc.?)	☐ Yes ☐ No	
4	Have there been any new human alterations to the land?	☐ Yes ☐ No	
5	Are there any plans to sell the property or otherwise make changes to ownership?	☐ Yes ☐ No	
6	Have any management activities been conducted or initiated by an entity other than DNR since the last monitoring visit?	☐ Yes ☐ No	
7	If yes, who conducted the management activities?		
8	If yes, what type of management activities were conducted or initiated?		
9	If yes, when were these management activities conducted or initiated?		
10	If yes, what areas of the protected property were affected by these management activities?		
11	Have there been any observations of interesting or unusual plants or wildlife?	☐ Yes ☐ No	
12	Do you have any questions or concerns?	☐ Yes ☐ No	
13	Do you have all information about the easement (baseline report, easement document, maps, etc.)?	☐ Yes ☐ No	

COMPLIANCE WITH CONSERVATION EASEMENT TERMS

	CONSERVATION EASEMENT TERM	Are there any concerns about compliance?	IF YES, EXPLAIN, PHOTOGRAPH, GIVE LOCATION
1	**[EASEMENT TERM]**	☐ Yes ☐ No	
2	**[EASEMENT TERM]**	☐ Yes ☐ No	
3	**[EASEMENT TERM]**	☐ Yes ☐ No	
4	**[ETC.]**	☐ Yes ☐ No	

Are there reserved rights in the Conservation Easement?	☐ Yes ☐ No

	RESERVED RIGHT	Exercised since last visit?	EXPLAIN
1	[RESERVED RIGHT]	☐ Yes ☐ No	
2	Etc.	☐ Yes ☐ No	

MONITOR'S OBSERVATIONS

	OBSERVATION QUESTIONS	ANSWER	COMMENTS
1	Were invasive species observed?	☐ Yes ☐ No	
2	Were other management needs observed?	☐ Yes ☐ No	
3	Are there any other issues or concerns?	☐ Yes ☐ No	

MONITOR'S SUMMARY AND COMPLIANCE ASSESSMENT

Monitoring Date:		**COMPLIANCE ASSESSMENT**
Monitor Name:	Monitor Name:	Based on your Knowledge of the easement and your observations from monitoring, are the terms of the easement being met? ☐ **Yes** ☐ **Pending** (need additional information ☐ **No** (possible violations observed)
Title:	Title:	
Phone:	Phone:	
Email:	Email:	
Address:	Address:	
City: State: **MN** Zip:	City: State: **MN** Zip:	

Narrative Summary of Monitoring Visit:

Required Next Action(s) – check all that apply
- ☐ Send standard follow-up letter/routine monitoring at next regularly scheduled visit
- ☐ Schedule management review for pending/possible violation
- ☐ Schedule management visit
- ☐ Contact area supervisor
- ☐ Prepare corrective action plan
- ☐ Other

Notes or Summary of Next Action Items or Enforcement:

ATTACHMENTS AND PHOTOGRAPHS

Describe Attachments:

List Documents Collected or Prepared in Connection with Monitoring Visit:

Scanned/Appended?
1

Photographs [The photographs need to identify the easement, the date taken and the photographer. This information can be provided once for all photos in the set from the monitoring visit. Each individual photo should have a label identifying: (1) the photopoint where taken (which will correspond to a photopoint map; (2) photo number; (3) direction (N, S, SE, etc.); (4) location (either latitude/longitude or UTM Coordinates (northing/easting)); and (5) description.]

Monitor Signature: _____ **Date:** _____

Monitor Signature: _____ **Date:** _____

2011-2012 MAIN PROPOSAL

PROJECT TITLE: Conservation Easement Stewardship & Enforcement Program, Phase II

I. PROJECT STATEMENT

Minimum standards for conservation easement stewardship require baseline property reports for all easements, regular monitoring, landowner relations, record keeping and enforcement to address easement violations. This project accelerates implementation of DNR's agency-wide Conservation Easement Stewardship and Enforcement Program Plan developed in Phase I by addressing time-sensitive, one-time needs, by training staff and by facilitating the transition to DNR's use of a new conservation easement administration computer application built in Phase I. Project goals are to bring stewardship of at least 180 (approximately 19%) of DNR's existing conservation easements (primarily trout stream, scenic river and prairie bank) up to minimum standards; to refine the new computer application; to train staff; and to identify all fee owners of existing conservation easements. Goals will be achieved by monitoring, collecting baseline data, as needed, and completing baseline reports for at least 180 easements; by utilizing and refining the computer application; by researching current easement ownership, updating the land records system (LRS) and developing a process for future ownership updates; by developing a staff training program and conducting training and by developing enforcement protocols. Activities will be coordinated with divisional staff to support their simultaneous implementation of the Program Plan with respect to all easements.

II. DESCRIPTION OF PROJECT ACTIVITIES

Activity 1: Monitoring, Baseline Data and Reports, Application Refinement

Budget: $385,000

Stewardship of at least 180 conservation easements will be brought up to minimum standards by monitoring per methods developed in Phase I and, where needed, by collection of baseline data. Easements included will be of the highest priority for monitoring (e.g., sites of high biodiversity significance, sites with factors that increase the risk of violations). Baseline property reports, tailored to the easement type, will be completed for at least 180 conservation easements (which may or may not be the same as those monitored). Project staff will utilize the new computer application for conservation easement administration. Based on experience gained through this utilization, the application will be refined.

Outcome	Completion Date
1. Monitor at least 180 of DNR's conservation easements and collect baseline data for those without existing baseline property reports	6/30/2013
2. Complete baseline reports for at least 180 conservation easements	6/30/2013
3. Utilize and refine conservation easement administration application	6/30/2012

Activity 2: Conservation Easement Stewardship Training **Budget: $50,000**

A training program will be developed for DNR staff whose duties include conservation easement administration and/or stewardship. Training will address baseline reports, monitoring, use of the new computer application, record keeping, landowner relations, resolving violations and handling enforcement issues. At least 10 workshops to train 150-175 staff will be conducted.

Outcome	Completion Date
1. Develop conservation easement stewardship training program	6/30/2012
2. Conduct at least 10 workshops, train 150-175 staff	6/30/2013

Activity 3: Conservation Easement Enforcement Protocols **Budget: $15,000**
Agency-wide conservation easement enforcement protocols will be developed and implemented. The protocols will outline specific steps for staff to take when a violation is detected and will ensure that all easement violations are addressed in a prompt, fair and consistent manner, in accordance with all legal requirements for easement enforcement.

Outcome	Completion Date
1. Develop and implement conservation easement enforcement protocols	12/31/2012

Activity 4: Landowner Data **Budget: $50,000**
Research will be conducted to verify and update fee ownership and owner contact information for all existing DNR conservation easements (969, based on the Phase I inventory). In coordination with DNR's Land Records Project, project staff will develop a process to regularly update this information in the LRS in the future.

Outcome	Completion Date
1. Research ownership and contact information for all DNR conservation easements, update LRS as necessary, develop process for future updates	6/30/2012

III. PROJECT STRATEGY

A. Project Team/Partners

Project staff in the Lands and Minerals Division will be responsible for overall project coordination, baseline report preparation and all of Activities 2-4. Field staff, who will be based in DNR area offices, and Conservation Corps Minnesota will be hired for most monitoring and baseline data collection. A contractor will perform computer application refinement. Project staff will collaborate with DNR conservation easement administrators as they implement the Program Plan developed in Phase I, and with DNR's Land Records Project.

B. Timeline Requirements

Funding for two years (July 1, 2011 through June 30, 2013) is requested to provide multiple field seasons for monitoring and baseline data collection.

C. Long-Term Strategy and Future Funding Needs

A $15,000 appropriation partially funded a minimum standards report. (ML 2007, ch. 57, art. 1, § 4, subd. 2). A $520,000 appropriation from the ENRTF (ML 2008, ch. 367, § 2, subd. 5(h)) funds Phase I of this project. DNR's Conservation Easement Stewardship and Enforcement Program will rely largely on funding sources as recommended in Phase I of the project in the long term. Phase II is designed to address one-time needs and to jump-start Program Plan implementation. Future requests for ENRTF appropriations for conservation easement stewardship will be for the purpose of addressing additional portions of DNR's baseline report backlog and bringing existing conservation easements up to minimum standards and to address one-time needs or emerging issues.

2008 Project Abstract
For the Period Ending June 30, 2010

PROJECT TITLE: Waters of Minnesota: Television/Outreach Documentary on Watersheds
PROJECT MANAGER: Barbara Coffin
AFFILIATION: Bell Museum of Natural History, UofMN, TC
MAILING ADDRESS: 10 Church St. SE
CITY/STATE/ZIP: Minneapolis, MN 55455
PHONE: 612-624-4986
E-MAIL: bcoffin@umn.edu
WEBSITE:
FUNDING SOURCE: Environment and Natural Resources Trust Fund
LEGAL CITATION: ML 2008, [Chap.367], Sec.[2], Subd.6(a)

APPROPRIATION AMOUNT: $ 349,000

Overall Project Outcome and Results

The documentary film that resulted from this project, ***Troubled Waters: A Mississippi River Story,*** examines our relationship to the Mississippi River and its surrounding watershed through the competing interests of food, fuel and environment. Excess nitrogen and phosphorus, fertilizers essential to the growth of plants, are contaminating the nation's rivers, lakes and aquifers at the same time as precious soils wash away. The film tells the complex story of these troubled waters both here in Minnesota and downstream as far away as the Gulf of Mexico and highlights innovative solutions – high-tech farmers that practice precision agriculture and conservation farming methods; cattle farming while maintaining perennial cover on the landscape; and new technologies that hold water back on the land. Farmers, scientists, and entrepreneurs offer new ideas for meeting the goals of an ambitious, food-producing nation while ensuring the long-term health and sustainability of one of its most precious resources – the Mississippi River and its watershed.

Engaging, serious and hopeful documentary video has proven to be an innovative and effective environmental education tool that reaches a broad audience of students and adults. Following the successful model of the recent Emmy award-winning television series *Minnesota: A History of the Land*, this new documentary will be broadcast on public television and be available in DVD format for local distribution.

Project Results Use and Dissemination

Troubled Waters: A Mississippi River Story will be broadcast on Twin Cities Public Television. Subsequent broadcasts are planned for the Minnesota Channel.
Public television stations along the length of the Mississippi River will have the opportunity to air the film. A public premiere screening event is planned for October 3, 2010. The documentary is available in professional quality DVD format for educational uses. The DVD will be distributed to Mississippi River venues (e.g. the National Mississippi River Museum & Aquarium and Mississippi National River and Recreation Area Interpretive Center).

Trust Fund 2008 Final Report

Date of Report: August 30, 2010
Final Report
Date of Work program Approval: June 10, 2008
Project Completion Date: June 30, 2010

I. PROJECT TITLE:
*Wat*ers of Minnesota: Television/Outreach Documentary on Watersheds

Project Manager: Barbara Coffin
Affiliation: Bell Museum of Natural History, U of MN, TC
Mailing Address: 10 Church St. SE
City / State / Zip: Minneapolis, MN 55455
Telephone Number: 612-624-4986
E-mail Address: bcoffin@umn.edu
FAX Number: 612-626-7704
Web Page address:

Location: Upper Mississippi River Watershed and its global connection downstream to the Gulf of Mexico *(This watershed drains approximately 60% of the land surface of the State of Minnesota.)*

Total Trust Fund Project Budget:	**Trust Fund Appropriation:**	**$**	**349,000**
	Minus Amount Spent:	**$**	**349,000**
	Equal Balance:	**$**	**0**

Legal Citation: ML 2008, [Chap.367], Sec.[2], Subd.6(a).

Appropriation Language: 18.30 (a) Waters of Minnesota Documentary on Watersheds. $349,000 is from the trust fund to the Board of Regents of the University of Minnesota for the Bell Museum of Natural History to begin the development of an educational documentary television series on the waters of Minnesota designed to promote watershed understanding and citizen action in protecting, restoring, and conserving water resources. This appropriation is available until June 30, 2011, at which time the project must be completed and final products delivered, unless an earlier date is specified in the work program.

II & III. FINAL PROJECT SUMMARY:
The documentary film that resulted from this project, ***Troubled Waters: A Mississippi River Story,*** examines our relationship to the Mississippi River and its surrounding watershed through the competing interests of food, fuel and environment. Excess nitrogen and phosphorus, fertilizers essential to the growth of plants, are contaminating the nation's rivers, lakes and aquifers at the same time as precious soils wash away. The film tells the complex story of these troubled waters both here in Minnesota and downstream as far away as the Gulf of Mexico and highlights innovative solutions –

high-tech farmers that practice precision agriculture and conservation farming methods; cattle farming while maintaining perennial cover on the landscape; and new technologies that hold water back on the land. Farmers, scientists, and entrepreneurs offer new ideas for meeting the goals of an ambitious, food-producing nation while ensuring the long-term health and sustainability of one of its most precious resources – the Mississippi River and its watershed.

Engaging, serious and hopeful documentary video has proven to be an innovative and effective environmental education tool that reaches a broad audience of students and adults. Following the successful model of the recent Emmy award-winning television series *Minnesota: A History of the Land*, this new documentary will be broadcast on public television and be available in DVD format for local distribution.

IV. OUTLINE OF PROJECT RESULTS*:*

Result 1: Waters of Minnesota: The Upper Mississippi River Watershed (A Television/Outreach Documentary)

Description: The first episode of *Waters of Minnesota,* titled *Troubled Waters: A Mississippi River Story,* focuses on the Upper Mississippi River and its connection downstream to the Gulf of Mexico. Stories about the upper Mississippi River watershed, a system that extends over approximately 60% of the Minnesota landscape, will reveal much about Minnesota's lakes, wetlands, and rivers. This one-hour documentary tells stories that: 1) provide an overview and basic understanding of the Mississippi River's hydrology; 2) look at the Mississippi River watershed both as a natural system and as an engineered system; and 3) explore how the river links us ecologically and economically at a global scale.

Summary Budget Information for Result 1:	**Trust Fund Budget:**	**$ 349,000**
	Amount Spent:	**$ 349,000**
	Balance:	**$ 0**

Deliverable	**Completion Date**	**Budget**	**Status**
1. Broadcast quality episode	June 30, 2010	$349,000	$000,000
2. DVD for distribution	June 30, 2010	$0.00	
(Note: other non-LCCMR project funds will cover this expense)			
3. Marketing Plan & Implementation	Spring-Fall, 2010	$0.00	
(Note: other non-LCCMR project funds will cover this expense)			

Completion Date: *June 30, 2010*

Final Report Summary: June 30*, 2010*
The *Waters of Minnesota: The Upper Mississippi River Watershed* project, final title – *Troubled Waters: A Mississippi River Story* – was completed in June 2010. Final editing, scientific animations, music cues, and final narration were completed in time for post-production online editing at Twin Cities Public Television in April-May 2010. Professionally produced and packaged DVDs were produced in summer 2010. Plans

for public television broadcast and educational distribution of the DVDs were developed and finalized in August 2010. The premiere broadcast is set for October 5, 2010 on Channel 2 of Twin Cities Public Television.

V. TOTAL TRUST FUND PROJECT BUDGET:

Staff or Contract Services: $331,657
Equipment: $ 0.00
Development: $ 0.00
Restoration: $ 0.00
Acquisition, including easements: $ 0.00
Other: $ $17,343 (travel and expenses)

TOTAL TRUST FUND PROJECT BUDGET: $349,000

VI. OTHER FUNDS & PARTNERS:

A. Project Partners: Larkin McPhee of Larkin McPhee Productions (Producer, Director, Writer); Shanai Matteson of the Bell Museum of Natural History (Assistant Producer);

B. Other Funds Proposed to be Spent during the Project Period: In addition to the $349,000 of LCCMR appropriated funds, an additional approximately $150,000 will be spent. The project budget total is approximately $500,000.

C. Past Spending:

Bell Museum of Natural History, UMN: Concept Development (May-June 2008: in-kind $25,000)
Dept. of Fisheries, Wildlife and Conservation Biology, UMN: National Science Foundation – Master Naturalist Program (Jan 07-June 2008: $33,000)

Minnesota: A History of the Land (LCMR $400,000 [1999-2001], $254,000 [2001-2003]; McKnight Fdn $450,000; UMN $250,000; Met Council $165,000; Other foundations, corporations, & individuals $481,000 – total $2,000,000 for four-part television series [1999-2005])

D. Time:

This appropriation funded a major portion of the documentary titled, *Troubled Waters: A Mississippi River Story*. The project began with concept development in 2007 and was completed in June of 2010.

VII. DISSEMINATION:

Troubled Waters: A Mississippi River Story will be broadcast on Twin Cities Public Television on October 5th, 2010 at 9PM. Subsequent broadcasts are planned for the Minnesota Channel. Public television stations along the length of the Mississippi River will have the opportunity to air the film. A public premiere screening event is planned for October 3, 2010. The documentary is available in professional quality DVD format for educational uses. The DVD will be distributed to Mississippi River venues (e.g. the National Mississippi River Museum & Aquarium and Mississippi National River and Recreation Area Interpretive Center).

VIII. REPORTING REQUIREMENTS:

Periodic work program progress reports will be submitted not later than December 31, 2008, June 30, 2009, and December 31, 2009. A final work program report and associated products will be submitted between June 30 and August 1, 2010 as requested by the LCCMR.

Attachment A: Budget Detail for 2008 Projects			
Project Title: Waters of Minnesota: Television/Outreach Documentary			
Project Manager Name: B*arbara Coffin*			
Trust Fund Appropriation: $ *349,000*			
2008 Trust Fund Budget	**Result 1 Budget:**	**Amount Spent** (6/30/10*)*	**Total Balance** *(6/30/10))*
	Waters of Minnesota: The Upper Mississippi River Watershed	*6/30/2010*	*6/30/2010*
BUDGET ITEM			
PERSONNEL: UMN wages and benefits (one FTE @ 60% and one FTE @ 75% for two fiscal years)	103,137	103,137	
Contracts			
Professional/technical *(Independent Contractors for Video Editor/Director; Videographer; 3-D Animation Graphics; Music Composition; Post-Production w/ Twin Cities Public Television*	228,520	228,520	0
Other contracts *(with whom?, for what?) list out: personnel, equipment, etc.*			
Printing			
Other Supplies and Services *(video tape, office supplies, courier services, postage, contractor mileage and overnights expenses, licensing of specific images and footage)*	11,939	11,939	0
Travel expenses in Minnesota	5,404	5,404	0
Travel outside Minnesota *(where?)*			
Other *(Describe the activity and cost) be specific*			
COLUMN TOTAL	**$349,000**	**349,000**	**$0**

Abstract For 2008 Minnesota Schools Cutting Carbon Project Ending June 30, 2011.

PROJECT TITLE: GLOBAL WARMING: REDUCING THE CARBON FOOTPRINT OF MINNESOTA SCHOOLS

PROJECT MANAGER: William Sierks
AFFILIATION: Minnesota Pollution Control Agency
MAILING ADDRESS: 520 Lafayette Road, Suite 200
CITY/STATE/ZIP: St. Paul, MN 55101
TELEPHONE NUMBER: (651) 757 2722
E-MAIL ADDRESS: bill.sierks@state.mn.us
WEB PAGE ADDRESS: www.schoolscuttingcarbon.org; www.pca.state.mn.us

FUNDING SOURCE: Environment and Natural Resources Trust Fund
LEGAL CITATION: ML 2008, Chap. 367, Sec. 2, Subd. 6(b).

APPROPRIATION AMOUNT: $ 750,000.

Project Outcome and Results

Minnesota Schools Cutting Carbon (MnSCC) is a three-year project that engaged over 7,000 students in 100 public high schools, colleges and universities across Minnesota to save energy and reduce greenhouse gas emissions at their schools.

Results: The 100 MnSCC schools collectively saved their schools about 5 million kWh of electricity (totaling 18 billion BTUs) and $325,000 in energy costs annually, which means the three-year program paid for itself in two and a half years. The project also avoided 9.5 million pounds of carbon dioxide emissions (CO_2 is a greenhouse gas).

In addition, 23 of the MnSCC schools received a total of $202,828 in competitive grants for renewable energy, energy efficiency, recycling, and transportation reduction projects. Fourteen schools were able to measure and report savings of over 3 million kWh of electricity; 10,500 therms of natural gas; and 26,000 gallons of gasoline - totaling 14.4 billion BTUs. These projects saved approximately $300,000 in annual energy costs and avoided 6.2 million pounds of CO_2 emissions.

The cumulative impact of all 100 MnSCC school projects saved schools 32.4 billion BTUs of energy, $625,000 in energy costs, and reduced carbon dioxide emissions by 15.7 million pounds, the equivalent of taking 1,700 cars off of Minnesota roads.

Our project team helped schools create clean energy teams, personally visited every school, provided individual school reports with recommendations on saving energy and resources, and gave students the opportunity to develop and lead energy-saving projects, network with other schools, and share success stories.

Student leadership was a key focus of our project, and there are many great examples of students having a direct impact on their schools and communities:

- Students presented at the biennial Clean Energy Resource Teams (CERTs) conference in St. Cloud in February 2011 to over 100 conference attendees over two days.

- Students rallied in the State Capitol Rotunda on Earth Day 2010, meeting fellow students and several legislators.

- Students presented before the LCCMR and the House Environment Policy and Oversight Committee to talk about how their work has impacted their school.

Overall, MnSCC demonstrated that our students are highly motivated and very effective. They achieved significant energy savings, and they directly influenced their schools and communities through their leadership and interactions with school officials, teachers, fellow students, and community representatives.

Project Results Use and Dissemination

1. How Project Information Has Been Used and Disseminated.

One of the primary objectives of this project was to raise awareness of energy issues and to implement low cost and no cost energy-saving actions in schools through the leadership of students. We also were focused throughout the project on creating opportunities for students to talk about their projects, share results, and for MnSCC to recognize their successes. The following is a list of the resources we created to enable schools to take clean energy actions. Many of our students presented their projects to school boards, local officials, and others in their schools and communities through dozens of events throughout this project. Examples of some of these and our main recognition events are listed below. Many more school events are described in appendices 3 and 4 of our final report.

Project Planning Resources: The outreach materials created and published on the MnSCC website to assist school teams during the project include:

- ***Planning Tips:*** Basic questions to start thinking about, and specific tips for how to go about planning projects at high schools, colleges and universities.
- ***Planning Documents:*** Eight presentations and fact sheets geared toward project planning in general and specific types of projects.
- ***Case Studies:*** Sixteen case studies, mostly of previous CERTs-supported projects—each one has a basic description and link to a pdf.
- ***Funding Opportunities:*** A funding toolkit and updates on specific current and future funding opportunities for schools, each with a basic description and proposal due date.
- ***Useful Links:*** Including project partners, other organizations working with schools, technical resources, and educational resources.

Features of the MnSCC website include:

- A home page that has colorful navigation boxes to drive visitors to certain places on the site. The highlight boxes include: Grant Opportunity; Sponsorship Program; Mentorship Program; School Spotlight. We also added a fun image to the homepage that speaks to teamwork and the student-led initiatives that each school is working on. Link: http://www.schoolscuttingcarbon.org. The site also includes basic program description, news and event highlights, and map-based and project-based navigation to school pages.
- A page with more information on the MNSCC program, partners, grant application information and forms, and a timeline. A video introducing the Schools Cutting Carbon staff team was posted to the public 'About' page and the internal Site Intro page (where users are taken when they log in).
- Statewide and regional listings of participating schools, with interactive map navigation and regional event and news highlights. Link: http://www.schoolscuttingcarbon.org/full-map
- A public web page for every school that allows students to track their carbon footprint reduction and share their team name and photo, the projects they are working on, all of their news and events, and any other information. Each school has a master account holder who has permission to edit their school's content. Many schools used the website to update their projects, posting text, pictures, and videos. We have captured many success stories from individual schools and intend to preserve this data on the CERTs website after the MnSCC website becomes inactive.
- Project planning resources, sponsor and mentor opportunities, information about energy efficiency, renewable energy and other projects that MnSCC schools are doing across the state, funding opportunities available to schools, and links to find more information on specific topics and technologies, including narrative tips, project case studies, and planning guides.
- An internal forum that allows students to discuss energy efficiency and clean energy issues and connect and collaborate on their projects. School leaders create and manage their own school's forum users, allowing students at each school more opportunity to be involved. More than 500 Minnesota students and teachers interacted through the forums. Topics discussed include waste reduction strategies in the lunchroom, webcast announcements, energy efficiency presentations, goal-setting and accomplishment celebrations, Earth Week events, green roofs, Project Green Fleet, greenhouses, solar projects, fundraising ideas, and Lights Out Day.
- There are links to on-line resources for all MnSCC partner organizations in the "Useful Links" page under Project Planning.

Website statistics. From the website launch in December of 2008 until the end of August 2011, there were 14,038 visits with 86,958 page views. The average person visited 6.19 pages per visit. The average time spent on the site was 4:13 minutes. The website had visitors from every state in the United States except Wyoming and visitors from 70 countries worldwide with the majority from the United States, followed by India, Canada, and Australia.

Many schools used the website to update their projects, posting text, pictures, and videos. We have captured many success stories from individual schools and intend to preserve this data on the CERTs website after the MnSCC website becomes inactive.

Recognition Events that Publicized Project Information

Earth Day at the Capitol 2010. Students from Central High School and LEAP High School in St. Paul; The City, Inc. in Minneapolis; Ortonville High School; Henry Sibley High School in Mendota Heights; Osseo Senior High School; and the School of Environmental Studies in Apple Valley participated in "Earth Day at the Capitol: Thumbs Up for Clean Energy!" This celebration of student-led energy efficiency and clean energy projects showcased Minnesota's future leaders on clean energy and green jobs. It featured presentations by the seven school teams as well as Senator Ellen Anderson, Representative Kate Knuth, and Abby Fenton of the Will Steger Foundation. WCCO Radio also interviewed students from Ortonville High School about their initiatives to reduce their school's carbon footprint during the Noon News Hour.

Student Presentations to Legislature and Elected Officials. Several student teams were invited to present their projects to the LCCMR in November 2010, and still others had the opportunity to present before the House Environment Policy and Oversight Committee to talk about how their work has impacted their school.

Minnesota Environmental Initiative Award – Energy and Climate Protection Project of the Year. The annual Environmental Initiative Awards honor innovative projects that have achieved extraordinary environmental outcomes by harnessing the power of partnership. The Environmental Initiative (EI) is a non-profit organization that believes that partnership is an effective way to find solutions to Minnesota's environmental problems. EI established the Environmental Initiative Awards in 1994 to honor innovative projects and their many partners, to inspire other organizations to create similar successful projects, and to encourage innovative collaborative approaches to environmental problem solving. Awards are given in five categories, and the Schools Cutting Carbon project received the award in the Energy and Climate Protection Category at the Environmental Initiative Awards dinner on May 27, 2010.

CERTs Bi-Annual Energy Conference. The CERTs Conference in February 2011 featured several MnSCC schools in the "Creating a Clean Energy School" conference track. Students from Aitkin, Rosemount, and Ortonville High Schools had the opportunity to develop their leadership and networking skills by attending and presenting at this conference. The two-day student track attracted over 110 people.

Minnesota State Lottery Twentieth Anniversary Celebration. The MnSCC Team, including Patrick Santelli, Project Coordinator, Dan Reinke of ERM, and Bill Sierks, Project Manager, spoke about the MnSCC project at the twentieth anniversary celebration of the Minnesota State Lottery at the Mall of America on April 17, 2010.

Greening the Heartland Conference. Through our partnership with the Minnesota chapter of the U.S. Green Building Council, MnSCC had the opportunity to participate in the Greening the Heartland Conference in May 2010 at the Minneapolis Convention Center. MnSCC participated in the conference workshops and had a table to display school projects in the exhibit hall for the duration of the conference, which was sponsored by the Minnesota USGBC Chapter and Green Communities.

2. Communication and Outreach Activities for MnSCC.

Communication and outreach have been at the heart of this project since it began. MnSCC began with a major communication and outreach effort to all Minnesota public high schools, colleges and universities to let them know about our project and encourage them to participate. Specific outreach included:

Specific outreach methods included:

- Contacting the lowest 25 performing schools identified in the B3 database project. The B3 database allows school teams to see how their buildings are performing compared to an energy benchmark and determine where efficiency improvement options exist.
- The U.S. Green Building Council (USGBC) and MNSCC project team issued a joint press release sent out to the USGBC mailing list.
- The Minnesota Technology Education Association, the Minnesota Rural Partners, National Teach-in, and NextStep posted the project on their websites and newsletters.
- Team members presented at the Science and Nature Conference at Gustavus Adolphus College.
- Diana McKeown was a featured guest on the “Everything Green” radio show on 12/6/08 (KTNF 950 AM)
- Attended four Youth Environmental Activist! MN (YEA! MN) and Youth Environmental Summit (YES) meetings.
- Met with the Minneapolis sustainability director to assist in reaching the Minneapolis school district, and sent emails to all of the relevant Minneapolis teachers and administration.
- Met with the St. Paul Public Schools service-learning department, sent emails and made phone calls made to administration and interested teachers.
- Contacted professors within the Minnesota State Colleges and Universities (MnSCU) system who are experts in their respective fields.
- Sent emails to all MnSCU media contacts about the program.
- The Minnesota Science Teachers Education Project (MN-STEP) sent out a blast email for MNSCC to its list serve of Minnesota science teachers.
- The Minnesota Environmental Partnership, the Will Steger Foundation, the Bog Walker, the Science Museum newsletter, and Education Minnesota placed MNSCC in their newsletters.
- Promoted MNSCC at the Will Steger Summer Institute in August 2008.

- Phone calls were made and follow up emails sent to over 40 charter school science teachers and administrators.
- Discussed MNSCC at a meeting of the Minnesota State Colleges Student Association advisors.
- Spoke about MNSCC at the Powershift conference.
- Contacted Rebuild America Building Efficiency Workshops attendees.
- Contacted all schools that applied for the recent Environmental Learning in Minnesota (ELM) grant program and all schools that took the Minnesota Energy Challenge.
- Emails were sent to all members of SEEK (Sharing Environmental Education Knowledge).

Regular and consistent communication with schools was a very important component of this project. Patrick Santelli prepared a regular MnSCC newsletter that highlighted events, funding possibilities, and highlighted different schools in a “school spotlight” segment**.** He personally phoned teachers to talk about the project, our goals and objectives, what schools were doing, and followed this with regular updates. We also held several webinars for schools throughout the project to explain the grant application process and to explain how they could follow up on the individual school action plans to implement low cost and no cost energy actions at their schools.

In addition, the recognition efforts discussed above, including Earth Day at the Capitol, student presentations to the LCCMR and the House Environment Policy and Oversight Committee, the Environmental Initiative Award, CERTs Bi-Annual Conference, Minnesota Lottery Celebration, Greening the Heartland Conference, and the many presentations by student teams to their schools, school boards, local elected officials, and their presentations at fairs, festivals, and other events all resulted in widespread communication and outreach of the MnSCC projects and results.

Environment and Natural Resources Trust Fund
2008 Work Program Final Report

Date of Report: September 30, 2011
Final Report
Date of Work Program Approval: June 10, 2008
Project Completion Date: June 30, 2011

I. PROJECT TITLE: GLOBAL WARMING: REDUCING THE CARBON FOOTPRINT OF MINNESOTA SCHOOLS

Project Manager: **William Sierks**
Affiliation: **Minnesota Pollution Control Agency**
Mailing Address: **520 Lafayette Road, Suite 200**
City / State / Zip: **St. Paul, MN 55101**
Telephone Number: **651 757 2722**
E-mail Address: **bill.sierks@state.mn.us**
FAX Number: **651 215 0246**
Web Page address: **www.pca.state.mn.us; www.schoolscuttingcarbon.org**

Location: Statewide

Total Trust Fund Project Budget:	**Trust Fund Appropriation:**	**$ 750,000**
	Minus Amount Spent:	**$ 748,393**
	Final Balance:	**$ 1,607**

Legal Citation: ML 2008, Chap. 367, Sec. 2, Subd. 6(b).

Appropriation Language: (b) Global Warming - Reducing Carbon Footprint of Minnesota Schools --- $750,000 is from the trust fund to the commissioner of the Pollution Control Agency to provide student-focused grants to high schools, colleges, and universities to identify their carbon footprints and develop and implement innovative plans to reduce carbon emissions. This appropriation is available until June 30, 2011, at which time the project must be completed and final products delivered, unless an earlier date is specified in the work program.

II. and III. FINAL PROJECT SUMMARY.

Minnesota Schools Cutting Carbon (MnSCC) is a three-year project that engaged over 7,000 students in 100 public high schools, colleges and universities across Minnesota to save energy and reduce greenhouse gas emissions at their schools.

Results: The 100 MnSCC schools collectively saved their schools about 5 million kWh of electricity (totaling 18 billion BTUs) and $325,000 in energy costs annually, which means the three-year program paid for itself in two and a half years. The project also avoided 9.5 million pounds of carbon dioxide emissions.

In addition, 23 of the MnSCC schools received a total of $202,828 in competitive grants for renewable energy, energy efficiency, recycling, and transportation reduction projects. Fourteen schools were able to measure and report savings of over 3 million kWh of electricity; 10,500 therms of natural gas; and 26,000 gallons of gasoline - totaling 14.4 billion BTUs. These projects saved approximately $300,000 in annual energy costs and avoided 6.2 million pounds of carbon dioxide emissions.

The cumulative impact of all 100 MnSCC school projects saved schools 32.4 billion BTUs of energy, $625,000 in energy costs, and reducing carbon dioxide emissions by 15.7 million pounds, the equivalent of taking 1,700 cars off of Minnesota roads.

Our project team helped schools create clean energy teams, personally visited every school, provided individual school reports with recommendations on saving energy and resources, and gave students the opportunity to develop and lead energy-saving projects, network with other schools, and share success stories.

Student leadership was a key focus of our project, and there are many great examples of students having a direct impact on their schools and communities:

- Students presented at the biennial Clean Energy Resource Teams (CERTs) conference in St. Cloud in February 2011 to over 100 conference attendees over two days.

- Students rallied in the State Capitol Rotunda on Earth Day 2010, meeting fellow students and several legislators.

- Students presented before the LCCMR and the House Environment Policy and Oversight Committee to talk about how their work has impacted their school.

Overall, MnSCC demonstrated that our students are highly motivated and very effective. They achieved significant energy savings, and they directly influenced their schools and communities through their leadership and interactions with school officials, teachers, fellow students, and community representatives.

IV. OUTLINE OF PROJECT RESULTS*:*

Result 1: Education and Outreach — Budget: $25,000

Through in-person, written and on-line outreach, phase one of the project will explain the importance of determining a school's carbon footprint, becoming carbon neutral, and how student-led behavioral and operational changes can have significant climate change impacts. Outreach will include information about how to participate in this project, the importance of acting to stop global warming and becoming carbon neutral, and an emphasis on the opportunity for student-led teams to work with other schools across Minnesota on a project that will directly affect their schools, curriculum, and

community. The outreach materials will explain that schools can access a broad range of resources through this project.

Priority Outreach:

In particular, our outreach will target the following public school sectors:

- **School buildings with high energy-savings opportunities:** The school buildings with energy performance falling in the lower 50% as determined by the Minnesota Buildings, Benchmarks and Beyond (B3) database (http://www.mnbenchmarking.com) or the ENERGY STAR Portfolio Manager (http://www.energystar.gov/index.cfm?c=evaluate_performance.bus_portfolio manager)

- **Schools demonstrating environmental leadership:** Past participants in the Clean Energy Resource Teams (CERTs) Rebuild America workshops, the Will Steger Foundation, EPA's Energy Star program, or similar sustainable campus initiatives.

- **Schools with active student leaders:** Environmental student groups like MPIRG (http://www.mpirg.org), WeCAN (http://wecannetwork.org/), Youth Energy Summit teams (http://www.prairiewoodselc.org/YES%20flyer%2007.pdf), and the Minnesota Colleges and Universities that have signed the Climate Commitment (http://www.presidentsclimatecommitment.org/html/list_state.php).

Rationale for Prioritized Categories. The buildings with energy performance falling in the lower 50% as determined by the Minnesota B3 database or the EPA ENERGY STAR Portfolio Manager will most likely have significant opportunities to conserve energy and reduce carbon at very low or no cost (the B3 program is described in Result 2). Project partners will contact these schools directly and encourage them to participate in the project. In addition, we will work with the B3 program to encourage any public school districts, colleges and universities who have not yet entered their schools into the benchmarking database to participate in that effort so they can identify the potential energy-saving opportunities in their schools. Based on the additional resources and incentives we will provide, schools already active in developing a sustainable campus or reducing greenhouse gas emissions are also likely well-positioned to work with us to integrate project actions into their curriculum and implement behavior-change actions in areas such as building operation, transportation, and land and water use practices that reduce carbon.

Summary Budget Information for Result 1:	**Trust Fund Budget:**	**$ 25,000**
	Amount Spent:	**$ 25,000**
	Balance:	**$ 0**

Deliverable	Completion Date	Budget	Status
1. Create program education and outreach materials; develop and implement strategies for use.	January 31, 2009	$14,000	Completed.
2. School officials, teachers, and students receive information about the project and an invitation to participate through targeted mailings, administration, teacher or student conferences, and other outreach/events.	January 31, 2009	$0	Completed.
3. CERTs website updated to inform schools of project, provide on-line grant applications, resources, and access to technical assistance.	June 30, 2011	$11,000	Completed.

Final Report Summary - Result One: The first steps in this project were very important, since we had an ambitious goal of recruiting 100 schools across the state to participate in the project during the first six months. Through a major outreach effort by all project team members, we reached our goal of recruiting 100 schools statewide. The list of MnSCC schools organized by region is presented in Appendix 1. The schools are listed by city in Appendix 2. The project team outreach and education efforts were led by University of Minnesota (UM) Humphrey Institute graduate student Patrick Santelli, who was hired as project coordinator in October 2008. As discussed below, we are proud of the outcomes we achieved under Result 1. In addition to reaching our goal of 100 schools, we created a robust website and developed many resources to help student teams.

Deliverable 1 - Develop Outreach Strategies and Materials.
The UMN hired Patrick Santelli as the project coordinator. Mr. Santelli, as well as U of M CERTs coordinators Lissa Pawlisch, Joel Haskard, and Dan Thiede, Diana McKeown of the Green Institute (now part of Eureka Recycling), and others of the project team contributed significant in-kind hours to designing and implementing the outreach strategy to reach hundreds of schools across the state.

Project team efforts included developing an outreach database, strategy, press release and other materials to inform students, teachers, school administrators, and school building officials about the project and announce the launching of MnSCC. The project team's methods of communication included personal phone calls and using many different organizations' list servers to contact school administration and science/interested teachers, building operators, and student organizations; and speaking at a number of meetings, conferences, and community events to promote the project and distribute project information.

Project Planning Resources: The outreach materials created and published on the MnSCC website to assist school teams during the project include:

- ***Planning Tips:*** Basic questions to start thinking about, and specific tips for how to go about planning projects at high schools, colleges and universities.
- ***Planning Documents:*** Eight presentations and fact sheets geared toward project planning in general and specific types of projects.
- ***Case Studies:*** Sixteen case studies, mostly of previous CERTs-supported projects—each one has a basic description and link to a pdf.
- ***Funding Opportunities:*** A funding toolkit and updates on specific current and future funding opportunities for schools, each with a basic description and proposal due date.
- ***Useful Links:*** Including project partners, other organizations working with schools, technical resources, and educational resources.

Deliverable 2 - Contact school officials, teachers and students. The project team spent many hours informing Minnesota high school, college and university officials, students and teachers about our project and encouraging them to apply. Specific outreach methods included:

- Contacting the lowest 25 performing schools identified in the B3 database project. The B3 database allows school teams to see how their buildings are performing compared to an energy benchmark and determine where efficiency improvement options exist.
- The U.S. Green Building Council (USGBC) and MNSCC project team issued a joint press release sent out to the USGBC mailing list.
- The Minnesota Technology Education Association, the Minnesota Rural Partners, National Teach-in, and NextStep posted the project on their websites and newsletters.
- Team members presented at the Science and Nature Conference at Gustavus Adolphus College.
- Diana McKeown was a featured guest on the “Everything Green” radio show on 12/6/08 (KTNF 950 AM)
- Attended four Youth Environmental Activist! MN (YEA! MN) and Youth Environmental Summit (YES) meetings.
- Met with the Minneapolis sustainability director to assist in reaching the Minneapolis school district, and sent emails to all of the relevant Minneapolis teachers and administration.
- Met with the St. Paul Public Schools service-learning department, sent emails and made phone calls made to administration and interested teachers.
- Contacted professors within the Minnesota State Colleges and Universities (MnSCU) system who are experts in their respective fields.
- Sent emails to all MnSCU media contacts about the program.
- The Minnesota Science Teachers Education Project (MN-STEP) sent out a blast email for MNSCC to its list serve of Minnesota science teachers.

- The Minnesota Environmental Partnership, the Will Steger Foundation, the Bog Walker, the Science Museum newsletter, and Education Minnesota placed MNSCC in their newsletters.
- Promoted MNSCC at the Will Steger Summer Institute in August 2008.
- Phone calls were made and follow up emails sent to over 40 charter school science teachers and administrators.
- Discussed MNSCC at a meeting of the Minnesota State Colleges Student Association advisors.
- Spoke about MNSCC at the Powershift conference.
- Contacted Rebuild America Building Efficiency Workshops attendees.
- Contacted all schools that applied for the recent Environmental Learning in Minnesota (ELM) grant program and all schools that took the Minnesota Energy Challenge.
- Emails were sent to all members of SEEK (Sharing Environmental Education Knowledge).

We designed the MnSCC application process to be user friendly, minimize demands on teachers' busy schedules, and not intimidate schools who may be interested in the program. The application was also designed to encourage students, teachers, and administration to start thinking about ways to reduce their carbon footprint. The section on the B3 database came with instructions of how to enter data and who to contact if the school was not in the database.

Official Launch of Schools Cutting Carbon - Earth Day Media Coverage: The Schools Cutting Carbon Program was officially launched to the Minnesota public and media on April 21st, 2009—Earth Day—in a press release titled, "100 Schools Launch Massive Effort to Reduce Carbon and Save Energy": http://www.cleanenergyresourceteams.org/files/SchoolsCuttingCarbon_Release_EarthDay2009.pdf. This release attracted a great deal of media attention, with one highlight being coverage on the Fox 9 Evening News: http://www.schoolscuttingcarbon.org/schools/metro/lakeville-south-high-school/news/lakeville-south-schools-cutting-carbon-fox-9.

Timing for Project Launch: The deadline for schools to apply for MnSCC was December 15, 2008. This gave us time to conduct outreach and assure that we reached as many schools as possible. The downside is that the school year was almost half over, and it would be preferable to engage the schools in the fall as students and teachers are getting into their school routine. We reached over 7,000 students, and working with them early in the school year is important to gain as much time as possible to help design and carry out projects

Deliverable 3 - Website Development and Operation. The Minnesota Project designed the project website from October through December 2008, with input from the rest of the project team. The website design was officially launched on February 19, 2009. This was timed to coincide with the four MnSCC Kickoff webinars that were organize by our consultant, Environmental Resources Management (ERM), held on

February 18-19, 2009. The website will remain active at least through the December 30, 2011.

Features of the Web site include:

- A home page that has colorful navigation boxes to drive visitors to certain places on the site. The highlight boxes include: Grant Opportunity; Sponsorship Program; Mentorship Program; School Spotlight. We also added a fun image to the homepage that speaks to teamwork and the student-led initiatives that each school is working on. Link: http://www.schoolscuttingcarbon.org. The site also includes basic program description, news and event highlights, and map-based and project-based navigation to school pages.
- A page with more information on the MNSCC program, partners, grant application information and forms, and a timeline. A video introducing the Schools Cutting Carbon staff team was posted to the public 'About' page and the internal Site Intro page (where users are taken when they log in).
- Statewide and regional listings of participating schools, with interactive map navigation and regional event and news highlights. Link: http://www.schoolscuttingcarbon.org/full-map
- A public web page for every school that allows students to track their carbon footprint reduction and share their team name and photo, the projects they are working on, all of their news and events, and any other information. Each school has a master account holder who has permission to edit their school's content.
- Badges were added to each school page if they worked with certain partners. Badges were created for Transcampus Energy Action Movement (TEAM MN); Youth Energy Summit (YES!); Youth Environmental Activists of Minnesota (YEA MN); and Project Green Fleet.
- Project planning resources, sponsor and mentor opportunities, information about energy efficiency, renewable energy and other projects that MnSCC schools are doing across the state, funding opportunities available to schools, and links to find more information on specific topics and technologies, including narrative tips, project case studies, and planning guides.
- We added information about the Sponsorship and Mentorship Programs to the site explaining how organizations and individuals can support schools, and the benefits of various sponsorship levels. The Sponsorship Program offered sponsorship three different levels of sponsorship ($500, $1000, and $1500) to assist school teams. Sponsors could select a specific technology or an individual school to support. Mentors were individuals who supported school efforts by sharing ideas, time, expertise, recommendations, and connections to help teams donating their time and expertise. Over twenty mentors volunteered to work with MnSCC schools during the project. Links: http://www.schoolscuttingcarbon.org/about-program/sponsor; http://www.schoolscuttingcarbon.org/about-program/mentor
- An internal forum that allows students to discuss energy efficiency and clean energy issues and connect and collaborate on their projects. School leaders create and manage their own school's forum users, allowing students at each school more opportunity to be involved. More than 500 Minnesota students and teachers interacted through the forums. Topics discussed include waste reduction

strategies in the lunchroom, webcast announcements, energy efficiency presentations, goal-setting and accomplishment celebrations, Earth Week events, green roofs, Project Green Fleet, greenhouses, solar projects, fundraising ideas, and Lights Out Day.

- The website gave schools access to application forms, instructions, webinars and powerpoints containing information about how to apply for both the competitive and small grants. Competitive grant assistance included an Application How-To Webinar from one of the several instructive webinars that were given to introduce schools to this opportunity. Link: http://www.schoolscuttingcarbon.org/project-planning/funding/RFP. All schools that applied for these grants successfully used the online form.
- There are links to on-line resources for all MnSCC partner organizations in the "Useful Links" page under Project Planning.

Website statistics. From the website launch in December of 2008 until the end of August 2011, there were 14,038 visits with 86,958 page views. The average person visited 6.19 pages per visit. The average time spent on the site was 4:13 minutes. During this time frame the most common visited pages were the home page, schools sites, and project planning sites. The website had visitors from every state in the United States except Wyoming. The website had visitors from 70 countries worldwide with the majority from the United States, followed by India, Canada, and Australia.

Examples of some websites that were extremely active include:

- Bemidji State University
- Dakota County Technical College
- Hibbing Community College
- Lac qui Parle Valley Schools
- Lakeville South High School
- Rainy River Community College
- Rosemount High School
- Springfield High School
- Staples-Motley High School
- Stephen-Argyle High School
- Two Harbors High School

The project website was originally developed as a place in which schools could design and update their own web pages and share information. We limited access to assure that only appropriate content was posted, but this may have limited the ability of students to interact in the website forums. Many schools used the website to update their projects, posting text, pictures, and videos. We have captured many success stories from individual schools and intend to preserve this data on the CERTs website after the MnSCC website becomes inactive.

The information area of the website was also very successful, although it required a large time commitment from the project team to keep current. Using Google analytics to track web traffic, we learned that visitors spent the most time on the funding information,

with visits averaging nearly twice as long as any other page. Our effort to aggregate funding information and experiences required a large time commitment, but also gave Patrick Santelli good grounding on funding opportunities for schools.

Ongoing School Outreach. Regular and consistent communication with schools was a very important component of this project. Patrick Santelli prepared a regular MnSCC newsletter that highlighted events, funding possibilities, and highlighted different schools in a "school spotlight" segment**.** He personally phoned teachers to talk about the project, our goals and objectives, what schools were doing, and followed this with regular updates. A future program should also provide more support for teachers to strengthen our relationship with school teams and build a stronger network across participating schools.

We held several webinars during the course of the project to recruit schools for the program; explain the grant requirements; and explain how they could continue to save energy and measure results of their actions. These webinars were successful in generating school interest. We recommend that a subsequent project schedule webinars on a regular basis to not only explain project features but also to showcase work that schools are doing. School teams would have the opportunity to present their project to the web audience, and we could facilitate a dialogue during the webinar. This would create more networking and connection opportunities for school teams.

We did not have funds to cover travel costs for schools to meet face to face. When they did have opportunities to meet in person, such as Earth Day at the Capitol and the Bi-annual CERTs conference, students welcomed the opportunity to talk about their work. These events also provided opportunities for recognizing their good work.

Result 2. Carbon Footprint Identification and Initial Reduction Budget: $467,172

Overview of Result 2. In phase two of the project, schools will receive technical and financial assistance to determine their carbon footprint, identify the most effective actions to reduce their footprint, and take steps toward becoming carbon neutral. After developing their carbon footprint reduction plans, this phase of the project will emphasize the leadership role of students in changing behavior to reduce greenhouse gas emissions and track the impact of their actions through the remainder of this three-year project. We expect to reach approximately 100 schools. To maximize the reach of our project, applicants will be required to provide a financial or in-kind match and identify faculty, student and administrative commitment to the project. Result 2 will provide the following assistance to schools:

1. **Technical Assistance.** A team of technical experts will work with school teams to evaluate between one and three of their school buildings (participating high schools will typically assess one building; colleges and universities may assess up to three buildings) and identify actions that can reduce greenhouse gas emissions. We will select a consultant to assemble this team via a request for proposal process. Using the

Minnesota public building B3 benchmarking database to identify school buildings with the greatest potential for cost-effective greenhouse gas reductions, the consultant will explain how changes to building operations, including student behaviors, can reduce energy use and greenhouse gas emissions. We will also provide on-line resources and other materials that explain the connection between behavior change and reducing greenhouse gas emissions and demonstrate how students can monitor changes in building energy use and carbon emissions. Students can participate in developing and implementing no cost and low cost energy savings actions.

2. **Assistance to Student Teams.** Our consultant team, assisted by CERTs teams and project partners, will help student-led teams to identify and implement greenhouse gas reduction actions that they can take at both their school and in their communities. The focus will be on topics such as sustainable land and water use practices; promoting ride-share, walking, and other alternatives to student driving; promoting school bus "green fleets"; purchasing of environmentally-friendly products; and promoting waste reduction and recycling. Students will develop their own school carbon reduction plans, selecting those options most appropriate for their schools.

3. **On-line Resources.** School teams will access an on-line mechanism to connect to project partners in their area, exchange information with each other, publish case studies, and form teams to compete against other schools to see who can achieve the greatest carbon footprint reductions.

How Schools Will Be Selected. Interested Schools will apply through the CERTs website and provide the name/contact of the project leader (a faculty advisor such as a science teacher); student organization/student leader; school superintendent; school facility manager; local utility provider; number of buildings on the campus; and student body size. Schools will be able to apply to enroll in the project through January of 2009.

We will apportion the funding for Result 2 between public high schools and higher education institutions so that we involve 100 schools overall. In selecting participants, we will strive for geographic representation of both the metropolitan area and greater Minnesota schools; small, medium, and large schools; and schools with one or more buildings identified in the lower half of the Minnesota benchmarking database. Those schools who identify and commit to broader student participation, schools with a history of student leaders addressing sustainability issues, and those demonstrating commitment of outside partners or additional financial resources to the project will also receive priority consideration.

Consultant Technical Assistance Available to Schools in Result 2:

Schools selected to participate in the project will work with project consultants to develop carbon footprints and identify greenhouse gas reduction actions during the winter and spring of the 2008-2009 school year. The state will issue an RFP to assemble a team of technical experts who will work with school teams to develop carbon footprint action plans. A project consultant will assess the school building

operations and work with the school team to identify and implement no cost and low cost actions to reduce the building carbon footprint, implement low cost/no cost actions most appropriate to their schools, and monitor the impact of those actions during the remaining two years of the project. We have allocated $467,172 in project funds to work with school teams to carry out this work, allocated as follows:

- $361,693 for a consultant team to work with school teams to reduce building carbon footprints, with an estimated cost of $2500 to $2800 per school for building assessments and to develop student-led carbon footprint action plans to address transportation, commuting, land and water use, recycling, and similar topics.

- $60,479 for grants of $250 to $500 that will be awarded directly to school teams to develop and begin implementing student carbon footprint action plans; $8,307 of this amount will be used to purchase vending misers that will be given as an incentive during the spring 2011 semester to school teams that maintain updated energy databases and are reporting project results.

- $45,000 for the UMN project coordinator to work with school teams to apply for and implement grant projects, and assist the consultant team and school teams in implementing carbon reduction action plans.

Result 2 will offer schools several sources of technical assistance and resources to reduce their carbon footprint. These include:

1. **Minnesota Benchmarking for School Buildings**: In 2001, the Minnesota Legislature established a benchmarking tool for public buildings, including schools larger than 5,000 sq. ft., to maintain energy use information, establish benchmarks, and track building performance. M.S. Sec. 216B.241. Many public schools have entered energy data for their buildings into this database. The legislature intended that the Benchmarking database evaluate building performance and identify those with the highest return on investment for energy conservation funding. There are hundreds of school buildings already in the Benchmarking database.

Our project will use this database by working with school teams to analyze their benchmarking data and identify the greatest opportunities for cost-effective energy and greenhouse gas reductions. Schools will be able to compare the energy usage of their buildings to school buildings of similar size and use in Minnesota. Those buildings performing in the lower half of the Benchmarking database will most likely have significant opportunities to save energy and reduce greenhouse gas (GHG) emissions (primarily carbon dioxide emissions) at little or no cost. Because of the potential carbon reduction opportunities of school buildings, we will encourage schools not yet participating in the Benchmarking project to do so.

2. **Energy and Carbon Reduction Actions - Buildings**: After identifying the most cost-effective opportunities through the Benchmarking database, student-teacher teams

will work with our technical experts to walk through their campus buildings and identify low and no-cost actions that can reduce their energy use and greenhouse gas emissions. The consultant team selected through the RFP mentioned earlier will discuss with school teams a plan for efficient operations and annual energy awareness campaigns, training, and utility tracking. The focus includes eliciting behavior change aimed at staff and students to identify low and no-cost operational changes for schools to save energy. Our technical experts will visit schools and work with school teams to develop their energy/carbon reduction actions.

3. **Carbon Footprint Reduction Actions – School-wide:** Student-teacher teams will also identify behavior changes in areas such as commuting to school, land and water use, recycling, and other areas that can reduce greenhouse gas emissions. Our consultant team will work with project partners, including CERTs regional teams, to provide information, including web-based tools that can help school teams calculate their carbon footprint and learn how to reduce greenhouse gas emissions in the areas discussed above. We will discuss how the Benchmarking website will be used to track changes to the carbon footprint of school buildings. Our consultant team will also provide a web-based tool to track changes to campus-wide greenhouse gas emissions. To assist students in developing and implementing greenhouse gas-reducing actions and behavior changes, we will designate a portion of the funding in the RFP for this task to be made available by the consultant to individual schools to assist in implementation.

As mentioned above, $361,693 in project funds will be awarded through a consultant RFP for assistance to schools in developing and implementing carbon footprint reduction actions in their buildings and school-wide. In addition, the project will provide funds directly to schools to begin implementing their plans. School teams may apply to the state to receive between $250 and $500 in grant funds to cover expenses such as developing their team's carbon footprint action plan, hosting a conference, implementing some low-cost actions, or preparing materials to publicize and encourage support for their action plan. There is $60,479 in project funds that will be awarded through the school grants and to purchase vending misers as an incentive during the spring 2011 semester to school teams that maintain updated energy databases and report project results.

4. **Resource Materials:** Schools will receive technology and resource information about various technologies (e.g., wind, solar, geothermal, green buildings), energy efficiency options, Project Green Fleet and clean-car technologies, recycling and waste reduction, and other resources through our project partners and the CERTs website. Each school will be able to learn what other schools in the project are doing through the CERTs website. Each school will have a designated slot into which they can post text updates, YouTube videos, flyers, etc. At the end of this phase of the project, the school will receive a template to create a case study that will report the actions that the school has identified, the actions the school is implementing, and the impact on its carbon footprint. The school can use this information in applying for the Result Three competitive grants during the second year of the project.

Summary Budget Information for Result 2: **Trust Fund Budget: $ 467,172**
Amount Spent: $ 467,039
Balance: $ 133

Deliverable	Completion Date	Budget	Status
1. Schools receive technical assistance to develop carbon footprint, identify low cost/no cost EE options, and implement carbon cutting actions.	June 30, 2011	$361,693	Completed.
2. Schools receive grants to prepare and implement student-based climate change action plans.	December 31, 2009	$60,479	Grants have been awarded to 93 schools; remaining funds were used for incentives on projects during 2010-11 school year.
3. School teams implement low cost/no cost actions and report changes to carbon footprint.	June 30, 2011	$45,000	Completed.
4. Students see the impact of behavior changes in everyday life on school carbon footprint.	June 30, 2011	$0	Funding included above.

Final Report Summary - Result 2:

Deliverable 1 – Technical Assistance to Schools. The MPCA issued an RFP in the fall of 2008 requesting proposals to provide technical and educational services under Result 2. Five proposals were received. The MPCA entered into a contract with the successful bidder, ERM, in January 2009. The ERM team then worked with our project team to design a kickoff webinar for the schools, populate the project website with resources and information for schools, and prepare for in-person site visits and meetings with each school team.

1. Project Kickoff Webinars. ERM hosted and led four live project kick-off webinars on February 18 and 19, 2009. All of the webinars were recorded and made available through the project website. 111 participants from 76 schools participated in the live webinars. Many schools participated as a group with their school teams using one registration. Registrants included school team leaders (coaches), principals and administrators, students, facility directors and district energy coordinators.

2. School Data Collection. ERM requested that each school team collect data such as quantity of energy used as well as behaviors around the use of energy. ERM created a web-based data collection tool for schools to provide energy use data as well as building- specific information and showed school teams how to input their data. We strongly encouraged school teams to enter their data before their school visits, so that ERM could make the best use of the time available for the school visit to discuss the school's actual carbon footprint and the specific data contributing to its carbon emissions. The data collected included:

a) Building information (building material of construction information)
b) Electricity use including lighting types
c) Interior spaces including computers, swimming pools and kitchens
d) Fuel burning equipment
e) Heating, ventilation and air conditioning
f) Commuting
g) Water Use
h) Waste Generation
i) Refrigerant Leakage

3. School Visits. To help ensure consistency in the school visits, ERM conducted an in-depth training class for all its school energy auditors. Topics covered included carbon footprint calculations, energy and HVAC basics, school energy systems and best practices, the auditing process, engaging students and school teams, and ERM energy audit tools. Following the one day classroom training, participants joined a school energy audit. ERM distributed ninety-three vending misers that were donated by the MPCA during school visits. ERM completed the majority of the school visits in the spring of 2009 and the remainder in the fall of 2009.

ERM observed that many schools have similar carbon reduction opportunities. Some examples include:

- Creating an energy policy.
- Reduce light levels. Using lighting to illuminate areas adequately lit by day-lighting, excess light levels in corridors, and lighting on in areas not in use were some examples of electricity use that can easily be reduced.
- Increase night, weekend, and holiday setbacks. One degree setback = 1% energy savings. Some schools maintain temperature levels throughout the evening and weekend hours and many only set back to 65˚F.
- Install vending misers.
- Turning off refrigerated water fountains.
- Insulating door frames and hot water/steam piping.
- Turning off equipment such as computers when not in use and during evening and weekend hours.
- Encourage commuting changes to reduce use of single occupancy vehicles.

Importance of Personal Interaction and Suggestion for Enhanced Effectiveness. In our opinion, the on-site personal contact is the most effective way to build and maintain interest. Although the travel and time commitment to visit 100 schools was

significant, the in-person site visits were an extremely effective component of our project. Face-to-face interaction with students, teachers and school officials created a strong sense of partnership and interest. The visits validated the commitment of our project team to the individual schools and showed that the student teams have an important voice in helping to develop their school projects and influence their success. We believe that having an in-person visit during the second and third years of the project would have been very helpful in maintaining interest, particularly as school teams change with departing seniors and new student members.

4. School Reports. After the school visit, ERM provided each school with a report that included background information about the school, a summary of their energy data, information about the ERM site visit, and photographs and thermal images where applicable. The reports also contained recommendations for reducing their carbon footprint, focusing mostly on low and no cost energy-saving solutions. For each recommendation, ERM calculated estimated energy savings, estimated carbon reduction and cost and return on investment for any investment recommendations. The carbon calculator includes instructions and was uploaded to the website. See http://www.schoolscuttingcarbon.org/project-planning/carbon-calculator.

In addition, ERM provided each school with a carbon footprint calculator in excel format that shows the school's baseline carbon footprint. School teams can use this tool to measure changes to their carbon footprint. A sample school report and carbon footprint calculator were submitted with an earlier report. All reports are available upon request.

5. Community outreach tool. ERM completed a PowerPoint template and project flyer based on the statistical data submitted by the schools that were visited. The materials were intended as tools for school teams to share with their communities.

6. School Assistance by Project Coordinator. Patrick Santelli, the CERTs project coordinator, provided assistance to schools in a number of areas. Examples of these activities, which support both Results Two and Three, include:

- Scheduled and attended meetings with the Hennepin County River Watch to learn more about their programs and how they teach about water conservation and quality as Schools Cutting Carbon moves forward with water conservation. In addition, explored how Schools Cutting Carbon can best complement this work, reduce overlap, and provide a more comprehensive experience for schools involved in both programs.
- Met with John Geissler of the University of Minnesota Duluth and the Boulder Lake Environmental Learning Center to discuss his upcoming project looking at carbon sequestration in school forests. Discussed how to do outreach and whether schools in our program may be candidates for their project.
- Met with MPCA staff and the CERTs Northeast Coordinator to discuss how to do outreach with high schools under a replacement lamping grant coordinated by the MPCA. The grant, funded by U.S. EPA, focuses on proper handling of PCBs in fluorescent lighting ballast when those lights are replaced.

- Met with various utilities to discuss moving our proposed Utility Pilot forward, and worked with Otter Tail Power to form a partnership for the Utility Pilot project.
- Attended both Youth Environmental Summits Career Fairs in the fall of 2010, and attended their winter workshops.
- Worked closely with the Youth Environmental Activists to help plan meetings and events at metro area schools.
- Presented at the Minnesota State College Student Associate annual meeting. Presentation included success stories of peer schools, common things the students could do to reduce their carbon footprint, and group discussion on best strategies for achieving success.
- Worked with the Steger Institute to promote and do outreach about their new British Council grant designed to recognize and reward Minnesota schools for innovative energy reduction projects.
- Worked with a group including the Minnesota Renewable Energy Society on a grant they were awarded by the Office of Energy Security to create a guide for schools interested in pursuing renewable energy. This work included looking at various renewable energy projects already implemented in schools in Minnesota and nationally.
- Extensive contact with an initiative in its infancy regarding formalizing energy concepts into school education. This work within the initiative has been to do the background on what schools are currently teaching, and if schools with renewable energy have incorporated the renewable energy source as a learning opportunity in the classroom or through their MnSCC team.
- Planned and organized the "Creating a Clean Energy School" two day tracks for the CERTs biennial conference in February 2011.
- Met with the MnSCC team and ERM to discuss webinar content to be designed for school administration, to be followed by a technical training for students and building operation managers regarding energy usage in schools.
- Wrote monthly newsletters which highlighted a new school each month, various funding opportunities, and other relevant school information for energy conservation.
- Discussed with a number of schools how to create a revolving loan fund to provide a continuous incentive, motivation, and ongoing means to fund school energy efficiency projects.
- Supervised and helped create a work plan for an MPCA GreenCorps member assigned to CERTs. The member is working with schools to help benchmark, understand, and analyze the schools' energy usage through the Buildings, Benchmarks, and Beyond energy database.

Project consultant ERM also continued to provide technical assistance to schools during the remainder of the project. ERM prepared and presented several webinars in the spring of 2011 to educate students, school administrators, and building operators about the impact that low cost and no cost energy efficiency actions can have on energy costs. One webinar focused on school administrators; the second targeted building operators and have more detail on specific building operating and maintenance practices that save energy costs. Students were encouraged to attend one or both

webinars.

Each webinar was presented live at least twice to enable maximum participation. The webinars also encouraged school teams to update and maintain their school energy database and share the results of their projects. The CERTs project coordinator, a CERTs intern, and ERM also offered to assist schools that have questions or need assistance in the areas addressed by the webinars.

The Department of Commerce sent letters to the utilities servicing each of our schools in the early months of 2010. The letters encourage utilities to work with school teams in implementing energy-saving recommendations in the ERM reports to the schools.

7. Finding Additional Funding Sources for Schools. Our project team made strong efforts to link schools with other available funding sources to assist in implementing energy efficiency and carbon reduction projects. We encouraged schools to take advantage of the Clean Energy Resource Teams ACT campaigns! The ACT campaigns are designed to be simple, concrete ways to reduce energy usage. During this reporting period, the CERTs ACT campaigns featured a bulk-buy Vending Miser campaign allowing organizations to buy Vending Misers for a reduced price. The second campaign featured Project Green Fleet which offers free retrofit equipment to school districts to reduce the amount of pollution produced by their school bus diesel fleets. With the free retrofits, diesel emissions are reduced by 30-50% per vehicle.

We were very active in raising awareness of various grant opportunities for schools along with creating committees to study how schools can best utilize grant opportunities and leverage additional funding. Examples include promoting the Department of Commerce's Facility Cost-Share program, which awarded between $4 and $6 million Minnesota school districts and local governments to make energy efficiency improvements to existing facilities for cost-effective projects ready for immediate implementation. We have included regular updates on the Public Buildings Enhanced Energy Efficiency Program, which will provide financing for energy efficiency projects in school buildings, in our school newsletters.

Deliverables 2, 3 and 4 – Small School Grants for student-based actions. Each school was eligible to receive a $500 grant to help them get started implementing a carbon reduction project of their choice. The schools completed an online application through the project website. Ninety-three schools applied for and received grants. Five schools did not apply for the grants, and two schools applied but did not execute grant contracts. The MPCA entered grant contracts and awarded 93 grants during the spring of 2009 and continuing into the fall of 2010.

We allocated the remaining small grant funds to provide energy efficient equipment to schools that achieved certain energy benchmarking milestones and incorporate student learning and behavioral change at their schools. For example, energy misers have been very popular with student teams. We used $3227 of the remaining funds to purchased 20 vending misers at a reduced rate through a bulk purchase event created

by CERTs. In addition, we used $176 for costs charged by the Department of Administration to reserve equipment, tables and chairs at the Capitol Rotunda for the Earth Day event. (See Result 4).

The 93 school teams implemented a wide range of projects that are listed in Appendix 3. Several of these creative projects include:

The **Gibbon Fairfax Winthrop High School** Wind Energy Team and the Carbon Team "Carbon Fever" have committed significant amounts of time and resources to reducing the carbon footprint of GFW. The team has not only been working hard around the high school to reduce the amount of energy used, but has also taken their lessons to the GFW Middle School to talk to younger students about the importance of Reduce/Reuse/Recycle. By incorporating energy awareness and education into the school's curriculum, the team has been encouraged to research and raise awareness of renewable energy and carbon footprint issues. The Team's promotion of Project Green Fleet was featured on local television in May 2010. In addition to building relationships with local community partners, the team also toured the Great River Energy headquarters

The **Proctor High School** "Green Bandits" have emphasized their commitment to energy efficiency by outlawing excessive energy use at Proctor High! Using light meters to identify optimal locations for occupancy sensors and light harvesters, they were able to ensure that certain lights are only on when necessary. Also, they replaced metal halide with high-intensity fluorescent lamps in their field-house, which are twice as energy-efficient. In addition, they worked to convert old computer monitors to higher-efficiency LCD monitors and to implement an energy saving computing system in their media center computer lab. In an effort to decrease food waste, the Bandits partnered with Western Lake Superior Sanitary District in Duluth to help increase recycling and start composting food waste on the high school campus.

The "Something Green" team from **Winona High School** has made many changes to encourage clean energy at the organizational and individual level throughout the district. The new Winona Area Learning Center uses geo-thermal HVAC, light harvesting sensors that dim classroom lights when enough natural light is available, as well as other technologies to reduce the school's carbon footprint. The team involved the Winona Area Public Schools (WAPS) in an effort working with 14 other school districts to create a wind farm cooperative reducing carbon emissions and creating revenue for the schools. The students used the grant to purchase equipment to measure and monitor energy usage in each classroom. From there they will recommend methods for reducing energy consumption. The Winona Team also worked with Sustain Winona and Winona State University to highlight bike and walk commuting to school and by creating new bike facilities.

Jordan High School's Environmental Science program is creating behavioral change and reducing their carbon footprint by having students apply stickers to the light switch plates in all of the classrooms as a reminder to shut off lights. The team also collects

recycling and manages the ‘Second Chance’ paper program for the entire school, going into the elementary schools to talk to students about relevant environmental issues such as recycling and the importance of shutting off lights when leaving the room. The Team is also responsible for taking lessons learned about water contaminants and testing home tap water.

The **Eden Valley Watkins** Carbon Eating Eagles are taking control of their clean energy future and reducing their schools carbon footprint through many actions. At the EVW’s "Green Day" on May 28th, 2010, the school unveiled its new solar panels funded and made possible entirely by the hard work of the students and coach; hosted classes at the school aimed at creating knowledge and sparking interest in the community about renewable energy and energy conservation; created games around energy conservation to take into the elementary school and trivia questions for high school students; installed more recycling bins around the campus; hosted a "green" science fair; and sent letters to the editor of the local paper urging support for their solar project at the school.

Lessons Learned – Result 2.
On-Site Visits To Keep School Teams Engaged. The ERM site visits, involving the first face to face contact with students and the project team, were a resounding success. During the first year, ERM visited every school, meeting with students, teachers and building officials, walking through their school buildings, identifying energy saving actions and allowing students to use equipment that experts use during building audits, such as digital thermometers, infrared cameras, and light meters. The on-site visits involved ERM staff meeting with school administration, the building operator, and the school team. The building walk through typically involved the boiler room, with ERM explaining to students how their building’s energy systems worked. ERM met with the team after the walk through for a debrief, discussing initial observations, and answering questions. The student involvement in the site visit, combined with recommending low and no cost actions that students could lead, gave them a sense of ownership and opportunity.

ERM’s site visits created a high level of interest and involvement, engaging school teams to not only learn about energy practices at their schools, but also to get information to determine their schools energy baseline and carbon footprint, create their own project web pages, and raise awareness of energy issues in their schools.
The site visits developed an initial relationship with the school team and provided them with an understanding of the overall project goals and objectives. In cases where the school “coach” and students were less engaged, ERM found the school visits to be a mechanism to energize and educate the team on carbon emissions and energy behavior. At the conclusion of the visits, ERM received numerous thank you emails with details of the climate change team’s project efforts. For most participating schools, ERM found the building mechanical staff supportive and appreciative of the visit, even if they were apprehensive at the beginning of the visit.

In sum, the ERM visits were a huge success, and they reinforced the importance of meeting people in person as a key to creating enthusiasm and support for the project. These site visits, including travel, building audits, data analysis and follow-up individual reports, were relatively inexpensive, averaging about $2,000 to $2,500 per school. The challenge was that we did not have the financial resources to continue these in-person visits during the second and third years of the project. It was difficult to keep a high level of interest in the schools that did not receive the second-year grants, particularly as students who were involved in the first year graduated and were replaced by others who were not familiar with MnSCC.

One suggestion for strengthening school connections in the future is to seek funds to have trained energy auditors from CERTs follow-up with schools to encourage them to follow through with actions recommended in their reports. The CERTs regional teams have a good network of contact who would likely be interested in working with the schools on local energy projects. Also, the regional organizers and other CERTs partners, such as YES! Coordinators, could do follow up visits to schools to maintain in-person contacts at a low cost.

More Support for Implementing School Action Plans. Every school visited by ERM received an individual report with specific low cost and no cost actions that would save energy and reduce their carbon footprint. The report also contained the school's carbon footprint based on actual energy, transportation, water, and other data for the school. Students really enjoyed the energy audit and site visit. With more resources to follow-up with schools, we can better link the audit enthusiasm with the recommendations in the report. (See utility partnership recommendation below). We also recommend site visits by regional CERTs coordinators or other staff to keep enthusiasm high after the report has been issued.

Tracking school energy usage proved more challenging than anticipated. We expected that most schools would enter their data into the statewide B3 database. Many schools lacked the resources, knowledge, or access to the database. Because of the difficulties working with B3, we instead worked with school teams to get one year of utility data before the audit visit, so that ERM could discuss the data during the visit. In the future, we would use a single database, allocate more effort to helping school teams gather and understand the energy data, and offer training and technical support for those entering and interpreting school energy data. It is important for school teams to understand how energy benchmarking serves an important tool in determining the effectiveness of energy saving actions.

Simplifying Small Grant Program. Each school was eligible to receive a $500 grant during the first year. Although small, these grants helped create significant enthusiasm for MnSCC. High school teams in particular were thrilled to receive these grants. Overall, the level of engagement in the 100 schools was highest in the first year because of the ERM visits and small grants. Students had a strong sense of ownership in the program, since they selected and implemented the projects in their schools, with assistance from their teachers and our project team.

We encountered several challenges in administering the small grants. First, many schools thought that by applying to participate in MnSCC, they had already submitted their $500 grant application and no additional paperwork was needed. Also, many teachers and teams were not familiar with state contracting requirements. Applications were delayed as we worked with school teams to explain the process; we also assisted a number of schools in completing their applications. Because of these issues, many schools received grants late in the spring, when students were preparing for finals or focusing on graduation. Most of the schools expected to receive the grants quickly, and many were disappointed that funds were not available until late in the school year.

These grants were paid electronically to schools through the state system, and this created an unanticipated difficulty. The e-payments were not identified as a grant award when transmitted, and the amounts were small so did not trigger the attention of school accounting staff, who then did not notify school team when grant funds were received. This contributed to delays as school teams were uncertain when they could start their projects.

The small grants were difficult to monitor. While schools were eager to tell us how their projects turned out, reporting results was challenging. Because we wanted to keep paperwork to a minimum to encourage schools to apply for these small grants, we encouraged but did not require written reports for the $500 grants. While many schools provided updates through newsletters or their websites, attempting to quantify measurable outcomes was difficult in many cases.

To minimize these issues In the future, we would offer schools a limited selection of energy saving actions or devices, such as vending misers, kilowatt meters, or pre-rinse spray valves I n lieu of awarding a monetary grant, eliminating the grant paperwork and making it much easier to measure results.

Creating Stronger School-Local Utility Partnerships To Implement Energy-Saving Actions. One of the biggest challenges for schools is a lack of technical and financial resources. Although energy is a major part of school budgets, they do not have the expertise to identify and design energy-saving projects nor money to finance these projects. Because a primary focus of MnSCC was low and no cost energy saving actions, many of our projects did not involve utility rebates or other utility financing programs (other than several competitive grant projects). Nonetheless, one of the most significant opportunities we identified is the development of stronger partnerships between schools and their local utilities. Developing a stronger relationship with local utilities can help schools identify energy efficiency projects that will save money and offer quick return on investment.

Most schools were unfamiliar with utility financing options and utility rebates, and did not have a working relationship with their local utility. In many rural and smaller districts, schools are the local utilities' biggest energy user and offer significant energy efficiency opportunities. We encouraged these partnerships in several ways. The Department of

Commerce Division of Energy Resources sent a letter to CIP representatives of all utilities that serviced MnSCC schools. The letter explained the MnSCC program, invited the utility representatives to participate in the ERM building walkthroughs and on-site visits. Only a few utilities accepted this offer.

In the last year of the project, we worked closely with Ottertail Power Company and talked with other utilities about designing a pilot project with a school district. Our intended pilot project involved creating an energy team including school members and a utility representative. Patrick Santelli and others at CERTs, with support from the Commerce Division of Energy Resources, developed details of a pilot project that would focus on energy and water conservation. If project financing develops in the future, this school-utility pilot partnership should be a major focus of Phase-Two.

Result 3. Grants for Carbon Reduction Projects. Budget: $224,328

Phase three is a competitive grant program to award grants of up to $20,000 to schools to implement innovative ways to reduce or sequester carbon. Any school with an identified carbon footprint and a carbon reduction/sequestration plan is eligible. This competitive grant program begins in the second year of the project.

Criteria for awarding the competitive grants will include the ratio of students/student body who participated in Result 2, the actions that were taken and any carbon reductions that have occurred through those actions, the number of building retrofits/upgrades or other carbon reductions identified, the extent of student leadership in the project, the extent to which the project will serve as an educational tool in the school, whether the project proposed is sustainable and replicable, the amount of public engagement on the topic, and the outside partnerships for additional funding and technical assistance that were established.

Summary Budget Information for Result 3:	**Trust Fund Budget:**	**$ 224,328**
	Amount Spent:	**$ 222,854**
	Balance:	**$ 1,474**

Deliverable	**Completion Date**	**Budget**	**Status**
1. Schools receive competitive grants.	March 2010	$202,828	Completed.
2. School teams report results of grant project implementation.	May 31, 2011	$21,500	Completed by most schools.

Final Report Summary - Result 3:

Deliverable 1 – Awarding Competitive Grants. We issued the Competitive Grant Request for Proposal (RFP) in October 2009, and the MnSCC team developed a

powerpoint and webinar to explain the application process to schools. We made a significant effort to strongly encourage all MnSCC schools to apply for grants through several efforts. We promoted the project through our website and monthly newsletter. Project coordinator Patrick Santelli contacted schools, and email and website announcements were sent to schools publicizing the webinars and on-line instructions. Patrick Santelli and ERM answered questions and advised student teams in developing their project ideas. We offered six interactive webinars over a three-week period in November, explaining how to prepare grant applications, the importance of student leadership, and the need to focus on cost effective actions that will save energy and reduce greenhouse gases. School teams had the opportunity to ask questions during and after the webinars.

The grant submission deadline was December 3, 2009. We received forty-one applications requesting more than three times the amount of grant funding available. The grant review team awarded $202,838 in grant funds through nineteen grants to twenty-three schools. The offers were communicated to the schools in early January 2010.

Deliverable 2 – School Teams Report Results. School grant projects began in early spring when contracts were entered and work plans approved; all grant projects ended on June 30, 2011. Projects range from making energy improvements such as energy efficient lighting and motion sensors; installing renewable energy projects including solar photovoltaic and solar thermal systems; increasing recycling and composting; reducing paper use and food waste; supporting community greenhouse production of local foods; and increasing sustainable transportation options by encouraging walking, biking, carpooling and bus riding to school. Detailed summaries and results of all 23 competitive grant projects are in Appendix 4.

Patrick Santelli, Schools Cutting Carbon Project Coordinator, worked closely with the school teams to help them implement these grant projects, report their results, and track energy use on their school campus over the long term. In addition, much of Patrick's work reported under Result 2 (see pages 15-16 above) applies to this Result 3 as well.

We also used the remaining Result 2 grant funding to develop incentives to motivate and encourage school teams that did not receive competitive grants. Some ideas included creating sponsorship and mentoring programs that link schools with entities that are interested in supporting their efforts with additional funding or in-kind support; contacting utility companies to request that they work with school teams to implement energy-saving actions identified in ERM's school reports; and identifying conferences and other events at which student teams can display and receive recognition for their actions.

Lessons Learned – Result 3. The highlight of our second year was the competitive grant projects. The twenty-one schools that received competitive grants in the second year continued a high level of active participation in the project. Our observations on what worked and what could be improved are outlined here.

Improve Timing of Competitive Grants. We established a December 3, 2009 deadline for schools to file competitive grant proposals, primarily to give schools enough time to understand the grant requirements, develop a good project, and write their grant application. Because of the time involved in entering grant contracts, including developing workplans that were included in each grant, these projects did not begin until April and May of 2010. As with small grants, this created some frustration because senior students who worked on the grant proposals had only a short time to actually work on them before graduating. By working more closely with schools to get them more familiar with state contracting requirements, we anticipate that we could have grant projects begin several weeks earlier in the future.

Assist Schools That Did Not Receive Grants. We received over forty applications but were able to fund only about half of them. Many of the unsuccessful applications were from high schools that lacked grant-writing expertise and thus did not score well during the review process. The grant process also did not enable us to follow up with the unsuccessful applicants to work with schools to either find alternative funding or continue to build on their ideas. We would recommend exploring a way that the project team could keep a copy of both funded and unfunded proposals after the evaluation process concludes. The second recommendation involves the role of the project coordinator. Patrick Santelli worked with most of the schools to help them develop applications. Because of his involvement in grant development, we did not include him on the evaluation team, which was limited to those with no involvement in preparing the grant proposals. Mr. Santelli could have provided more information on those applications that were not as well written as others. If it were possible to get this additional input in the review process, it would strengthen the basis for decisions by the review panel.

Leveraging Resources. We emphasized and encouraged schools to develop competitive grant projects in partnership with utilities or local businesses. Very few grant applicants were able to leverage resources, although the ERM reports identified a number of school projects that were eligible for utility rebate. Several school proposals did involve utility rebates, which were then used to fund additional energy saving actions in the schools.

Result 4. Measurement and Evaluation – Case Studies. Budget: $33,500

Phase four, the measurement and evaluation phase, will primarily occur in the third year of the project. The main aspects of this phase are to quantify and document actual carbon reductions from grant projects, recognize and promote success of school actions, and encourage behavior change to continue. The CERTs Minnesota Project will provide communications assistance to project participants to increase recognition from the CERTs partners and the broader community. Assistance will include presentation materials, press releases, media visits, help in scheduling presentations within the community as well as highlighting projects and publishing case studies on the

web page. Funding will be used for the UMN graduate student project coordinator, web technical costs, and materials.

Summary Budget Information for Result 4:	**Trust Fund Budget:**	**$ 33,500**
	Amount Spent:	**$ 33,500**
	Balance:	**$ 0**

Deliverable	**Completion Date**	**Budget**	**Status**
1. Students will develop case studies to show how well the plan was implemented.	June 30, 2011	$3,500	Completed. Many schools have uploaded case studies and school project highlights on the website.
2. Schools that reduced their carbon footprint the most, demonstrate notable school and community participation, or identify innovative actions will receive special recognition from the project partners.	June 30, 2011	$30,000	Completed. CERTs project coordinator assisted in developing case studies and recognizing school teams.

Final Report Summary - Result 4:

We began working on school recognition and sharing project results early in January 2009 and continued throughout the project. A number of schools have reported results of actions they have taken through the MnSCC website. As explained in our Result 2 Status update, we also presented several webinars that included examples of successful school projects in the spring of 2011 to educate students, school administrators, and building operators about the impact that low cost and no cost energy efficiency actions can have on energy costs. School recognition opportunities occurred throughout our project. Students had the opportunity to discuss their projects with legislators and each other at unique events such as Earth Day at the Capitol; student team presentations at the biennial CERTS conference; testifying before the LCCMR and the House Environment Policy and Oversight Committee; and attending a leadership training workshop sponsored by the Steger Foundation. Patrick Santelli, the Project Coordinator, and other partners such as the Steger Foundation, YES and YEA, encouraged student participation in a number of energy-related events during the past three years.

Deliverable 1 – Case Studies Showing Project Implementation. The small grant projects are discussed in Result 2 and Appendix 3. Result 3 and Appendix 4 similarly describe the outcome of the competitive grant projects.

Deliverable 2 – Special Recognition and Leadership Opportunities. One of the most exciting and enjoyable aspects of the MnSCC project was to see how many students demonstrated leadership skills in their schools and communities. Many students had the opportunity to present to their administration, school boards, local elected officials, and members of the community. Students from several schools discussed their projects before the LCCMR and House Environment Policy and Oversight Committee. Students attended and presented at the bi-annual CERTs conference in St. Cloud; other students shared their projects with legislators and students at the State Capitol on Earth Day 2010. We have also sponsored or attended a number of events intended to promote MnSCC, recognize schools successes, and gain additional support and resources. The more significant are described below.

Earth Day at the Capitol 2010. Students from Central High School and LEAP High School in St. Paul; The City, Inc. in Minneapolis; Ortonville High School; Henry Sibley High School in Mendota Heights; Osseo Senior High School; and the School of Environmental Studies in Apple Valley participated in "Earth Day at the Capitol: Thumbs Up for Clean Energy!" This celebration of student-led energy efficiency and clean energy projects showcased Minnesota's future leaders on clean energy and green jobs. It featured presentations by the seven school teams as well as Senator Ellen Anderson, Representative Kate Knuth, and Abby Fenton of the Will Steger Foundation. WCCO Radio also interviewed students from Ortonville High School about their initiatives to reduce their school's carbon footprint during the Noon News Hour.

Student Presentations to Legislature and Elected Officials. Several student teams were invited to present their projects to the LCCMR in November 2010, and still others had the opportunity to present before the House Environment Policy and Oversight Committee to talk about how their work has impacted their school.

Minnesota Environmental Initiative Award – Energy and Climate Protection Project of the Year. The annual Environmental Initiative Awards honor innovative projects that have achieved extraordinary environmental outcomes by harnessing the power of partnership. The Environmental Initiative (EI) is a non-profit organization that believes that partnership is an effective way to find solutions to Minnesota's environmental problems. EI established the Environmental Initiative Awards in 1994 to honor innovative projects and their many partners, to inspire other organizations to create similar successful projects, and to encourage innovative collaborative approaches to environmental problem solving. Awards are given in five categories, and the Schools Cutting Carbon project received the award in the Energy and Climate Protection Category at the Environmental Initiative Awards dinner on May 27, 2010.

CERTs Bi-Annual Energy Conference. The CERTs Conference in February 2011 featured several MnSCC schools in the "Creating a Clean Energy School" conference track. Students from Aitkin, Rosemount, and Ortonville High Schools had the opportunity to develop their leadership and networking skills by attending and presenting at this conference. The two-day student track attracted over 110 people.

Greening the Heartland Conference. Through our partnership with the Minnesota chapter of the U.S. Green Building Council, MnSCC had the opportunity to participate in the Greening the Heartland Conference in May 2010 at the Minneapolis Convention Center. MnSCC participated in the conference workshops and had a table to display school projects in the exhibit hall for the duration of the conference, which was sponsored by the Minnesota USGBC Chapter and Green Communities.

Other Activities. We promoted school successes through the project website, newsletters, and other events. We offered to assist schools in the areas addressed by the webinars and in carrying out energy saving actions. In addition, we offered schools a second free Vending miser as an incentive to encourage school teams to maintain their energy database and report project results. Vending misers have been popular with school teams, since each miser reduces energy usage by an estimated 45% and saves approximately $130 in electricity costs per year. A number of schools have purchased additional vending misers. With many Minnesota utilities offer a rebate of $50-$75 per vending miser, the payback is under a year.

Recommendations for Future MNSCC Efforts. There are several recommendations we offer that relate to the broader program rather than a specific deliverable.

Maintaining School Team Engagement. One of the biggest challenges of our three year project was to maintain the level of engagement created in the first year during the remainder of the project. The personal on-site visits by ERM during the first year of the project were highly effective in catalyzing student involvement. We did not have the funding to continue those on-site visits during the second and third years, but we believe we could maintain a personal connection by relying upon regional CERTs coordinators to a greater extent in a future phase of the project. This regional connection could help to build and institutionalize school teams to maintain student interest during the second and third years of the project with reduced travel costs. Personal visits during the second and third years would be a very effective and relatively inexpensive way to maintain school engagement and encourage student teams to follow through on action items identified in their ERM reports.

Strengthen Support of School Administrators and School Districts. The support of school administrators can determine whether a project succeeds or fails. Administrators often can connect a team to external resources and help to make connections that significantly boost a project's influence. To create real momentum around school energy projects, a strong team must include students, teachers, administrators and building officials.

Equally important to the success of school energy projects are school district officials, since they often play a central role in implementing district wide energy saving measures. They also can help with program administration by providing centralized expertise for reporting, project tracking, and grant writing. In several districts, there is top-level support for energy benchmarking of all school buildings in the district. In addition, grant opportunities or energy funding exists at the district level, not at the

individual school building level. The authority to sign grant applications and contracts often is at the district level, which makes good communication with and support by district officials an important step in the success of a school project. Relations between districts and schools have a wide range; typically, the bigger districts have more centralized control, while smaller districts often have greater autonomy for schools to address building maintenance and education issues.

Student Leadership and Energy Reduction. MnSCC strongly encouraged students to lead low and no cost energy saving actions at their schools. We also sought to achieve measurable reductions in school building operations. These goals did not easily complement each other. Not surprisingly, the student-led energy conservation projects included a strong education and outreach component. Several schools had teams which focused on actions involving building energy use, such as identifying areas needing insulation or weather-stripping, rooms with equipment such as computers running all night, or lighting upgrades. Students were not able to evaluate whether building systems were operating effectively or whether similar aspects of building operation and maintenance had energy saving opportunities. An effective evaluation of the operation of the school building required a more detailed evaluation by energy experts than we were able to do through ERM. This in-depth building audit would likely have identified some significant energy saving opportunities but limited opportunities for student leadership.

Expanding to Elementary and Middle Schools. During the project, we had the opportunity to visit Miltona Elementary School. The students were very engaged and excited about how their own actions could help their school energy use. They were very active in the building walkthrough, and responded with enthusiasm to the opportunity for hands on experience with the infrared camera. Exposing these students to energy and sustainability concepts is a great opportunity.

Long-Term Sustainability. One overarching goal of our project was to learn how to incorporate energy awareness and energy-saving actions into the daily routine of schools. One way to help maintain focus and interest is to reward various participants for energy savings. By sharing dollars saved among students/teachers, administrators, and building operations, each group is rewarded for the results of their conservation actions.

There are a number of good energy efficiency opportunities in the 99 schools that ERM visited, and we were only able to address a handful of them. The potential energy and cost savings that still exist in these schools is significant. The enthusiasm of students and their interest in leading projects at their schools also is strong. The challenge is to connect the potential projects with the students' enthusiasm and access financing mechanisms to address the opportunities that need funding. Student involvement and enthusiasm are affected by graduation, exams, the demands of other events during the school year, and having time and resources to implement, measure, and reward outcomes.

V. TOTAL TRUST FUND PROJECT BUDGET:

Grant funds to be passed through: $750,000

1. Consultant hired through RFP to administer Result 2:		$361,693
a. Reducing Building Carbon Footprint -		
b. Help Student-Teams Develop Action Plans -		
2. Grants awarded directly to schools		$263,307
a. Grants for student action plans (result 2) ($104.00 remains unspent)	$60,479	
b. Carbon reduction projects (result 3)	$202,828	
3. Grant to The Minnesota Project to design, operate and maintain the project website that will support school teams with educational materials, technical information, grant applications, case studies, and information exchange.		$14,500
4. Grant to the University of Minnesota to provide a project coordinator and project supervisor to lead project outreach and education efforts and assist school teams in implementing carbon reduction action plans and applying for and carrying out grant projects, measuring and reporting results, preparing case studies, sharing information, and recognizing success. ($29.00 remains unspent)		$110,500
TOTAL TRUST FUND PROJECT BUDGET: ($1607.00 remains unspent)		**$750,000**

VI. OTHER FUNDS AND PARTNERS:

A. Project Partners: Project partners include the Minnesota Pollution Control Agency; Minnesota Department of Commerce Division of Energy Resources; the Clean Energy Resource Teams, including the University of Minnesota Regional Sustainable Development Partnerships, The Minnesota Project, and the Green Institute; Environmental Resources Management (ERM); the Mississippi Headwaters Chapter of the U.S. Green Building Council; the Will Steger Foundation; Environmental Initiative; Project Green Fleet; Environmental Resources Management (project consultant); Youth Environmental Activists of Minnesota (YEA MN); Youth Energy Summit (YES); and the Transcampus Energy Action Movement. We also consulted the Department of Education on aspects of this project.

B. Other Funds Spent during the Project Period:.

Final Project Update: The project team dedicated significant in-kind hours throughout this project, as did many of the project partners. In designing and delivering outreach; evaluating grant proposals; creating opportunities for student participation and recognition; recruiting additional partners and mentoring and sponsorship opportunities; MnSCC benefitted and is deeply grateful for these efforts. The MPCA provided 125 vending misers at no cost. These were distributed to schools as an example of a low-cost energy saving measure. The vending misers have a retail value of about $150 per unit, for a total in-kind contribution of approximately $18,750. The MPCA also donated time and materials for producing flyers, posters, pictures, and other handouts for conferences and events.

Commerce staff contacted all utility representatives for participating schools to request that they work with school teams to implement energy efficiency actions identified in the school reports prepared by MnSCC consultant ERM. During the last months of the project, we had discussions with the Minnesota Municipal Utilities Association, Xcel Energy, and Ottertail Power about agreeing to become project partners in anticipation of continuing the next phase of the project.

The Department of Commerce awarded a grant contract to the Minnesota Renewable Energy Society and its partners to develop a guide for Minnesota schools interested in renewable energy in September 2010. The project is supported by a $40,000 grant from the U.S. Environmental Protection Agency under its Clean Energy-Environment State Partnership program. That project created a step-by-step Renewable Energy Guide for Schools to help school districts in Minnesota and elsewhere evaluate different renewable energy technologies, determine which are the most appropriate for their situation, identify financing options, and address operation and maintenance issues. The guide compares the energy and other environmental impacts of renewable energy systems, including the effect on greenhouse gas emissions; economic costs and benefits; financing options; ownership, operation and maintenance factors; and methods for integrating energy data and information about their renewable energy system into educational activities. The resource materials will be publicly available through the Department of Commerce website.

C. Past Spending: This project benefitted from access to data on energy use in school buildings in the B3 Minnesota Benchmarking Project. The legislature has provided funding to this program, administered by the Department of Commerce and the Department of Administration. This data assisted the project by identifying those schools with accurate energy information in the database having the greatest potential for cost-effective energy reductions. In addition, the MPCA allocated over $40,000 to support the Retired Engineers Technical Assistance Program. These engineers assisted some MnSCC schools in areas such as energy, waste management, recycling, and reducing toxics in schools at no additional cost to the project. Finally, the Minnesota Project, one of the MnSCC partners on this project, allocated funding to

upgrade its website which matched the $8,000 allocated to enabling the CERTs website to function interactively as described in Results 1 and 2 of the proposal.

D. Time: This is a three year project that began on July 1, 2008 and ended on June 30, 2011.

VII. DISSEMINATION: The information collected from this project has been available via the MnSCC website, which will remain operational through December 31, 2011. The LCCMR has been acknowledged in the website, in promotional materials, project press releases, webinars, project handouts, grant information, appearances at workshops and conferences, including Earth Day at the Capitol in April 2010, and the Greening the Heartland Conference in May 2010, and the project presentation at the Mall of America in conjunction with the MN Lottery.

VIII. REPORTING REQUIREMENTS: Periodic work program reports were submitted not later than January 31, 2009; July 31, 2009; January 31, 2010; July 31, 2010; January 31, 2011; and July 31, 2011. The final report summary is being submitted not later than September 30, 2011.

APPENDIX 1. SCHOOLS PARTICIPATING IN MN SCHOOLS CUTTING CARBON LISTED BY REGION

Metro Region Schools - 36	**City**		**Metro Region Schools Continued**	**City**
Como Park Senior High School	St. Paul		Minneapolis Community and Technical College	Minneapolis
Dakota County Technical College	Rosemount		North High School	St. Paul
Eagle Ridge Junior High School	Savage		North Lakes Academy	Forest Lake
Edina High School	Edina		Northfield School of Arts and Technology (ARTech)	Northfield
Farmington High School	Farmington		Northwest Passage High School	Coon Rapids
Gordon Park High School	St. Paul		Osseo Senior High School	Osseo
Harding High School	St. Paul		Patrick Henry High School	Minneapolis
Henry Sibley High School	Mendota Heights		Roosevelt High School	Minneapolis
Higher Ground Academy	St. Paul		Rosemount High School	Rosemount
Highland Park Senior High School	St. Paul		School of Environmental Studies	Apple Valley
Hopkins High School	Minnetonka		South High School	Minneapolis
Humboldt Senior High School	St. Paul		Southwest High School	Minneapolis
IA Leap High School	St. Paul		St. Michael-Albertville High School	Albertville
Interdistrict Downtown School	Minneapolis		St. Paul Central High School	St. Paul
Irondale High School	New Brighton		Tartan High School	St. Paul
Jordan High School	Jordan		The City Inc	Minneapolis
Lakeville South High School	Lakeville		University of Minnesota – Twin Cities	Minneapolis
Metropolitan State University	St. Paul		Washburn High School	Minneapolis
Supporting Schools:				
Macalester College	St. Paul			

Southwest Region Schools - 8	**City**		**Southwest Region Schools Continued**	**City**
Lincoln High School	Ivanhoe		Round Lake Brewster Secondary	Round Lake
Marshall School District	Marshall		Springfield High School	Springfield
Mountain Lake Public School	Mountain Lake		St. James High School	St. James
Redwood Area Schools	Redwood Falls		Wabasso Secondary School	Wabasso

Southeast Region Schools - 13	City		Southeast Region Schools Continued	City
Austin High School	Austin		Minnesota State College-Southeast Technical	Winona
Byron High School	Byron		Pine Island High School	Pine Island
Century High School	Rochester		Plainview-Elgin-Millville Junior High School	Elgin
Faribault High School	Faribault		Spring Grove High School	Spring Grove
John Marshall High School	Rochester		Winona State University	Winona
La Crescent Public Schools	La Crescent		Winona Senior High School	Winona
Mayo High School	Rochester			

West Central Region Schools - 13	City		West Central Region Schools Continued	City
Atwater-Cosmos-Grove City School	Grove City		Lac Qui Parle Valley Schools	Madison
Canby High School	Canby		Morris Area School	Morris
Dawson-Boyd School	Dawson		Ortonville High School	Ortonville
Eden Valley-Watkins High School	Eden Valley		Ridgewater College – Willmar Campus	Willmar
Gibbons-Fairfax-Winthrop Schools	Winthrop		University of Minnesota - Morris	Morris
Glencoe-Silver Lake Public Schools	Glencoe		Willmar High School	Willmar
Hutchinson High School	Hutchinson			

Central Region Schools – 10	City		Central Region Schools Continued	City
Battle Lake Public School	Battle Lake		Parkers Prairie High School	Parkers Prairie
Central Lakes College	Brainerd		Perham-Dent Public Schools	Perham
Crosby-Ironton High School	Crosby		Princeton High School	Princeton
Minnesota State Community and Technical College	Fergus Falls		Sebeka Public School	Sebeka
New York Mills Public School	New York Mills		Staples Motley High School	Staples

Northeast Region Schools - 11	City		Northeast Region Schools Continued	City

Aitkin Public Schools	Aitkin		Rainy River Community College	International Falls
Hibbing Community College	Hibbing		Two Harbors High School	Two Harbors
Itasca Community College	Grand Rapids		University of Minnesota - Duluth	Duluth
Lake Superior College	Duluth		Vermillion Community College	Ely
Mesabi Range Community and Technical College – Eveleth Campus	Eveleth		Virginia Secondary School	Virginia
Proctor High School	Proctor			

Northwest Region Schools - 9	**City**		**Northwest Region Schools Continued**	**City**
Bemidji High School	Bemidji		Northland Community and Technical College	Thief River Falls
Bemidji State University	Bemidji		Northwest Technical College	Bemidji
Fertile-Beltrami Schools	Fertile		Stephen-Argyle Central High School	Stephen
Hawley Public Schools	Hawley		University of Minnesota Crookston	Crookston
Minnesota State University - Moorhead	Moorhead			

APPENDIX 2. PARTICIPATING SCHOOLS LISTED BY CITY

CITY	SCHOOL		CITY	SCHOOL
Aitkin	Aitkin Public Schools		Minnetonka	Hopkins High School
Albertville	St. Michael-Albertville High School		Moorhead	Minnesota State University Moorhead
Apple Valley	School of Environmental Studies		Morris	Morris Area School
Austin	Austin High School		Morris	University of Minnesota Morris
Battle Lake	Battle Lake Public School		Mountain Lake	Mountain Lake Public School
Bemidji	Bemidji High School		New Brighton	Irondale High School
Bemidji	Bemidji State University		New York Mills	New York Mills Public School
Bemidji	Northwest Technical College		Northfield	Northfield School of Arts and Technology (ARTech)
Brainerd	Central Lakes College		Ortonville	Ortonville High School
Byron	Byron High School		Osseo	Osseo High School
Canby	Canby High School		Parkers Prairie	Parkers Prairie High School
Coon Rapids	Northwest Passage High School		Perham	Perham-Dent Public Schools
Crookston	University of Minnesota - Crookston		Pine Island	Pine Island High School
Crosby	Crosby-Ironton High School		Princeton	Princeton High School
Dawson	Dawson-Boyd School		Proctor	Proctor High School
Duluth	Lake Superior College		Redwood Falls	Redwood Area Schools
Duluth	University of Minnesota Duluth		Rochester	Century High School
Eden Valley	Eden Valley-Watkins High School		Rochester	John Marshall High School
Edina	Edina High School		Rochester	Mayo High School
Elgin	Plainview, Elgin, Millville Jr. High		Rosemount	Dakota County Technical College
Eveleth	Mesabi Range Community and Technical College – Eveleth Campus		Rosemount	Rosemount High School
Ely	Vermillion Community College		Round Lake	Round Lake Brewster Secondary
Faribault	Faribault High School		Savage	Eagle Ridge Jr. High
Farmington	Farmington High School		Sebeka	Sebeka Public School
Fergus Falls	Minnesota State Community and Technical College		Spring Grove	Spring Grove Public School
Fertile	Fertile-Beltrami Schools		Springfield	Springfield High School
Forest Lake	North Lakes Academy		St. James	St. James High School
Glencoe	Glencoe-Silver Lake Public		St. Paul	Como High School

	Schools			
Grand Rapids	Itasca Community College		St. Paul	Gordon Park High School
Grove City	Atwater-Cosmos-Grove City High School		St. Paul	Harding High School
Hawley	Hawley Public Schools		St. Paul	Higher Ground Academy
Hibbing	Hibbing Community College		St. Paul	Highland Park Senior High School
Hutchinson	Hutchinson High School		St. Paul	Humboldt High School
International Falls	Rainy River Community College		St. Paul	IA Leap High School
Ivanhoe	Lincoln High School		St. Paul	Metropolitan State University
Jordan	Jordan High School		St. Paul	North High School
La Crescent	La Crescent Public Schools		St. Paul	St. Paul Central High School
Lakeville	Lakeville South High School		St. Paul	Tartan High School
Madison	Lac Qui Parle Valley Schools		Staples	Staples Motley High School
Marshall	Marshall School District		Stephen	Stephen-Argyle Central High School
Mendota Heights	Henry Sibley High School		Thief River Falls	Northland Community and Technical College
Minneapolis	Interdistrict Downtown School		Two Harbors	Two Harbors High School
Minneapolis	South High School		Virginia	Virginia Secondary School
Minneapolis	Minneapolis Community and Technical College		Wabasso	Wabasso Secondary School
Minneapolis	Patrick Henry High School		Willmar	Ridgewater College – Willmar Campus
Minneapolis	Roosevelt High School		Willmar	Willmar High School
Minneapolis	Southwest High School		Winona	Winona Senior High School
Minneapolis	University of Minnesota – Twin Cities		Winona	Minnesota State College - Southeast Technical
Minneapolis	The City Inc		Winona	Winona State University
Minneapolis	Washburn High School		Winthrop	Gibbons-Fairfax-Winthrop High School

Appendix 3
SUMMARY OF $500 GRANT PROJECTS

Ninety-three schools received $500 grants. Five schools did not apply - Irondale High School, John Marshall High School, North Lakes Academy, Virginia Secondary School, and Wabasso Secondary School. The University of Minnesota - Twin Cities and Como Park Senior High School applied but did not sign the grant agreement sent to them.

School	Project
Aitkin HS	Install wind anemometer to measure viability of wind turbine, or install small PV array on a light in parking lot and measure energy savings
Atwater-Cosmos-Grove HS	Purchase supplies and materials to build composting bins
Austin HS	Purchase materials to encourage students to join the "Go Green" club
Battle Lake HS	Purchase supplies to build compost bins and materials to build a home-made wind generator
Bemidji HS	Purchase recycling containers to be placed across campus
Bemidji State University	Purchase native plants to plant on campus and signage to discuss benefits of plants and impact of bottled water waste
Byron HS	Work with Go Green Group to purchase recycle bins for plastic and aluminum
Canby HS	Purchase recycle bins for paper; hire consultant to write program to shut down computers after 5:00 pm
Central Lakes College	Purchase recycling containers larger than garbage containers in common areas
Century HS	Purchase and install 4.8 kwh solar array for roof of school
Crosby-Ironton HS	Conduct a study of school vending machine power usage by using kill-o-watt meter; purchase additional vending misers
Dakota County Technical College	Produce educational materials to encourage recycling and other green initiatives; purchase energy-efficient light bulbs to give to students
Dawson Boyd Schools	Document the installation and operation of new geo-thermal heating/cooling system with photos and articles; describe benefits of this system compared to alternatives and advantages compared to the 100+ year old boiler system.
Eagle Ridge Jr. HS	Purchase trees for school grounds and generators hooked to stationary bikes in weight room to generate electricity for school use
Eden Valley–Watkins HS	Purchase two vending misers and occupancy sensors for entryways & hallways
Edina HS	Create signage to advertise Bike to School Day; purchase composting bins for cafeteria and art rooms for food and paper waste
Faribault HS	Purchase up to ten recycling bins
Farmington HS	Purchase IR Thermal Temperature gun and watt meters for use in school; if funds remain, purchase recycling bins
Fertile Beltrami Schools	Purchase materials and supplies to assist in processing vegetable oil into biodiesel fuel
Gibbon-Fairfax-Winthrop HS	Determine if purchase of wind generator is feasible; alternatively, sponsor an event for electronics recycling with licensed recyclers
Glencoe-Silver Lake HS	Purchase photo sensor lights to replace timed outside lights; install LED exit lights in place of incandescent signs
Gordon Parks HS	Purchase additional bike racks and create materials to encourage students to bike to school; host a bike repair event
Harding HS	Purchase kill-a-watt monitor; infrared thermometer laser; digital light meter to evaluate energy use and demonstrate how behaviors impact the environment; send ten students to Camp Widjiwagon in May 2009 to study about carbon footprint issues
Hawley Public Schools	Develop educational materials to promote monthly energy-environment themes and implement carbon cutting initiatives
Henry Sibley HS	Develop educational materials describing effects of diesel emissions from school buses
Hibbing Community College	Study commuting patterns at college and encourage students to spend time on campus and

	reduce commuting between classes; develop database to track process and store survey information
Higher Ground Academy	Purchase recycling bins for paper, cans and bottles, and energy audit tools to measure electricity use in school.
Highland Park Sr. High	Purchase solar powered kits and accessories for student use
Hopkins HS	Host a bike-to-school event, purchase materials to promote event, and assist in purchase of bike rack for campus
Humboldt Senior HS	Purchase materials for display to encourage energy conservation; and distribute reusable water bottles and materials for teachers to give presentations to explain the project
Hutchinson HS	Purchase signage, bags and bins to increase composting efforts; purchase "no-idling" signs; purchase supplies and host event to educate students on weather stripping, plastic and caulking of windows for energy efficiency.
IA Leap HS	Purchase materials to design and sew Bonita Ifas to cover windows in winter and summer to reduce energy usage. Purchase measuring tool for research on energy use and conservation.
Interdistrict Downtown School	Purchase materials and supplies for Green Rooftop to be planted and maintained by students
Itasca Community College	Purchase recycling bins to be placed around campus and educational materials to promote energy saving ideas.
Ivanhoe Public Schools	Purchase small recycling bins for classrooms and larger bins for hallways
Jordan HS	Purchase up to 3 recycling bins for athletic complex area and seven Kill-a-watt monitors
La Crescent Public Schools	Purchase recycling bins and supplies to build a compost bin
La Qui Parle Valley HS	Purchase materials and supplies to create a vermicomposting system and a larger composting bin for grass clippings and other waste
Lake Superior College	Purchase five Kill-a-watt monitors for computer labs and other areas; purchase software to change energy use in computer labs
Lakeville South HS	Purchase equipment to electronically transmit homework to students and decrease amount of paper used in school
Marshall HS	Replace less efficient lighting fixtures and create promotional materials explaining the changes and upgrades to lighting
Mayo HS	Plant trees on school grounds
Mesabi Range Community and Technical College	Purchase recycling bins and educational materials to educate on the types of items to be recycled
Metropolitan State University	Purchase five or six no-sort recycling containers to increase campus wide recycling
Minneapolis Community and Technical College	Purchase books on sustainability issues that will be stored in 3-legged Frog library display; purchase art supplies for campus displays to encourage recycling and energy conservation.
Minnesota State College – Southeast Technical	Purchase recycling bins to be placed around campus
MN State Community and Technical College	Purchase recycling containers for classrooms across campus
Minnesota State University Moorhead	Survey to determine students' energy use during peak hours; produce educational materials to educate students on reducing energy use in campus residence halls
Morris Area School District	Purchase more recycling containers and upgraded containers for Morris Tigers Recycle program
Mountain Lake Public School	"Going Green" by implementing one or more: solar panel for school; replace paper towels with air dryers in bathrooms; recycling in school and cafeteria.
New York Mills Public School	Purchase supplies to build compost bin near community garden site and purchase recycling canisters for gym, common areas, and cafeteria
North HS	Purchase materials to design and build a rain garden on campus; purchase CFL bulbs to replace incandescent
Northfield School of Arts and Tech (ARTech)	Host an event to encourage attendees to become carbon neutral; purchase trees for planting on campus
Northland Community and Technical College	Purchase additional recycling bins to be placed around campus
Northwest Passage HS	Create an awareness campaign about what it means to be "off the grid". Help school explore alternative energy options, including wind, solar and geothermal, and emphasize water and energy conservation and recycling. Funds spent primarily on printing and

	copying costs for environmental awareness campaign
Northwest Technical College	Host a tour of Great River Energy facility in Maple Grove for students and teachers to learn how to become more energy efficient
Ortonville School District	Purchase electricity usage meter, motion sensors and timers, and additional recycling containers; produce and distribute survey to determine how to develop materials to educate students on actions to reduce their carbon footprint
Osseo Senior High	De-lamp vending machines and purchase 3 vending misers; also purchase durable recycling bins.
Parkers Prairie HS	Purchase recycling bins for plastic for locations where wastebaskets/garbage cans are located and additional recycling bins for classrooms
Patrick Henry HS	Purchase recycling containers for school
Perham-Dent Public Schools	Purchase equipment to build red wigglers vermiculture bed in HS boiler room, use soil in school greenhouse or garden
Pine Island HS	Purchase gloves and aprons for use by students collecting recyclables on campus; plant trees on campus; purchase 2 kill a watt energy monitors
Princeton HS	Purchase insulation strips and recycling bins and disposal fee for items collected during the student "River Clean Up" project.
Plainview Elgin Millville HS	Purchase vending miser and equipment to install on water fountains
Proctor Public Schools	Evaluate feasibility of installing solar panels at athletic field
Rainy River Community College	Purchase CFL bulbs for student exchange to replace incandescent; purchase recycling containers and produce educational flyers to promote recycling on campus
Redwood Area Schools	Purchase supplies and materials for a food digester and composter and a bike to generate energy when pedaled
Ridgewater College	Purchase Energy Misers and more recycling stations for campus
Roosevelt HS	Create an advertising campaign to encourage students to sort garbage and to be more green conscious
Rosemount HS	Purchase signage and implement educational campaign to create a No Idling Zone to reduce emissions from cars and buses in school parking lot
Round Lake-Brewster	Purchase thermostats and new lighting with the proper foot-candles for classrooms. Purchase supplies and materials to create educational awareness displays.
School of Environmental Studies – Rosemount Apple Valley Eagan	Purchase energy efficient bulbs and other energy saving devices, and sell them through school green energy store, using any proceeds to purchase additional energy saving devices
Sebaka Public School	Purchase recycling bins to place around campus
South HS	Purchase vending misers to be placed on campus machines
Southwest HS	Build interior storm windows to insulate single pane glass windows in metal frames; work performed by volunteers and students
Spring Grove Public School	Purchase energy saving equipment to assist school in reducing energy and greenhouse gases
Springfield Public School	Purchase composting bins and additional supplies necessary to begin compositing in school cafeteria
St. James HS	Purchase energy monitors, timers for water coolers, and reduced flow showerheads to reduce energy and water use throughout school
St. Michael-Albertville HS	Purchase composting bins and educational materials for waste reduction strategies with cafeteria food waste
St. Paul Central HS	Purchase food waste collection bins to provide waste to pig farm in Anoka County. Purchase art supplies and materials for signs to encourage sustainable behavior.
Staples-Motley HS	Purchase vending miser; energy usage monitor; infrared non-contact thermometer; and additional recycling bins; produce and distribute materials encouraging carpooling, walking and taking the bus to school
Stephen-Argyle Central HS	Create materials to promote the school's Click Off- Green Up campaign, which is directed at reducing unneeded lighting by turning off lights when not in use and encouraging use of naturally available light. Also purchasing additional recycling bins for small electronics.
Tartan HS	Purchase materials to design and build a rain garden on campus; purchase CFL light bulbs to replace incandescent bulbs
The City, Inc.	Create music video to instruct viewers on changes they can make to reduce energy use,

	intended for students, staff, family and community. May also purchase materials such as CFLs, weather stripping for school building
Two Harbors HS	Host a school event to raise awareness on environmental and energy issues; may purchase energy misers for use on school vending machines
U of M – Crookston	Purchase materials to build an educational kiosk to engage and educate students on benefits of sustainability and LEED certified building construction
U of M – Duluth	Create and distribute educational materials for students on the importance of energy conservation; produce signs to promote an energy challenge between dorm buildings; purchase materials to support Earth Day campus events
U of M – Morris	The goal of the project is to raise awareness in the area of energy conservation. Purchase three vending misers and document energy savings via Kill-a-watt devices. Make the results public so both students and faculty are aware of their presence on campus.
Vermilion Community College	Purchase a scale to measure cafeteria food waste and moveable white board to place in cafeteria next to trash cans to inform on progress in recycling; purchase up to eight recycling receptacles with grant and matching funds
Washburn HS	Students will take trip to learn about waste to energy facility
Willmar HS	Purchase materials to build shelter to protect the biomass being used to heat the greenhouse; purchase a hopper for biomass with any remaining funds
Winona Senior HS	Purchase equipment to assist in measuring energy usage in classroom; purchase materials and supplies to launch educational campaign to reduce energy use and lower carbon footprint
Winona State University	Purchase solar panel for use on school fountain

Appendix 4
SUMMARY AND RESULTS OF THE 23 COMPETITIVE GRANT PROJECTS AND SCHOOL TESTIMONIALS

1. Gobblers Go Green -- Aitkin High School

Project Summary: An energy audit by Environmental Resources Management (ERM) from the Schools Cutting Carbon program indicated that Aitkin High School's carbon footprint was "above average." Using suggestions from the ERM audit report, the school's Green Team created a list of energy-saving projects that is saving energy and reducing the school's carbon footprint. Building upgrades that provide visible and teachable energy-savings include replacing existing exit lights with LED signs, replacing mercury vapor lights in the gym with more efficient lighting, installing motion detectors, and installing vending misers on school vending machines.

Project Results: The Gobblers Go Green project is a great example of student leadership and significant energy savings. Its two objectives were to save energy through replacing lights and to raise awareness of energy use to change behavior on campus. This project involved replacing lights in the gymnasium with energy-efficient T5 lamps; replaced fluorescent exit signs with LED signs; installed occupancy sensors in 26 areas; and installed three vending misers in the cafeteria. The school also replaced 40 overhead lighting in the district office with energy efficient lights. The cost to replace these lights exceeded the budgeted grant amount, but the school district decided to replace all fixtures at one time because of the energy savings payback.

The team also successfully completed its objective to hold a school-wide promotion. The Gobbler Green Team worked throughout the school year to develop an educational display focused on energy use and savings, which was displayed during Earth Week 2010 in the cafeteria. Students played an energy trivia game and won “green” prizes.

The Green Team also exhibited the display at the annual River and Lakes Fair in June 2010. This event attracts thousands of regional visitors. The team has also partnered with their local municipal utility to fund more energy efficiency projects as the original grant has proven so successful. The Student Green Team presented a summary of the project to the Aitkin School Board, and discussed its project at the CERTs conference in St. Cloud in February 2011.

The calculated energy savings for this project are 20,571 kwh/year, 31.7 tons of GHG/year, and a cost savings of $3,137/year.

Testimonial - Aitkin High School: “*Schools Cutting Carbon has been a worthwhile and exciting opportunity for the Aitkin Schools. Being selected into the Minnesota Schools Cutting Carbon Program (MnSCC) was a highlight as it allowed us to focus on some upgrades that improved our energy efficiency even further.*

MnSCC allowed us the opportunity to bring together a group of community members to discuss the energy efficiency of the Aitkin Schools, and discuss ideas on how we might best make improvements. Forming the "Aitkin Green Gobblers" student group was fun. The students learned from the upgrades that were made to the building.

The MnSCC project allowed students to grow as individuals and take some pride and ownership in their school building.” Ruth Reeves, Adviser, Aitkin High School

2. Beavers Cut More than Trees - Bemidji State University

Project Summary: Three campus facilities at Bemidji State University installed more efficient lighting technology to reduce energy use, operating costs, and safety concerns associated with these buildings. Deputy Hall, the BSU Gymnasium, and Bangsberg Fine Arts Complex are locations with high visibility because several thousand students, faculty, staff, community members, and visitors pass through these buildings each year. The project team used various outreach methods to make the benefits of these lighting retrofits even more visible.

Project Results: The Bemidji State University project was very successful! The first objective was to replace inefficient T12 lighting in Deputy Hall with fluorescent T8 fixtures. This task was completed at a cost of $26,768, and qualified for a rebate of $22,757 from Ottertail Power Company. The rebated funds were used to achieve additional lighting upgrades.

In the BSU gymnasium, 400 watt metal halide lamps were replaced with energy efficient fluorescent T5 high bay fixtures. The school paid $2500 in additional costs for renting a lift and electrical work; it qualified for a $1747 rebate.

The third objective was to replace high wattage incandescent lights with higher efficiency and LED lighting in performance areas of the Bangsberg Fine Arts Complex. This work was completed with a significant match by the university ($19,500), and reinvestment of a rebate from Ottertail Power Company ($8,094), which enabled the replacement of even more inefficient lights. The Bangsberg Fine Arts project bids were under budget, enabling the University to replace six additional worklight lamps with more efficient lighting.

The campus education and outreach started in the Spring of 2010 and lasted through this year. Outreach included articles in the student newspaper regarding the gym lighting retrofits. The Athletic Department announced the lighting retrofit in the gymnasium at athletic events. That announcement emphasized both energy and cost savings of about 15,000 kWh and $920 annually. The Deputy Hall retrofits are expected to save 191,000 kWh per year and $11,460 in energy costs annually. Twenty posters are hanging in the gym and Deputy Hall to publicize the lighting retrofits. These were all completed with matching funds. Finally, the students coordinated an Earth Day event last April with five other on-campus student organizations to emphasize their relationship to this project and to the environment.

The school energy retrofits are saving energy. The Deputy Hall lighting retrofits are saving approximately 191,030 kw annually, with an annual savings of $11,461 and a return on investment of two years. The BSU Gymnasium retrofit is saving an estimated 15,288 kw annually, yielding a $917 annual savings and a return on investment of about sixteen years. The Bangsberg lighting retrofit will save an estimated 30,000 kw annually.

The team spent a great deal of time performing energy calculations and was somewhat disappointed with the calculations. The calculations for Deputy Hall and the Bangsberg Complex show that energy use in those buildings increased by about 22,000 kw between FY 10 and FY 11. Calculations for the Gymnasium showed a savings of over 26,100 kw between FY 10 and FY 11. The team noted the challenges posed by university buildings include variations in heating degree days, special events, and construction activities. They were not able to determine the impact that special events and activities in particular had upon the energy use data. The team was satisfied that the objectives for this project were achieved.

3. We Only Have One Earth: Reducing Our Carbon Footprint and Emissions - Crosby-Ironton High School

Project Summary: Crosby-Ironton High School is an Energy Star school that implemented a multi-faced project driven by students using behavior change and technological advances to continue reducing carbon emissions. One focus involved

eliminating the “phantom load” from electronic devices by installing power strips and working with students and staff to shut down appliances and electric devices during the night. (Phantom load refers to the fact that many devices continue to use electricity even when turned off if they remain plugged into an outlet.) Another focus was an analysis of the building structure to identify areas of energy inefficiency by using energy-audit equipment such as an infrared camera, and identifying areas needing proper insulation, sealing, and other energy efficiency actions on an annual basis. Students participate in these building inspections annually and present their recommendations to the school district.

Project Results: One of the team’s objectives, to reduce phantom load on electronic devices and appliances, raised many obstacles. The team found it difficult to track results due to several factors: new computer labs, new roof top air handlers, extended use of art kilns, and extended hours in the auto shop. These made a year-to-year comparison difficult.

The team changed focus and used a kill-a-watt meter to monitor energy use in several individual classrooms using power strips. Their results indicate a savings of $18 to 20 per month for each television/DVD player using the power strip. With 70 units in the district, the cost savings totals $1260 to $1440 monthly with full participation. Student teams are helping to monitor the use of the power strips district wide. They continue to work on behavioral aspects of this step and evaluating complications with shutting off electronic devices. To date the school has reduced energy consumption and indicated that its baseline energy star rating increased from 66 to 87. The school team has also purchased an infrared camera to survey the building for air leaks and heat loss and identify areas of the school that appear to need additional insulation and sealing. The team will present their findings to the school board and administration in February 2011.

In the other main focus of the project, the school team, led by two teachers/mentors, worked with building staff to identify and address areas of the building in need of energy efficient repairs and upgrades. The team identified leaking and inefficient doorways that were addressed by installation of weather-stripping. The school team noted that the school’s energy star rating declined from 89 to 86 during the past year. The team noted that weather conditions and the school administration’s decision to increase the base temperature of the building from 68 to 69 degrees, and other changes in building operations and activities, were a contributing factor.

4. LED Retrofit of Exterior Lighting - Dakota County Technical College

Project Summary: Standard High-Intensity Discharge (HID) exterior parking lot fixtures were replaced with LED lamps to improve and lower energy consumption, carbon emissions, and maintenance costs. Existing light poles were used, with only the head and arm of the fixture needing replacement. A significant portion of this work was integrated into the technical program curriculum and performed by students in this program. The project provided valuable insight for future lighting decisions on campus

and in the community, ongoing classroom learning, and the opportunity for a student-led team to share their experience with other students and community members.

Project Results: Dakota County's original workplan proposed to retrofit three poles in the exterior parking lot with LED lighting. The grant awarded was $13,400, which at the time was estimated to retrofit two poles with three LED heads each. The team was able to identify an LED lamp at a lower cost than originally estimated. As a result, the team was able to increase the scope of the project to complete an LED retrofit for all three poles as originally proposed. The installation of the three retrofits was completed on time and on budget. Students in the Electrical Lineworker program and the Electrical Construction and Maintenance program completed the installation, which took a full day using 30 students and two bucket trucks. Students in these classes benefited from the learning opportunity during installation and evaluation, and will continue to learn from the maintenance opportunities.

Before installation of the LED lights, students inspected the lights and took light readings from the existing HID lamps (20 readings per pole). Students reviewed these light readings and took new readings to calculate changes in the spring of 2011. The cost savings equals $51.58 per year for the lights, with light levels more even and less wasted light. The team is using various media to notify the campus of LED lighting, and hosted an interactive student display and a learning booth at spring and fall events.

5. Triple Purpose Solar Training and Demonstration Project - Eden Valley-Watkins High School

Project Summary. The Carbon Cutting Eagles were awarded a grant to support their solar photovoltaic project. Assisted by volunteer construction workers, as well as labor and materials donated by local businesses, high school students built a solar project that will be used in the Eden Valley-Watkins science, math, and computer curriculum. Several photovoltaic modules were mounted on a sun-tracker on the southeast corner of the school building, with an additional module incorporated into a solar training and demonstration unit. The team also built an informative display in the main entrance lobby. In addition, the project will continue to involve the community through student-assisted community education courses.

Project Results. The Eagles created four teams to implement their solar project: a Cabinet Team focused on design, construction and installation of the kiosk display system; a design team to finish designing the solar system; a Publicity Team to raise public awareness; and a Floating Team to help other teams and for miscellaneous tasks. The students worked directly with the electrical engineer to finalize the design; coordinated the construction, welding, and concrete companies; promoted an "installation day" for the solar panels that they paired with a Green Fair. They have also partnered with Sterns Electric and Meeker Cooperative. The project team managed many changes in materials and schedule, including discovering an old school foundation while digging a trench for the electrical conduit.
The team worked on setting up a wireless internet for their solar installation over the summer of 2010, and their project was featured on the front page of the St. Cloud Times

in August 2010! The school had a very successful Installation Day/Green Fair, including presenting classes on living green, home energy audits, demonstrations of solar technology (i.e. a solar powered corn dryer), and an energy rally. Nearly 100 people participated, even though it was competing with high school baseball playoffs. The school sponsored community education classes on topics including alternative energy, home energy audits, tax rebates, credits and incentives and other topics relevant to the community regarding clean energy. Through additional fundraising and other efforts, the team was able to install two additional solar panels and micro inverters on the side of the building next to the panels funded by the grant located on the tracking array.

Additional projects for the team school year included a second round of outreach to elementary students, another Green Fair, an enhanced website for the solar array, more recycling bins, and a carbon cutting scrapbook. During the past year, the team's focus was primarily on community education. The team raised additional grant funds this spring to help with the expanded recycling program. The school participated in the CERTs conference in St. Cloud in February 2011, sharing the results of their project.

The education department was given the task of getting solar related curriculum into the Eden Valley- Watkins classrooms. The department helped the 8th grade science teacher run the "alternative fuels" segment of his class, which lasted a full week. Students in the class learned and did projects about ten types of alternative fuels and some of the environmental effects of these fuels compared to fossil fuels.

The marketing and education departments teamed up to make a presentation for the 4-6th graders at the Eden Valley-Watkins elementary school science fair in April 2011. The presentations lasted all day, and the Carbon Cutting Eagles received great reviews and were rated as one of the top 3 presenters. The team used a miniature solar panel to power a DC fan to show how solar systems work and demonstrated how to use a solar oven to show other uses for solar energy. The children received booklets called "101 Ways to Save Energy" (donated by Stearns and Meeker Coop) to bring home to their parents.

The education department would like to integrate more solar curriculum into classes. A survey of the high school seniors revealed that only 32.5% of the seniors had a basic understanding of how our solar energy system worked (panels collect DC, inverter transfers to AC, school uses power); 45% could remember what kWh stands for (which they learned in 9th grade science); 25% knew what a CFL was; and only 17.5% knew (within 25 cents) how much they pay for a unit of energy. The team strongly believes that the state should have alternative energy curriculum requirements written into the state standards. Steph Wirz, the team's student leader, was asked by the American Solar Energy Society to present at their national conference about the school's project. She said people at the conference were also shocked by the survey results. Her speech was meant to sound the alarm to solar companies, educators and the lawmakers present.

The team did its best to provide information to the community about green energy and energy conservation. They continue to go to the elementary school to help the students form “green” habits and teach about recycling. They will also continue to find ways to work energy and green technology related curriculum into high school classes. The team knows that no one type of alternative energy can solve the energy crisis, but maybe teaching can. Their hope is that teaching will not only touch a life, but touch the community and even the state.

Testimonial - Eden Valley Watkins High School. “*The MNSCC program is the reason that our school created a "green team". We have built a solar system for the school, educated students about green topics, and have held green community education classes and community events all because of the MNSCC Program. This organization has provided the funding and support to help our school group succeed. It would be great to see required funding from the state for a "green team" at every school so that every student would have the opportunity to learn about alternative energies, green technologies, etc. We were very fortunate to have come across such a supportive organization.” Stephanie Wirz, Student Team Leader, Eden Valley Watkins High School*

6 – 10. Northeast Higher Education District Sustainability Collaborative - Hibbing, Itasca, Mesabi Range, Rainy River, and Vermilion Community Colleges.

Overall Project Summary: Five community colleges comprise the Northeast Higher Education District (NHED). Student sustainability teams at each NHED campus focused on one of five areas relevant to the carbon footprint of higher-education institutions: student housing (Rainy River), commuting (Hibbing), food service (Itasca), solid waste (Mesabi Range), and lighting (Vermilion). Each sub-project included a strong educational component to promote carbon emissions reductions throughout the NHED campuses and communities of greater Northeastern Minnesota. Each campus will share their challenges and triumphs with the other campuses.

6. Sustainable Transportation - Hibbing Community College (HCC)

Project Summary: The student project at Hibbing Community College involved reducing carbon emissions through developing and promoting a more effective rideshare program; more bicycle commuting; and greater use of public transportation.

Project Results: The team worked with the IT staff to improve the on-line rideshare database and establish a permit program to allocate priority parking for rideshare participants. The team organized a bike collection and bike loan program; set up a secure bike storage area and repair workshop; and promoted these efforts in the local paper. To promote public transit, the team worked with Hibbing Area Transit to include the college as a regular stop; arranged for subsidized transit passes for students; and promoted this program at the college and in the community.

In a major achievement in December 2010 on promoting ridesharing and carpooling, the Dean of Students at Itasca Community College wrote a successful grant to the Blandin

Foundation to pay for NHED college access to "Zimride", an online social ride-sharing and transportation software (http://www.zimride.com/rideshare/university). The NHED purchased a three-year license to use the Zimride rideshare database. Access to Zimride is available at all five NHED campuses. Advertising will begin during the fall orientation in August 2011, and hang tags distributed. The program is being rolled out this fall. In addition, HCC has purchased and installed "Carpool Parking Only" signs in the main college parking lot. It is likely that signs will also be purchased for the North Parking Lot. Carpool mirror hang tags have been purchased. The carpool only spaces are being used frequently.

HCC launched its bike loan program in September 2010. The project included a public request for donation of bicycles – over 40 bikes were donated during collections in August! Students sign up through a bar code system similar to the library book checkout program. Bike repair and maintenance equipment and supplies have been purchased and a repair workshop established in the former vo-tech building.

Finally, the team negotiated with Hibbing Area Transit to secure three daily bus stops on campus. The team arranged for subsidized transit passes through a contract between the City and HCC and a special vote by the City Council. The ridership program has been very successful - with 1,176 rides have occurred since the program launch in September 2010!

Testimonial - Hibbing Community College. "*The MN Schools Cutting Carbon grant has opened up a whole new set of opportunities for Hibbing Community College: TASC (Toward a Sustainable Campus) students were awarded $4000 as part of the Northeast Higher Education District's Schools Cutting Carbon grant initiative. Students decided to work on issues of transportation. They now have an agreement with the City of Hibbing to subsidize student bus passes and HCC is now a regular stop on the Hibbing Area Transit bus route; our student bike loan program is now loaning bikes to students at no charge; four new "Carpool parking Only" signs are now in place; and ZimRide will soon be available to link up those wishing to carpool These student-led initiatives would not have been possible without this funding!" Don Graves, Project Director, Hibbing Community College*

7. Composting and Tray-less Dining -- Itasca Community College

Project Summary: Itasca Community College focused on reducing the carbon footprint of its cafeteria by introducing a composting initiative and implementing tray-less dining with reusable dishes and utensils.

Project Results: Tray-less dining has been successfully implemented, first on a pilot scale and then permanently. Two hundred and fifty polycarbonate plates and bowls were purchased and put in use. Thirty-five plates have disappeared, possibly "borrowed" by students, but this was not a continuing problem in the full-scale rollout.

The second objective of the grant project, construction of a composting unit for cafeteria organic food waste, was less successful. Attempts to separate organic compostable food from other trash have not been successful. Students appeared to ignore posted signs, and without continual supervision of compost sorting during meal times, students do not separate compostable items. The team decided not to construct a composting unit for cafeteria organic food waste as a result, which means that the second objective was not completed.

The school team's third objective, developing an education campaign for the campus on sustainability issues relating to food, dining, and resource use, is underway, with the first goal to meet with student life and student housing directors to create a training program for Resident Assistants and students. The team plans to work on this program during the Fall 2011 semester. The school has been diligent in keeping its B3 energy database up to date.

One of the lessons learned in this project was the importance of maintaining student interest. With five NHED colleges splitting the grant, Itasca focused on composting. The students had a much stronger interest in engineering-related projects such as solar or dorm renovation, but less interest in composting. This feedback will help shape future projects at the school.

8. Improving Recycling and Minimizing Waste - Mesabi Range Community College

Project Summary: The Mesabi Range Community College project includes an overhaul of the campus recycling programs and reducing the campus solid waste stream.

Project Results: Mesabi Range's team has not submitted a final report yet. This update is based on their second interim report. portion of the grant was used to purchase new indoor and outdoor recycling bins for high traffic areas of both the Virginia and Eveleth campuses. Grant funds were also used to purchase two large 500 gallon composting bins. These tasks are complete and bins are in place.

The school team created marketing posters and clear labeling for recycling and waste containers. The team worked with food service staff to reuse kitchen and cafeteria waste. Students created "Garbage" sculptures, such as one using pop pebbles and cans. The sculpture will hang in the Commons area starting in the spring of 2011. Students also planned to create a campus native plant garden. The student sustainability team has written articles and press releases for the school and local paper and planned a Green Week celebration for this spring.

Testimonial - Mesabi Range Community College: "*Minnesota Schools Cutting Carbon for helping Mesabi Range College to initiate a Green Team on campus and to help the college become more sustainable. MNSCC was instrumental in creating a sustainability team on campus. With their grant assistance, a small team was formed to*

create a sustainability initiative on campus. Since receiving the grant, we have become very successful in our recycling efforts. We have also seen sustainability become more mainstream on campus and have begun working with other two-year institutions in the area. Thank you again MNSCC!" Toby Anderson, Project Coordinator, Mesabi Range Community College

9. Energy Competition! - Rainy River Community College

Project Summary. The Rainy River Community College project included engaging students in an energy competition and encouraging other energy strategies to reduce energy use, improve recycling, and implement other sustainable living strategies in dorms.

Project Results. The energy competition is planned for the Rainy Hall orientation in the fall of 2011. Student Senate and Rainy Hall RAs will lead the project. Due to inability to monitor energy use in individual floors, the college will hold educational games with student competitions based on properly sorting recycling, sustainability themed questions, and other hands on activities. Sustainable living strategies were emphasized during orientation activities in the fall of 2010 and updated for the fall of 2011.

The project also includes other actions to reduce energy consumption in Rainy Hall. Compact fluorescent bulbs were installed on two floors; power strips with switches have been distributed in rooms with instructions for use; drying racks and clothes lines are checked out by students; and signage for laundry, lounge, and individual rooms to educate students on energy and waste are in place.

The school also focused on increasing recycling on campus. Additional recycling bins were placed in each room, one for paper and one for plastic. Can collection bins are also located in common areas. The school purchased a trailer for storage and transport of recycled materials is in progress. Signs for common areas were developed and installed with our grant funds and a matching grant from the Rainy River Community College Foundation.

Two to four large bags of recyclables are collected from Rainy Hall each week. There are three central collection bins in the laundry room – plastic, paper, and cans. In total, over 1000 gallons of paper and plastic by volume were recycled last year. Over the life of the MnSCC project, starting with the $500 grant in 2009, approximately 3,600 gallons of plastic and 4,200 gallons of paper by volume have been recycled.

10. Energy Efficient Lighting - Vermilion Community College

Project Summary: The Vermilion team project was to reduce GHG emissions by replacing lighting fixtures in a prominent space on campus with an energy efficient lighting system and to develop and mount an interpretive display relaying information

about the project, including information about sustainability and carbon emissions reductions.

Project Results: The project concluded successfully. Eighteen metal halide lighting fixtures in the Fireside Lounge have been replaced with compact fluorescent fixtures and lights. The team also intends to replace lighting in two residence hall corridors adjacent to the Fireside Lounge was replaced with more efficient compact fluorescents and occupancy sensors at a later date. The team also completed a lighting upgrade of the gymnasium, with all new florescent lights and occupancy sensors. Although too early to know for certain, the estimate is that this upgrade will save the college at least $500 to $600 per month in electric costs.

The team created an interpretative display for the Fireside Lounge. The poster is in final printing and framing phase and will be displayed shortly. The team has been using the B3 database to determine changes to energy use in the building.

11. Mix, Match, Recycle - Higher Ground Academy, St. Paul

Project Summary: High school students organized a recycling program at the school for paper, plastic, glass and aluminum. They led the project by locating recycling bins throughout the school; educating students, teachers, and staff in how to separate recyclable products in the classroom and cafeteria; collecting and sorting recyclables; and measuring and reporting results. The project emphasized teaching students, staff and the community about the importance of recycling and the impact of recycling on reducing the school's carbon footprint. Elementary and high school students also went to see recycling centers. An important project goal was to foster a shared understanding of the benefits of recycling among the campus and community at large.

Project Results: Higher Ground Academy is very proud to have established a full-scale recycling program. Full implementation began in February of 2011. They are very proud of what they have established. All students, who are mostly of East African background, are now recycling. There are containers placed in three locations in the schools hallways being used to collect plastic bottles, cans, and glass bottles. Students are able to visualize and actively participate in the process of separating recyclable materials from other waste products. Approximately 97% of students completely empty their milk cartons and deposit them in the clearly labeled recycling container. They wait their turn to deposit their carton into the specially designed one-hole topped container that was purchased to expedite the separation process.

One problem has been observed with the recycling containers in the hallways. These specially designed blue recycling containers have one-hole on top and have printed signage indicating that they are for recyclables only. The containers, however, do not have a clearly visible recycling emblem on them. This may be part of the reason for other waste being placed inside. The team placed a waste basket next to the recycling container. This offered some improvement, but not a 100% correction rate. The team

also purchased several recycling stations that are clearly labeled for paper, waste, cans, and bottles. The team hopes this will make recycling even more inviting and fun!

Eureka Recycling Company collects the recyclables once a week and provides monthly data to the school. The team receives weekly and monthly recycling amounts in pounds, separated by types of material and carts collected. The team will do a follow-up in the fall to determine who has taken the idea of recycling into their homes. With this information, they will determine if there is a need to further educate families about the need to recycle and the how-to's in their households and in their communities. The idea of having the high school art class create brochures to spread the word about recycling was discussed.

The school currently has 2 paper carts and 7 bottle, can, [milk cartons] carts. Service Learning students are assigned to collect recycled materials weekly. Each class is asked to place their recycling containers outside their classroom door by 9 a.m. every Friday.

High school biology students began preparing for the school-wide recycling program by studying the positive effects of recycling on the environment. The biology teacher and the students gained knowledge about the benefits of recycling and what the students at Higher Ground Academy would do to help the environment. This information was shared with the entire student body by the biology students who did a presentation on recycling in each class.

The data collected for this project indicates that the Higher Ground green team has made a real difference in improving their environment. Over 4000 pounds of recycled materials have been collected in only 6 months, with an estimated reduction of 2 tons of GHG emissions. The team was excited about the opportunity and results that this project offered.

Testimonial – Higher Ground Academy. "*Thank you for giving us the opportunity to make a real difference in our school, families, communities and our country by choosing Higher Ground Academy as a recipient of the grant. I am pleased with what has occurred as a result of our implementation of our Mix. Match, Recycle project at Higher Ground Academy, where we will continue to do great things." Brenda Hassan, Teacher, Higher Ground Academy*

12. Walking Softer: Lightening John Marshall High School's Carbon Footprint - John Marshall High School, Rochester

Project Summary: John Marshall students promoted awareness of alternative energy sources and the efficient consumption of fossil fuels to their peers and the community.

Project Results: The John Marshall school team purchased the pool cover, but it not been installed due to administrative issues at the school. The school expected to recover the installation costs within six months and anticipated realizing energy and cost

savings for the remaining 4.5 years of the pool cover's expected lifetime. The school team still intends to install the cover at John Marshall, but there is no installation date at this time.

13. Reducing Electricity Use in Our School and Community - Ortonville School District

Project Summary: Ortonville's Local Environmental Focus Team (LEFT) identified ways to reduce electricity usage after reviewing recommendations in the school's ERM energy audit report. The team replaced T12 bulbs with more efficient T8 bulbs in all classrooms that use those bulbs, install energy misers, and replace less efficient lighting in other classrooms. Electricity monitors eliminated phantom electricity use, and the team programmed laboratory computers to be more easily shut down. Through in-kind donations of radio time and newspaper space, the school has educated the community about reducing energy use and the impact these actions have on the school's carbon footprint.

Project Results: The Ortonville High School successfully completed its project, although some work will continue long after the conclusion of the grant. The team hired an electrician to refit all light fixtures in elementary classrooms from T12 to T8 fixtures. The grant and utility rebate allowed replacement of light fixtures in all classrooms, the gym, music areas, offices, and shop areas. Lighting upgrades continued with higher efficiency lights replacing older ones in the high school. The school also purchased additional energy misers through the CERTs bulk-purchase campaign this spring. Students installed the energy misers under supervision of the building custodian.

The team began a reminder campaign to reduce phantom electrical usage by shutting down computers and turning off lights when not in use. The student team also gave presentations to fellow students from 10 other high schools on reducing electricity usage in school at an Earth Day event and at a Regional Middle School Science and Nature Conference at Southwest Minnesota State University in Marshall. The team was also featured on a WCCO Radio to talk about the work the school is doing related to energy efficiency.

There was a measurable decrease in energy use between 2009 and 2010 according to comparison reports using the state B3 database. There was an increase in usage between 2010 and 2011, which may be attributable at least in part to the colder 2010 winter, since the increases occurred during the December-March time period. Savings from the 182 fixture retrofits and bulb changes are estimated at 58,600 kWh and $3,300 in reduced energy costs each year. The school received a utility rebate of $4,887, which was used to complete additional retrofits and bulb changes. The installation of 10 energy misers reduces vending machine electricity use by about 45%, saving $850 in annual electric costs and 17,000 kWh of electricity.

The team was also working on reducing phantom wattage by sending regular reminders to faculty and staff to turn off computers and lights when not in use. These efforts continued throughout the project and will be continuing after the project ends. The

school worked with its utility to install a free computer program that automatically shuts off computers after a period of idleness. This has been installed on all computers that are able to accept the installation. This should save up to $530 and 10,719 kWh annually.

Finally the team continues to work on increasing awareness of the importance of reducing energy use in school and in the community through presentations in elementary classes, a booth at the local Sports and Leisure Show, working with presenters at the Sports and Leisure Show to reduce waste and increase recycling, and publicizing their efforts in the local newspaper, local radio talk show, school website, and Earth Day presentations.

14. The Green Take-Over - Proctor High School

Project Summary: Reducing electricity consumption and waste are the primary focus areas for reducing the carbon footprint of Proctor High School. To increase the energy efficiency of the building, eight motion sensors and two light harvesters were installed in the secondary school building to assure that lights are on only when necessary. Students read energy meters before and after the implementation of this system to determine energy savings. Also, the school replaced fifteen of its CRT computer monitors with energy efficient LCD monitors. To decrease food waste, Proctor implemented a composting campaign. Purchasing additional reusable dishes and utensils for the cafeteria also helped the school realize its goal of recycling at least 50% of its waste.

Project Results: The Proctor team focused the majority of work on food composting, recycling, and reducing use of disposable bowls and plates in the school cafeteria. The High School was recycling 27% of its waste in the spring of 2010, and increased to 38.5% in the spring of 2011, an improvement of 11.5% and a savings of 30.5 tons of GHG emissions.

The team purchased biodegradable garbage bags to increase composting, and placed a blue composting can in the cafeteria. Student volunteers staff the composting station to assure program success. The school monitored waste levels in compost, recycling, and garbage dumpsters. There was a significant decrease in garbage to the point where the district could cost effectively remove one six cubic yard dumpster and replace it with a six cubic yard recycling dumpster. The team collected 85.5 gallons of food waste each week, for a total of 13.4 tons of food waste annually. This program is labor intensive and requires a commitment from kitchen staff and the school district to continue in the future. In addition, students are emptying recycling containers, not custodial staff.

The school food service has replaced Styrofoam containers with reusable bowls and plates in most instances. The team partnered with the Western Lake Superior Sanitary District and its GreenCorps worker to print signage to encourage composting and recycling throughout the school. Green Bandit students have taught lessons on

composting and recycling in all elementary classrooms. They made a video about how to compost and recycle in the cafeteria that was shown to all 6-12 grade students. They have hung large posters in several locations in school buildings to encourage recycling, composting, and reduced energy use. Green Bandit students have educated the entire student body at the composting site during lunch periods. Recycling bins are located in classrooms, but more are needed in hallways, teachers' lounges, and workrooms.

The team updated the computer lab, installed two light harvesters, added motion sensors to two hallways, and updated the lighting in the school fieldhouse. The cost of the light harvesters and motion sensors was $2,380, and with an $839 utility rebate and an estimated energy savings of $567/year, the payback period is 2.72 years.

The team also replaced 35 of the school's 260 CRT monitors with LCD monitors. They then completed a partial transformation of the school's computer systems to nComputing desktop virtualization solutions, allowing the school to reduce the number of needed PCs while at the same time increasing the available amount of computing stations, splitting CPU cycles by various computer terminals simultaneously. The energy savings are significant: three nComputing terminals attached to an Energy Star dual core PC use the same electricity as one non-Energy Star computer with a CRT monitor. Two complete computer labs have been switched to nComputing with new LCD monitors. All classroom desktop computers used by teachers have been upgraded and replaced with LCD monitors.

Proctor students showcased their results at the "Earth Fair for Proctor's Future" in May 2011. This event involves community groups, education stations along a school hiking trail, a wind turbine monitoring building, and other features. A project survey indicates that knowledge of GHG and carbon footprint increased by 25.5%, with students even in kindergarten mentioning composting and recycling as ways to reduce garbage. About 75% of high school students are knowledgeable about their carbon footprint.

15. Cooling Our Heels - Rosemount High School

Project Summary: Rosemount High School's energy audit report by ERM indicated that Rosemount High has a larger than average carbon footprint. The team's project was intended to reduce energy use by over 10%, as well as reduce the amount of paper used at the school by a similar percentage. Students used light meters and infrared thermometers to identify areas needing energy efficiency improvements such as caulking, insulation and weather-stripping. Motion activated sensors, power strips, and energy misers are used for energy management. Sixteen LCD computer monitors replaced half of the existing CRT monitors. Paper reduction training for teachers and monitoring software reduced the amount of printing by teachers and students. The student team also organized and promoted a walk/bike/carpool/bus day.

Project Results: Rosemount High School's project has produced very impressive results. The project goal was to reduce the school's carbon footprint by 11% by June 2011, and reduce paper use by 10%. The school decreased its use of natural gas by 21% and electricity by 7% compared to 2008 baseline data. The GHG emissions from

these two sources were reduced by 374 tons, which is an 11% reduction and achieves the team's goal. Each strategy included a strong educational component and engaged a large portion of the student body. The team gathered data on energy use, lighting, and temperature readings around the school. They used that data to form action plans to conserve energy and improve energy efficiency.

The project's first objective was to educate the school about the team's goal of reducing the school carbon footprint. This was done through school news articles, web page outreach, and posters created by students displayed throughout the school. All ninth graders completed an assignment to determine their own carbon footprint and studied the schools' carbon footprint using the ERM report and the Schools for Energy Efficiency (SEE) data. One measure of success of this objective is the school's top team ranking in the Minnesota Energy Challenge, with 466 members. The number one action pledged was to turn off lights and unplug unused appliances.

The second objective was to develop and conduct an Energy Unit in 9th grade Earth Science. Students collected and evaluated data and formulated action plans to reduce their carbon footprint. Tools used to measure energy, lighting, and remote temperature readings were also available for students to use at home. Students also created public service announcements on energy or water conservation and re-checked lighting and energy use data during the second year of the project. In addition, students selected and promoted a different "Action of the Month" that was featured throughout the school year.

Students presented their action plans and supporting data to faculty and staff as well as high school administrators. The school's administrators worked with custodial staff to implement ERM project recommendations and student action plans. Specific energy saving actions taken at the school include adjusting lighting levels in classrooms and hallways; installing motion activated sensors; installing weather-stripping on external doors; programming TV monitors to shut down at days' end; installing energy misers; replacing 32 CRT monitors with energy star rated LCD monitors; providing power strips to 70 staff members; and allowing students to borrow the Kill A Watt and Luxmeters for home use.

The team worked on reducing student cars driven to school by 10% through several strategies, including sponsoring several monthly reward days for taking alternative transportation or walking; sponsoring walk/bike/carpool to school days; and twice sponsoring a "Walk with the Principal" event. While the school did not reach its goal, it received a county grant to make improvements to the bike rack area.

Finally the school's goal of reducing paper use by 10%, or 456,340 sheets, was partially successful. The school installed "Papercut" software and trained teachers in its use in the spring of 2010. Staff reported a reduction of 100,525 sheets. The team anticipates greater reductions as the staff get more familiar with on-line programs that reduce paper, such as Moodle and Papercut.

In sum, the team reported that the project greatly enriched the energy curriculum at Rosemount High School. Students developed important math and communication skills on this project, presenting their data and action plans to students, administrators, other schools, at the CERTs February 2011 conference, and to the LCCMR committee. The Green Team also earned two second place trophies for their wind turbine design and energy output at the first Renewable Energy Challenge.

Testimonial – Rosemount High School. ***"****As a 9th grade science teacher at Rosemount High School, I have seen the benefits of this program for my students and their families. Students have been actively engaged in hands on learning experiences and collecting and analyzing meaningful data. Using Materials the grant funds provided such as Kill A Watt Meters, Lux meters, and Infrared laser thermometers, students have found ways to save money and conserve both energy and resources both at school and at home." Veda Kanitz, Teacher and Project Coordinator, Rosemount High School*

16. Reducing Our Carbon Footprint through Alternate Energy - St. Michael-Albertville High School

Project Summary: Through a shop class design-and-build project, students constructed a passive solar air heating system in the school's greenhouse and a small solar thermal hot water heating system to demonstrate the power of solar thermal. Both projects are being integrated into the school curriculum. In addition, students evaluate the effectiveness of these projects through an electronic monitoring system that trains students in all grades through web-based system integration or video monitoring.

Project Results: St. Michael-Albertville's team worked with an expert to design and install two solar panels and related equipment to supplement the heating of the school greenhouse. The panels serve as a demonstration of the capabilities of solar power on a small scale. The electronic monitoring system reads how much energy the panels are providing continually. The greenhouse also has a solar thermal system and serves as a student learning center on alternative energy.

Testimonial – St. Michael – Albertville High School. "*The Minnesota Schools Cutting Carbon Grant enabled Patrick Lindquist, an independent study student, to design and create a solar panel system that will demonstrate to students the power of solar energy in Minnesota. Patrick worked with the Project Lead the Way engineering course as he researched and designed the demonstration system. Patrick gained an authentic learning experience that cannot be taught in a standard classroom. He plans to pursue a career in engineering at the University of Minnesota." Kay Nowell, Teacher and Project Coordinator, St. Michael-Albertville High School*

17. Southwest Community Education Green Team Solar Lighting Project - Southwest High School, Minneapolis

Project Summary: Nearly forty percent of the school's greenhouse gas emissions are from electricity usage. The Southwest Community Education Green Team ("SWCEd") proposed to educate the student body, community, and elementary students about

alternative energy sources, with an emphasis on the beneficial applications of solar energy. The team demonstrated how solar energy can reduce carbon emissions by building a solar lighting module and solar heating module. The team uses these materials in elementary school and community workshops to illustrate how solar energy can be effectively produced and used to reduce reliance on fossil fuels and reduce our carbon footprint.

Project Results: The Southwest Green Team successfully developed demonstration models of solar heating and lighting with assistance from a solar engineer in planning and construction. The solar electric water heating system was completed and delivered in June 2010. The solar electric model was completed and delivered at the end of June 2010. The water heating unit shows temperature, temperature changes, and water flow rates. The solar electric panel converts the sunlight to electricity to power a light and a fan.

The Green Team also developed materials for the elementary school and community workshops to illustrate how solar energy can be effectively produced and used to help reduce our reliance on fossil fuels and reduce our carbon footprint. Drawing from their own work, the team documented the potential savings that solar energy applications, as well as passive use of solar lighting, can provide in the home, business and school environments. This information, along with demonstrations of the Green Team's solar energy and solar heating modules, was shared with the elementary students in Green Team workshops, with the general public in community workshops, and with the Southwest High School teaching staff for integration into their classroom curriculum.

18. *EcoCity Works!* Cuts Carbon - The City, Inc., Minneapolis

Project Summary: The *EcoCity Works!* student environmental club conducted an energy audit to determine improvement options for the school and recommended that The City, Inc. replace the school's washing machine and milk cooler, which were not energy efficient due to their age and condition, with Energy Star qualified appliances to realize energy savings. The *EcoCity Works!* team promoted the project and the resulting energy savings through its website, Face Book account, newsletter, and at a planned special event to educate the school and community about the benefits of saving energy.

Project Results: The City, Inc. used its grant funds to purchase an Energy Star washer and Energy Star refrigerator for school operations. The impact of this purchase was to reduce the school's electric bill by about $230 per year. Unfortunately, severe budget issues forced a shut down operations and closed the North Minneapolis alternative school in January 2011.

Testimonial – The City, Inc. **"***The City, Inc. is a nonprofit organization that exists to provide various programs that benefit inner-city residents. We serve primarily people of color or people in poverty. Two alternative contract high school sites are run from the organization; North campus and South campus. MnSCC has sparked a tremendous change in direction for our schools, in that students have become empowered through*

their actions to make changes in their lives and at school, and are learning about environmental processes and stewardship. With MnSCC grant monies we purchased two much-needed major items: an energy efficient new cooler, and an energy efficient new washing machine. We provide school lunches from the cooler and needs-based access to the washing machine for students, many of whom are transient. We also changed out some of the lighting at the north side building to improve efficiency.

We could not have made these purchases without the MnSCC funding. These changes, however, have opened even more possibilities for us. We are now in process of furthering our environmental focus by expanding our activities and curriculum to include a local community food growing operation, acquiring green energy sources for our school site, and perhaps starting a community rain garden outreach program for the north side. With these new initiatives we hope to provide students with the skills and knowledge that will prepare them for a much-needed environmentally wise future. We are truly grateful for the work that MnSCC is doing to help organizations like us to head in new energy wise directions!" Carla Beaudette, Teacher, The City, Inc.

19. UMD Cutting Carbon: Conservation, Education and Investigation - University of Minnesota – Duluth

Project Summary: The University of Minnesota – Duluth (UMD) team work plan had four objectives – promoting student green events; auditing UMD buildings to identify energy saving projects; creating student sustainability displays; and establishing a Sustainability Pledge that campus community members could join. Students and staff led an energy conservation outreach campaign targeted at behavioral changes to reduce electricity use on campus. Campaigns included: Dorm Energy Wars, a UMD-Energy Saver pledge (with a web-based tracking component), departmental energy mini-audits, and a 'Green Your Office' presentation series providing energy-saving incentives (i.e. power strips, and possibly wool socks or sweatshirts funded by UMD). The project also offered the UMD community a way to pledge to save energy and track promised energy savings through a web-based database and modification of an existing energy conservation program pledge.

Project Results: The UMD team was very active during this project, completing a number of impressive sustainable actions. Students sponsored a major Earth Hour event on March 27, 2010, with a concert and information about energy issues, UMD greenhouse gas emissions, and energy saving ideas. On April 29, 2010, the Student Sustainability Coalition and the Cycling Club organized a Bike-to-School celebration and promotion. Following the success of that event, the team helped to arrange the first Bike-to-Work day at UMD.

UMD building staff purchased a multi-meter to help identify areas on campus that are over-cooled, over-heated, or over-lighted. Grant funds have also purchased kill-a-watt meters and smart strips. These have been distributed, and students are evaluating whether these reduce energy, measure energy use by refrigerators, and provide information to support further use of Vending Misers. The team continues to promote

the Sustainability Pledge to draw student attention to carbon emissions on the UMD campus. The Pledge is 10 simple actions that students can take to reduce energy on campus, such as using cold water whenever possible; washing full loads of dishes; double-sided printing; using reusable bags and water bottles. Students can join on-line, committing to some or all actions.

During Bulldog Welcome Week, incoming freshman are greeted with sustainability presentations, waste-free dining events, power strip give-aways, and "sustainability-themed bingo night." The school promotes reduced paper use, such as using recycled flash drives to reduce paper use. Waste reduction is also a priority during Bulldog Welcome Week, and two events were "zero waste", with an emphasis on sustainable action and carbon-cutting.

The Fall Sustainability Fair was attended by an estimated 250 students. Topics included energy conservation and reducing carbon emissions as well as many other sustainability topics. Students will promote the Energy Pledge in the school's spring campaign for energy awareness. The team also promoted energy awareness announcements on KUMD; public service announcements highlighting energy saving, carbon-light commuting, and encouraging recycling ran in November and December 2010. They collected 780 pounds of electronic waste for recycling. A week later, the UMD Honors Students held an Energy Forum, a day long event featuring discussions on a number of aspects of energy policy, including peak oil, biofuels, nuclear energy, and fossil and renewable fuels.

On March 27, 2010, UMD students celebrated Earth Hour (a week-long event), using posters, a concert, and displays of energy-saving information for attendees. The 2011 Earth Hour featured a trayless cafeteria, energy-saving pledges in Residence Halls, music, and a movie about fossil fuel issues. Students also launched the UMD Energy Action Plan as part of the American College and University Presidents' Climate Commitment, with a goal of 1,000 pledges. The team worked on the pledge for two years and now has over 340 signed pledges. They will continue working towards their goal.

UMD students sponsored bike-to-school days in April 2010 and again in 2011, with a fair including a raffle, tables about bike safety, a bike repair station, and other promotional materials. The event attracted over 50 students in 2011. A student intern helped to organize the first bike-to-work day at UMD as well. The team engages Resident Advisors in UMD housing to increase awareness of energy conservation. They distributed 42 smart power strips and provided information about energy, water, and resource conservation.

In the Dining Center, 37 light figures were retrofitted to use LED bulbs in the spring of 2011. These bulbs use 75% less electricity than existing bulbs, resulting in a payback of less than 3 years. In addition, the life expectancy is four times that of the existing bulbs, yielding an estimated savings in labor of $30 over the lifetime of each LED bulb.

School electricity use was reduced by 1% (320 mwh) during the grant period despite opening two new buildings, equivalent to a reduction of 236 metric tons of GHG emissions.

The team has reached hundreds of students through the Sustainability Facebook page, blog, and website. There was significant press coverage of events held during the project. Student leadership was extremely important in all aspects of project implementation.

Testimonial – University of Minnesota Duluth: "*Having a grant from MN Schools Cutting Carbon was truly a great motivator for our campus. The grant helped kick-start many ongoing activities and partnerships working on energy conservation on the UMD campus. An added benefit beyond the grant period: students who participated and led grant energy conservation activities are now playing leadership roles on campus sustainability committees." Mindy Granley, Project Supervisor, University of Minnesota Duluth*

20. Students Using Natural Energy (SUN-E): Solar Thermal Installation and Education Project - University of Minnesota – Morris

Project Summary: A new solar-thermal heating system was installed on the Recreation Fitness Center (RFC) community pool and serves as a demonstration site for the project. The Students Using Natural Energy (SUN-E) team at the University of Minnesota – Morris (UMM) used LCCMR grant funding to support the RFC solar-thermal project by recruiting student volunteers to support the technical and educational outreach objectives of the project and to educate the campus, other colleges, and local communities about solar-thermal energy. Funds were also used to purchase two of the solar thermal panels. The benefits of a solar-thermal heating system for the pool are reductions in natural gas consumption and resulting greenhouse gas emissions. The University of Minnesota-Morris (UMM) shares the RFC with Stevens County residents and the Morris Area Education System (MAES).

Project Results: The SUN-E project definitely achieved its goals, and the team is very pleased with the outcomes. The solar thermal panels on the RFC pool have been installed, and the school has established an ongoing performance monitoring process. The system is operating as planned so far. The installation will produce 280MBtu per year and will offset the commensurate amount of natural gas that would have been used to produce this energy. Roughly 30,000 lbs of carbon dioxide are offset each year. A note on operation, at 70F external temperatures, the system is producing 145F fluid at the panels.

The education and outreach campaign is also continuing. A Solar Swim was held in February 2011. Invitations were sent out to MnSCC schools to alert them about the Solar Swim date and time. There were several related events. The first event was focused on a more mature audience, and the team educated several seniors in the community about the solar thermal system. The second event was targeted at youth

and college students. The youth event featured music, education, and food, with about 100 people in attendance. The third outreach event was a collaboration with another local initiative, called Stevens Forward! For this event, called 'Cookies, Cocoa and Carbon Neutrality', the SUN-E team constructed a fun solar education game for children to play and offered education to community members about solar thermal technology.

The team also achieved its video-related goals. They obtained a video from United States' Senator Amy Klobuchar highlighting the solar thermal project at the RFC and renewable energy efforts in Morris. The *SunRay* films initiative was undertaken. Multiple videotaping sessions were conducted with campus and community stakeholders. The videotape material is currently being edited for an educational video describing the project that will be publicly available.

The team installed a solar powered informational kiosk, *Kiosk del Sol*, in the RFC, which provides information to community members about the project. A green kiosk was installed previously on campus for another project, and the team developed the *Kiosk del Sol* based on experiences with this initial kiosk. The installation of *Kiosk del Sol* was completed in February 2011.

The University is developing a campus-wide Green Ambassadors program to train students to conduct tours and share information about all the green initiatives at UMM. The solar thermal system is an important component of the training. Training materials have been developed, and students are giving tours that incorporate the RFC solar thermal system into the tour. The first ambassadors were trained and ready to lead tours in February 2011. The team has plans to grow the ambassador program, and a student was hired as a National Wildlife Campus Ecology Fellow to continue this development.

Finally, the school successfully planning a Solar Festival to kick off the Earth Day celebrations in the spring. They did this event in collaboration with the 'Cookies, Cocoa, and Carbon Neutrality' event discussed earlier. The event was held at a local park in Morris and was open to community members.

An informational brochure was completed for this project and is being distributed to visitors to the RFC. A web-based story was completed about the SUN-E project and posted on the UMM website, and a story appeared in the UMM alumni magazine about the project. Finally, the SUN-E team presented a poster about the project and their collaboration with MnSCC at the Upper Midwest Association for Campus Sustainability Conference in September 2011 to about 180 people.

The University reports that this experience has been very valuable to the student SUN-E team -- they have gained professional skills, and they have provided visibility for this community-based renewable energy system in a way that would not have happened without Minnesota Schools Cutting Carbon involvement and support. They expressed gratitude to MnSCC and staff for working with them to create this engaging project and to help fund a portion of the installation. The combination of support by MnSCC for both

the installation of the panels and funding student engagement was invaluable. The SUN-E project has been important in advancing the University's renewable energy efforts on campus. The 32-panel installation is highly visible in the community and is near Big Cat stadium. So, each time there is a campus football game or event, community members can see this installation.

The SUN-E student team has already continued their work, presenting at the UMACS conference in September 2011. They designed a poster and presented it on their own and without financial compensation. University student leaders are interested in continuing to convene events like the "Solar Swim", and they are looking for other opportunities to advance these efforts. The University intends to grow the ambassador program in the next year as well. This project was a catalyst for UMM efforts in this area, and will continue to be so in the years to come.

Testimonial – University of Minnesota Morris: "*I am thankful for the partnership with this program, the practical hands-on opportunities that it is providing for students, and for helping to catalyze a significant, and new investment, in a homegrown energy solution." Troy Goodnaugh, Campus Sustainability Coordinator, University of Minnesota Morris*

21. Willmar Community Greenhouse Expansion - Willmar Public School

Project Summary: The Willmar Community Greenhouse was created in fall 2007 as a student project by the Youth Energy Summit (YES) student team at Willmar Public School. A unique hybrid heating system heats the greenhouse, fueled primarily by passive solar heating, hot water solar collectors, and a biomass burner. This project involved expansion of the current operation by building more planting beds, improving delivery of produce, and increasing vermiculture. Expanding the number of planting beds involved building a new frame for insulation that increased production, heat retention, and thermal mass. The expansion of planting beds also helps the project move closer to becoming self-sustaining by generating more revenue. The vermiculture increase produces more heat, which helps maintain more consistent growing conditions and produces a high quality soil supplement.

Project Results: The Youth Energy Summit team has been growing and providing fresh produce for Willmar Public Schools, the Willmar Area Foodshelf, and individuals all year. The team used part of the grant to build new planting beds, which increased heat retention and thermal mass. Results of this project include increasing sustainability, increasing renewable energy by expanding production, reducing fossil fuel consumption, and improving harvest and delivery. The team reduced natural gas use by using solar collectors to heat the main hot water tank, insulating the north wall, using water tanks and rain barrels for thermal storage, vermiculture, and burning biomass produced locally and delivered in bulk.

The students maintain graphs showing temperature, relative humidity, and light intensity profiles. They also measure heat in the water storage tank and used software to

calculate growing days. In March 2010, the team built a suspended growing shelf and completed prototype planting beds in time for Prairie Wood's Earth Day celebration. They hosted an open house attended by 50 people. They also hired a new part time greenhouse coordinator in collaboration with Willmar School District's Nutritional Services and Kandiyohi County's Statewide Health Improvement Program.

The team purchased two 60-gallon rain barrels in June 2010 which provided over 500 gallons of water for the outdoor gardens the rest of the year. During winter, they are filled to provide the greenhouse with additional thermal mass. The team has two students serving as greenhouse managers to help with harvest and delivery of produce, as well as coordinating a compost pickup and delivery to the Willmar Municipal Compost site. A Team Dual tricycle and bike trailer were purchased in July 2010 to haul produce to market, make deliveries, and ride in a community parade. They applied for a Southwest Initiative YES grant, which was approved.

This project raised awareness of energy issues by demonstrating renewable solar and biomass systems, as well as why we should rely more on local foods. In addition, the team developed a greenhouse educational program through MinnWest Daycare. Volunteers engage an average of ten daycare students every Monday afternoon during the summer. Students learn gardening skills as well as energy conservation. The team has measured and reported data showing temperature, relative humidity, and light intensity profiles, and calculated the number of growing days.

This youth-driven project improved community confidence in them and the school system, and also fostered a strong collaboration among diverse community organizations. The project exposed over 1,200 students and staff to locally grown produce and concepts of sustainability. The team donated several hundred pounds of food to the local food shelf. The students partnered with the local market, city of Willmar, and Minnwest Technology Campus in various aspects of the project.

The student team determined that solar panels have offset over 6,000 hours of fuel from the natural gas furnace, saving about $1,924 and avoiding 7785 pounds of GHG emissions. The students also calculated the impact of burning biomass instead of natural gas. For the life of the project, biomass avoided about 1,360 therms of natural gas, saving about $952 in natural gas costs, although the school did not save money because the cost of purchasing biomass fuel exceeded the savings. Burning biomass is carbon neutral, so the team prevented about 3,852 pounds of GHG emissions.

22. Winona Senior High School Farm to School, Bike to School, and Water to School - Winona Senior High School

Project Summary: This project's goal is to increase the number of students and staff biking to school. The student team led the construction of a bike shelter equipped with a security system, and promoted these improvements and the benefits of biking to school to students and staff. In addition, the school team supported the use of reusable water bottles by making them available and creating an educational campaign to

increase student awareness about the benefits of replacing their disposable bottles with reusable bottles. The student team also sought to incorporate more local foods as options for its lunch program.

Project Results: These results are based Winona High School's December 2010 report, since the school has not yet submitted a final report. The Winona Senior High School project has attracted significant external funding. The school district applied for a local government renewable energy grant from the Minnesota Department of Energy Security to purchase and install solar panels on the new bike shelter that is being constructed under our grant. The location's high visibility and pedestrian traffic make this ideal for public education. Solar panels should be installed in March 2011. Educational materials will be on display at the bike shelter, and materials will be created to incorporate into the high school curriculum. The project also includes a security camera for the bike storage area, which will be installed when the shelter is completed. The Student Council will work with the student team to promote the bike shelter and solar panels as construction proceeds.

The school team has also focused on promoting reusable water bottles and decreasing dependence on non-reusable bottled water. Students from Something Green are now selling the Winona Senior High reusable water bottle that they designed. The bottles were produced by a local vendor. The High School administration has agreed to install a spout at the two drinking foundations to allow faster refill of bottles between classes.

Testimonial – Winona Senior High School: "*A Winona Senior High School survey indicated more students would bike to school if their bikes had protection from sun, rain, snow and from theft. The school received a grant through the Minnesota Schools Cutting Carbon program to build the bike shelter and add a security camera. Then the committee thought the bike shelter would be the perfect location for solar panels. The Minnesota Office of Energy Security awarded a grant to Winona Senior High to install and connect 27 solar panels as the shelter roof. Thanks to the Cutting Carbon grant that initiated this project, the high school will reduce its carbon footprint, save on energy costs, and provide a wonderful educational tool to the community." Valerie Williams, Teacher, Winona Senior High School*

23. A Million Miles per Gallon: Transitioning to a Bicycle-Based Community - Winona State University

Project Summary: This project promotes a viable alternative to automobiles by purchasing 20 industrial cruiser bicycles and helmets to expand Winona State University (WSU)'s student-led bike rental program. The project also provided student staffing for the recently launched WSU Bike Station, as well as installation of bicycle racks on school shuttles to enable mixed bike/public transportation options. WSU's goal for this program was to achieve a more sustainable, bicycle-based community throughout the City of Winona.

Project Results: Winona State's "Million Miles per Gallon" project promoted bicycles as a viable alternative to automobiles, supporting the tremendous growth in recent years of bicycling among Winona State students. The grant had three facets: (a) Expanding the current bike rental program by purchasing 20 bicycles for semester long student use; (b) guaranteed student staffing of the recently launched university bike station; and (3) installing bike racks on the student shuttle service, enabling mixed bike-public transportation options.

The daily rental program began in 2009 with five refurbished abandoned bikes. In the fall of 2010, with 30 new industrial cruiser bikes, the Purple Bike Program dramatically increased its daily rentals. Twenty were purchased through the grant, 10 by the WSU student senate. Bike rentals increased from 781 in the ten months from September 2009 through June 2010, to 2,121 rentals from July 1, 2010 to June 30, 2011. The Student Senate allocated $3,550 in matching funds for two years of bike maintenance and program management. The student billing process, tracking system and other aspects of the rental program are now in place. Bikes, helmets, and locks have been purchased, and the Student Senate approved the long term rental model and allocated funding for ongoing maintenance of rental bikes. The results of a student survey also have helped to shape the structure and operation of the program. The team worked with WSU's legal department to develop a long term bike rental contract for those renting by the semester or year. Also, they coordinated with the WSU Business Office to integrate billing for long term rentals into the campus student billing system.

The second objective of the project is staffing the bike station and educating students on bike repair. New staff have been hired and trained, and education on this aspect of the project occurred during the annual WSU bike week. Student staff operating the bike station contributed over 925 hours of in-kind project support. The Bike Station oversight and staffing is a collaboration involving the Parking Department, Enrollment Services, the Environmental Club, and Housing. The project is promoted and plays a key support roll in the annual WSU Bike Week, typically the 2nd week in April each year.

The third objective for this project was to install bike racks on the campus bus. A used rack was purchased and installed at a cost that enabled WSU to also purchase one or two racks for the vans used for intercampus transport during less busy hours. Since the bus operates only during peak hours, having racks on the smaller vans will provide more options for students transporting bikes. The racks are now in operation on campus.

In sum, the MnSCC project has assisted in continuing growth of bicycling at WSU, particularly the dramatic increase in the bike rental program. The bike racks on the intracampus bus and vans provide an essential component to a community that supports bicycling. The program has received a good deal of press coverage in the *Winona Daily News,* the *Winona Post,* on television and in local campus news coverage.

Attachment A: Final Budget Detail for 2008 Project - Summary Prepared by Minnesota Pollution Control Agency

Project Title: GLOBAL WARMING: REDUCING THE CARBON FOOTPRINT OF MINNESOTA SCHOOLS

Project Manager Name: Bill Sierks, MPCA Project Manager

Trust Fund Appropriation: $ 750,000.00

2008 Trust Fund Budget	Result 1 - Budget	Amount Spent as of 6/30/2011	Final Balance 6/30/2011	Result 2 Budget as amended 1/31/11 report	Amount Spent as of 6/30/2011	Final Balance 6/30/2011	Result 3 - Budget	Amount Spent as of 6/30/2011	Final Balance 6/30/2011	Result 4 - Budget	Amount Spent as of 6/30/2011	Final Balance 6/30/2011	TOTAL BUDGET	TOTAL BALANCE
	Education and Outreach			Carbon Footprint Identification and Initial Reduction			Grants for Carbon Reduction Projects			Measurement and Evaluation - Case Studies				
BUDGET ITEM														
Grant Contract with University of Minnesota for project coordinator and supervisor	14,000	14,000	0	45,000	44,971	29	21,500	21,500	0	30,000	30,000	0	110,500	29
Grant contract with Univ of MN for grad student project coordinator to assist project team in completing this project; CERTs project supervisor(s) will assist and supervise grad student. Project coordinator will lead assistance and outreach under Result 1, support project teams and assist consultant during Result 2, assist school teams in implementing grants under Result 3, and assist in recognizing achievements, assembling project results, and help school teams measure and report results and prepare case studies in Result 4														
Contracts														
Professional/technical	11,000	11,000	0							3,500	3,500	0	14,500	0
Grant contract with The Minnesota Project to design, operate, and support the project website, which will provide school teams with information, grant application forms, project tracking, case studies, information exchange, and other functions. Work on web design will be subcontracted to Triangle Park Creative														
Professional/technical				361,693	361,693	0							361,693	0
Grant contract entered with Environmental Resources Management (ERM) for professional services to: 1) Work with school teams to identify school carbon footprint and options to reduce greenhouse gas (GHG) emissions; 2) Work with school teams to develop and implement action plans to reduce their school carbon footprint, 3) Educate student teams and empower them to take action to address climate change, and (4) Measure and report results. Propose moving $5,000 from this budget to supplement small school grants.														
Other contracts: Grants to school teams				60,479	60,375	104	202,828	201,354	1,474				263,307	1,578
Funding for two types of grants: (1) Small grants of approx. $500 to each school team to fund carbon reduction project developed by school teams, and five or six small competitive grant awards of approx. $500 to promote innovative carbon reduction projects at schools; (2) 10 to 12 competitive grants of up to $20,000 awarded to schools with the most innovative carbon reduction and education projects														
Other														
COLUMN TOTAL	25,000	25,000	0	467,172	467,039	133	224,328	222,854	1,474	33,500	33,500	0	**750,000**	**1,607**

2008 Project Abstract
For the Period Ending June 30, 2010

TITLE:	Metro Conservation Corridors – Phase IV Overall Summary
PROJECT MANAGER:	Sarah Strommen
ORGANIZATION:	Minnesota Land Trust
ADDRESS:	2356 University Avenue West, Suite 240 St. Paul, MN 55114
WEB SITE ADDRESS:	www.dnr.state.mn.us/metroconservationcorridors
FUND:	Environmental and Natural Resources Trust Fund
LEGAL CITATION:	Minnesota Laws 2008, Chapter 367, Section 2, Subdivision 3(a)

APPROPRIATION AMOUNT: $3,150,000

OVERALL PROJECT OUTCOME AND RESULTS

During the fourth phase of the Metro Corridors project, the Metro Conservation Corridors Partners continued their work to accelerate protection and restoration of remaining high-quality natural lands in the greater Twin Cities Metropolitan Area by strategically coordinating and focusing conservation efforts within a connected and scientifically-identified network of critical lands. This corridor network stretches from the area's urban core to its rural perimeter, including portions of 16 counties.

The Partners employed a multi-faceted approach, which included accomplishments in four specific result areas.

1. *Partnership and Program Coordination*: Partners met quarterly to review project accomplishments and coordinate activity. With DNR support, the partners also continued efforts to develop an online database to facilitate tracking and reporting of MeCC projects over time.

2. *Restore and Enhance Significant Habitat*: Collectively, the partners restored 775 acres of land. Restoration of an additional 464 acres and 0.06 miles of shoreline was completed using other funds.

3. *Acquire Significant Habitat*: Collectively the partners protected 1,183 acres of land, including more than 4 miles of shoreline through acquisition of fee title and conservation easements and leveraged an additional 773 acres of land and more than 5 miles of shoreline using other funds.

4. *Other Conservation Tools and Incentives*: The Metro Greenways Program assisted three cities, two soil & water conservation districts, and one county with the development and gathering of natural resources information to identify sites for protection or restoration and/or to implement conservation measures.

Since 2003, MeCC partners have protected more than 8,000 acres and restored more than 6,500 acres. These strategic and coordinated efforts address a number of recommendations of the Statewide Conservation and Preservation Plan, including, protecting priority land habitats, protecting critical shorelands of streams and lakes, restoring land, wetlands, and wetland-associated watersheds, and improving connectivity and access to outdoor recreation.

PROJECT RESULTS USE AND DISSEMINATION

As projects were completed, the individual partners were encouraged to publicize accomplishments through press releases, organization newsletters and websites. These efforts resulted in information being distributed to the public through websites, email lists, daily and weekly newspapers, newsletters, and other print materials. Additionally, once the MeCC database development is complete, the partnership plans to incorporate a public web portal, which will display accomplishments.

Trust Fund 2008 Work Program Final Report

Date of Report: October 1, 2010
Date of Work Program Approval: June 10, 2008
Project Completion Date: June 30, 2010

I. PROJECT TITLE: Metro Conservation Corridors (MeCC) Phase IV: Overall Summary

Project Manager: Sarah Strommen
Affiliation: Minnesota Land Trust
Mailing Address: 2356 University Ave. W, Suite 240
City / State / Zip : St. Paul, MN 55114
Telephone Number: 651-647-9590
E-mail Address: sstrommen@mnland.org
FAX Number: 651-647-9769
Web Page address: www.dnr.state.mn.us/metroconservationcorridors or www.mnland.org

Location: Within mapped corridors in the counties of Anoka, Carver, Chisago, Dakota, Goodhue, Hennepin, Isanti, LeSueur, Nicollet, Ramsey, Rice, Scott, Sherburne, Sibley, Washington and Wright. Please see attached map.

Total Trust Fund Project Budget:	**Trust Fund Appropriation:**	**$**	3,150,000
	Minus Amount Spent:	**$**	3,149,248
	Equal Balance:	**$**	752

Legal Citation: ML 2008, Chapter 367, Section 2, Subdivision 3(a)

Appropriation Language:
$3,150,000 is from the trust fund to the commissioner of natural resources for the fourth appropriation for acceleration of agency programs and cooperative agreements. Of this appropriation, $1,915,000 is for Department of Natural Resources agency programs and $1,235,000 is for agreements as follows: $475,000 with the Trust for Public Land; $92,000 with Friends of the Mississippi River; $111,000 with Great River Greening; $225,000 with Minnesota Land Trust; $225,000 with Minnesota Valley National Wildlife Refuge Trust, Inc.; and $107,000 with Friends of the Minnesota Valley for the purposes of planning, restoring, and protecting important natural areas in the metropolitan area, as defined under Minnesota Statutes, section 473.121, subdivision 2, and portions of the surrounding counties, through grants, contracted services, conservation easements, and fee title acquisition. Land acquired with this appropriation must be sufficiently improved to meet at least minimum management standards as determined by the commissioner of natural resources. Expenditures are limited to the identified project corridor areas as defined in the work program. This appropriation may not be used for the purchase of residential structures, unless expressly approved in the work program. All conservation easements must be perpetual and have a natural resource

management plan. Any land acquired in fee title by the commissioner of natural resources with money from this appropriation must be designated as an outdoor recreation unit under Minnesota Statutes, section 86A.07. The commissioner may similarly designate any lands acquired in less than fee title. A list of proposed restorations and fee title and easement acquisitions must be provided as part of the required work program. All funding for conservation easements must include a long-term stewardship plan and funding for monitoring and enforcing the agreement.

II AND III. FINAL PROJECT SUMMARY:

During the fourth phase of the Metro Corridors project, the Metro Conservation Corridors Partners continued their work to accelerate protection and restoration of remaining high-quality natural lands in the greater Twin Cities Metropolitan Area by strategically coordinating and focusing conservation efforts within a connected and scientifically-identified network of critical lands. This corridor network stretches from the area's urban core to its rural perimeter, including portions of 16 counties.

The Partners employed a multi-faceted approach, which included accomplishments in four specific result areas.

1. *Partnership and Program Coordination*: Partners met quarterly to review project accomplishments and coordinate activity. With DNR support, the partners also continued efforts to develop an online database to facilitate tracking and reporting of MeCC projects over time.

2. *Restore and Enhance Significant Habitat*: Collectively, the partners restored 775 acres of land. Restoration of an additional 464 acres and 0.06 miles of shoreline was completed using other funds.

3. *Acquire Significant Habitat*: Collectively the partners protected 1,183 acres of land, including more than 4 miles of shoreline through acquisition of fee title and conservation easements and leveraged an additional 773 acres of land and more than 5 miles of shoreline using other funds.

4. *Other Conservation Tools and Incentives*: The Metro Greenways Program assisted three cities, two soil & water conservation districts, and one county with the development and gathering of natural resources information to identify sites for protection or restoration and/or to implement conservation measures.

Since 2003, MeCC partners have protected more than 8,000 acres and restored more than 6,500 acres. These strategic and coordinated efforts address a number of recommendations of the Statewide Conservation and Preservation Plan, including, protecting priority land habitats, protecting critical shorelands of streams and lakes, restoring land, wetlands, and wetland-associated watersheds, and improving connectivity and access to outdoor recreation.

IV. OUTLINE OF PROJECT RESULTS*:*

Result 1: Partnership and Program Coordination

Description: This result provided the leadership to coordinate the conservation efforts of the partners and to optimize results by focusing and leveraging external resources in the protection and restoration of significant natural habitat threatened by development. The coordinator 1) provided strategic direction for partnership action; 2) facilitated partnership meetings; 3) managed reporting and mapping requirements for LCCMR, 4) participated with partners in outreach with representatives of local communities, other agencies, and organizations; 5) worked with the partners to communicate local project successes; and 6) assisted partners with cartographic needs.

Summary Budget Information for Result 1:	**Trust Fund Budget:**	**$** 470
	Amount Spent:	**$** 470
	Balance:	**$** 0

Deliverable	**Completion Date**	**Budget**	**Status**
1. Program coordination	6/30/2010	$470	Complete

Final Completion Date: 6/30/2010

Final Report Summary:
Responsibilities for partnership coordination were shifted from the DNR to Minnesota Land Trust during this phase of the MeCC grant. Only $470 was required and by DNR for these activities. The remaining funds ($49,530) were transferred to Result 3: Acquire Significant Habitat and were used by Metro Greenways to provide a grant to Wright County for an additional acquisition at the Bertram Chain of Lakes Regional Park project site.

Result 2: Restore and Enhance Significant Habitat

Description: The nine partner organizations originally proposed to restore and/or enhance 293 acres with LCCMR funds and another 156 acres with other funds, for a total of at least 449 acres. During this phase, partner organizations actually restored/enhanced approximately 775 acres of significant habitat with LCCMR funds.

The partnership's restoration work was focused on reconnecting a highly fragmented urban and urbanizing landscape and addressed the pervasive issue of invasive species. Site priorities were key upland or riparian habitats that serve to buffer existing habitat patches and to reconnect significant habitat patches in the regional landscape.

Summary Budget Information for Result 2:	**Trust Fund Budget:**	**$** 379,497
	Amount Spent:	**$** 379,397
	Balance:	**$** 100

Deliverable	**Status**
1. Restore 293 acres	Complete

Final Completion Date: 6/30/2010

Final Report Summary:
The partner organizations restored approximately 775 acres of significant upland and wetland habitat with Phase IV funding, as well as an additional 464 acres and 0.06 miles of shoreline through other funds. Restoration activities have taken place on SNAs, AMAs, USFWS property, and Regional Park lands, as well as other significant lands.

A summary of each sub-result is provided below. For additional information and details on projects and expenditures, please see Table A and the individual work program update reports.

<u>2.1: Restore/Enhance significant watershed habitat – Friends of the Mississippi River</u>
Friends of the Mississippi River restored/enhanced a total of 215 acres with Phase IV funding and an additional 80 acres with non-state funding. FMR exceeded all of their goals committed to in the original proposal by restoring an additional 115 acres with Phase IV funding and leveraging 55 additional acres and $6,728 more than originally proposed.

Restoration work was completed at the following sites:

- Pine Bend Bluffs SNA
- City of Hastings Sand Coulee
- Hastings Sand Coulee Prairie SNA
- Hastings WMA
- Rosemount Wildlife Preserve
- Wilmar Property
- Katharine Ordway Natural History Study Area
- Hastings River Flats Park
- Gores Pool WMA & AMA
- Ravenna Block greenway
- St. Paul Parks

<u>2.2: Lower Minnesota Watershed Restoration and Enhancement Project – Friends of the Minnesota Valley</u>
Friends of the Minnesota Valley successfully restored and enhanced 131 acres of wetlands and 22.5 acres of prairie and oak savanna using Phase IV funding, and restored an additional 259 acres using other funds. Accomplishments include the following:

- Rapids Lake Wetland Restoration/Enhancement: 28 acres (260 acres total)
- Lake Renneberg Restoration: 93 acres (120 acres total)
- Upgrala Prairie Renovation: 3.5 acres
- St. Lawrence Wet Prairie: 9 acres

- Jessenland Unit Restoration: 10 acres
- Rapids Lake Unit Dry Prairie Restoration: 10 acres

2.3: Restore/Enhance significant Habitat – Great River Greening

Great River Greening and 600 volunteers restored/enhanced a total of 261 acres (136 acres with Phase IV funds, 74 acres from leveraged non-state funds, and 51 acres with other state funds) and 360 feet of shoreline (338 feet with other state funds), significantly exceeding their original goal of 90 acres.

Restoration activities were successfully completed at the following sites:

- Pilot Knob Hill – prairie and savanna establishment
- Meeker Dam - riparian forest restoration
- Eagle Creek AMA – prairie and savanna enhancement
- The Landing – oak savanna reconstruction
- Hidden Valley Park – dry prairie management and enhancement
- Spring Lake Regional Park – forest restoration
- Uncas Dunes SNA – oak savanna restoration
- Mississippi West Regional Park – shoreline and riparian restoration
- Indian Mounds Regional Park – oak savanna tree and shrub planting
- OH Anderson Elementary – prairie maintenance
- Arcola Mills Historic Foundation – maple basswood forest restoration
- St. Croix River Valley – early garlic mustard control
- Afton State Park – Henslow's sparrow habitat enlargement
- Robert Ney Memorial Park Reserve – forest reconstruction

2.4: Habitat/Enhancement Grants – DNR Metro Greenways

DNR Metro Greenways grants were used to complete restoration work on 4.3 acres. Restoration activities were successfully completed at Centennial Middle School in Lino Lakes and at Indian Mounds and Cherokee Parks in St. Paul. While working to restore land to native vegetation was the primary objective of both projects, they also had community-building and educational components.

2.5: Scientific & Natural Area Restoration and Enhancement – DNR Ecological Services

DNR Ecological Services successfully completed restoration and enhancement activities on 266.7 acres and constructed 0.4 miles of deer exclosure fencing, resulting in native habitat enhancement at 10 Scientific and Natural Areas (SNA) in six counties:

- Lost Valley SNA – Washington County
- Savage Fen SNA – Scott County
- Seminary Fen SNA – Carver County
- River Terrace Prairie SNA – Goodhue County
- Spring Creek Prairie SNA – Goodhue County
- Uncas Dunes SNA – Sherburne County
- Grey Cloud Dunes SNA – Washington County

- St. Croix Savanna SNA – Washington County
- Wood-Rill SNA – Hennepin County
- Falls Creek SNA – Washington County

Result 3: Acquire Significant Habitat

Description: The nine partner organizations proposed to protect at least 489 acres of regionally significant habitat with LCCMR funds and another 278 acres with other funds. Protection activities were accomplished through acquisition of conservation easements or fee title by the funded Metro Corridors partners, as well as through matching grants to local units of government and/or non-profits qualified to own and manage land. Partners applied a suite of criteria to select and prioritize for sites for funding within the corridors, including: (1) site is located within, buffers, or connects to a regionally significant ecological area; (2) site contains rare species or plant communities, (3) site protects surface and ground water quality and/or supply, (4) site is threatened by development pressure and fragmentation, degradation, or loss, (5) site offers opportunities for compatible public uses, (6) site has a committed landowner who is willing and ready to sell or donate fee title or easement; (7) site has a committed land steward who will purchase fee title or easement and support stewardship and monitoring of the land; (8) site has a feasible funding strategy that leverages non-state funds to protect water quality and natural lands; and (9) site conservation is only possible through a partnership arrangement.

Summary Budget Information for Result 3:	**Trust Fund Budget:**	**$** 2,670,033
	Amount Spent:	**$** 2,669,381
	Balance:	**$** 652

Deliverable	**Status**
1. Acquire 497 acres	Complete

Final Completion Date: 6/30/2010

Final Report Summary:
Six partners acquired fee title or conservation easements on 16 sites, protecting a total of 1,183 acres and 4.19 miles of shoreline. Acquisition of an additional 773 acres and 5.14 miles of shoreline was completed using other funds.

A summary of each sub-result is provided below. For additional information and details on projects and expenditures, please see Table A and the individual work program update reports.

<u>3.1: Critical Land Protection Program fee title & conservation easement acquisition-The Trust for Public Land</u>
The Trust for Public Land (TPL) purchased 70 acres of one of the highest quality natural resources sites in Chisago County, including 1/2 mile of shoreline on Green Lake and oak forests, meadows, and wetlands that provide critical habitat for a variety of wildlife & fish. Eight of these acres were acquired through Phase IV

funding and 62 acres were acquired with other state and non-state funding. TPL conveyed the property to Chisago City for protection and creation of a new regional park (Ojiketa Regional Park).

3.2: Protecting significant habitat by acquiring conservation easements – Minnesota Land Trust

The Minnesota Land Trust completed six perpetual conservation easements that collectively protect 960 acres of land and more than 16,600 feet of shoreline. Two easements were purchased, both at a bargain price, and the remaining four easements were donated. Projects were located in the Rum River area, St. Croix valley, and Mississippi River blufflands around Red Wing.

3.3: Fee Acquisition for the MN Valley National Wildlife Refuge – Minnesota Valley National Wildlife Refuge Trust, Inc.

The Minnesota Valley Wildlife Refuge Trust, Inc. acquired fee title to two parcels containing significant habitat along the Minnesota River for expansion of the Minnesota Valley National Wildlife Refuge, for a total of 88.82 acres. Both of these acquisitions expand upon prior acquisitions funded in part by the Environment and Natural Resources Trust Fund, as recommended by the LCCMR. Both parcels are adjacent to lands already protected by the Minnesota Valley Trust.

3.4: Grants & Acquisition of fee title & conservation easements – Minnesota Department of Natural Resources – Metro Greenways

Four fee title acquisition projects at three project sites were funded and completed through DNR Metro Greenways grants, totaling 466 acres (46 acres protected through 2008 funding). Over 2.7 miles of development-attractive shoreline were protected and all three properties will be designated regional parks:

- St. Catherine's Bluff property - Doyle-Kennefick Regional Park
- Bertram Chain of Lakes property – Bertram Chain of Lakes Regional Park
- Camp Ojiketa property – Ojiketa Regional Park

3.5: DNR Fish & Wildlife Acquisition – Minnesota Department of Natural Resources – Fisheries & Wildlife

DNR Fish & Wildlife successfully completed three fee title acquisition parcels on the Vermillion River in Dakota County. Totals for the three acquisitions equaled 323.3 acres, including 2.7 total miles of shoreline. One of the parcels on the Vermillion River was also paid for with 09 ETF acquisition dollars, resulting in both acres and miles being divided proportionately between the two phases.

3.6: Scientific & Natural Areas (SNA) Acquisition – Minnesota Department of Natural Resources – Ecological Services

DNR Ecological Services acquired fee title on 47.9 acres (34.58 acres with Phase IV funding) of white pine-hardwood forest of high biodiversity significance and 1,450 feet shoreline along Horseshoe Lake in Isanti County. The property was designated as the Twin Lakes SNA on June 29, 2010. An additional $114,250 of federal State Wildlife Grant funds contributed to the landowner payment.

The remainder of the Phase IV appropriation was allocated to a second Twin Lakes acquisition that did not come to fruition. Therefore, an amendment request was made to transfer $157,000 of the funds intended for this acquisition to the DNR Division of Fisheries for one of their Metro Corridors projects.

Result 4: Other Conservation Tools and Incentives

Description: The Metro Greenways Program, with partnership input, proposed to provide matching grants to about 6 communities that lie within the conservation focus areas (12 counties) to assist them in developing and gathering needed natural resources information to identify sites for protection or restoration and/or to implement conservation measures for already identified natural areas. Community selection was based on established selection criteria, including: communities that have remaining high quality land cover types or sensitive wetlands, shore land, or aquatic habitats that are relatively unimpaired; rapid growth and projected increases in impervious surface area; ability to provide cash or in-kind project support; willingness to incorporate project deliverables into local planning and implementation decisions; willingness to work across jurisdictional boundaries to accomplish conservation outcomes. Fast growth communities with high value natural resources that contact the program, seeking assistance with well-conceived projects, were especially desirable recipients for these grants. Likely deliverables include: land cover data (MLCCS) for critical natural areas; natural resources data compilation and assessment for direct application; integration of conservation strategies into comprehensive and other local plans; ordinance revision to afford greater protection of natural resources; and identification of various conservation approaches to be applied locally.

Summary Budget Information for Result 4:	**Trust Fund Budget:**	**$** 100,000
	Amount Spent:	**$** 100,000
	Balance:	**$** 0

Deliverable	**Status**
1. 5-6 community assistance grants to LGU's	Complete

Final Completion Date: 6/30/2010

Final Report Summary:
The Metro Greenways Program awarded six Community Conservation Assistance (CCA) grants to local governments in order to help communities address challenges associated with conserving the remaining natural habitats in rapidly changing landscapes. These grants leveraged almost 75% local match. Of the six projects, three were natural resource inventories, two were ordinance updates, and one was a priority-lands assessment model.

The three inventory projects helped to build a foundation for land use and management decisions and included the following:

1) invasive species mapping in Ramsey County
2) tree canopy mapping in Woodbury
3) natural area land cover inventory in a minor watershed (using MLCCS) in 12 Mile Creek Watershed in Wright County

Both the Lino Lakes and Minnetrista ordinance updates incorporated public values and sensitive resource needs into the proposed design by instituting a process that engages city staff, the developer and local agencies in an early on collaborative process.

Washington County developed a GIS model to prioritize the areas in the county that best meet the protection objectives of the Land and Water Legacy Program. The model includes four modules: surface water, drinking water, ecological and connectivity.

V. TOTAL TRUST FUND PROJECT BUDGET:

Please also see the attached Table B and individual final reports for additional detail.

Staff or Contract Services:	$377,266
Equipment:	$7,475
Development:	$3,000
Restoration:	$70,846
Acquisition, including easements:	$2,534,205
Travel:	$4,925
Other:	$54,531

TOTAL TRUST FUND PROJECT BUDGET: $ 3,150,000 ($3,149,248 spent)

Explanation of Capital Expenditures Greater Than $3,500: N/A

VI. OTHER FUNDS & PARTNERS:

A. Project Partners: The Metro Conservation Corridors partners include: Trust for Public Land, Minnesota Land Trust, Friends of the Mississippi River, Friends of the Minnesota Valley, Minnesota Valley National Wildlife Refuge Trust, Great River Greening, DNR Metro Greenways, DNR Fish and Wildlife, and DNR SNA Program. Other project partners include private landowners, local governments, regional, state, and federal agencies, nonprofits organizations, and citizen groups.

B. Other Funds Spent during the Project Period: Approximately $2,325,000 in other funds were proposed to be spent during the project period. Actual funds spent

or leveraged were: $5,766,639 of other state funds and $10,158,618 of other non-state funds (see Table A).

C. Past Spending:

LCCMR appropriations only:

MeCC Phase I (2003) - $4,500,000 ($4,850,000 appropriated)

MeCC Phase II (2005) - $3,529,655 ($3,530,000 appropriated)

MeCC Phase III (2007) - $2,465,225 ($2,500,000 appropriated)

D. Time: 2 years

VII. DISSEMINATION: As projects were completed, the individual partners were encouraged to publicize accomplishments through press releases, organization newsletters and websites. These efforts resulted in information being distributed to the public through websites, email lists, daily and weekly newspapers, newsletters, and other print materials. Additionally, once the MeCC database development is complete, the partnership plans to incorporate a public web portal, which will display accomplishments.

VIII. REPORTING REQUIREMENTS: Periodic work program progress reports were submitted February 1st and August 1st of each year, beginning February 1, 2009. This is the final work program report.

Metro Conservation Corridors 2008 - Phase IV

Table A: Summary of Funding & Accomplishments **LCCMR Appropriated Dollars: $3,150,000**

Result / Activity	Partner	Project Funding						Accomplishments				
		ENRTF 2008 Funds			Other Funds		Total Project Funds Spent *(ENRTF, Other State Funds & Non-State Funds combined)*	ENRTF		Other Funds		Total Project Acres Completed *(ENRTF & Other Funds combined)*
		ENRTF 2008 Funds Allocated	ENRTF 2008 Funds Spent	ENRTF 2008 Funds Balance	Other State Funding Spent	Other Non-State Funding Spent		ENRTF 2008 Acres/Miles Completed		Other Funds Acres/Miles Completed		
								ACRES	MILES	ACRES	MILES	
1. Coordinate MeCC Program												
1.1. Coordination of MeCC program, local outreach and conservation implementation assistance for two year project term	All partners below - led by DNR Metro Greenways	$470	$470	$0	$0	$0	$470					-
2. Restore & Enhancement Significant Habitat												
2.1. Restore/enhance significant watershed habitat.	Friends of the Mississippi River	$92,000	$92,000	$0		$36,728	$128,728	215		80		295
2.2. Lower Minnesota River Watershed Restoration & Enhancement Project.	Friends of MN Valley	$107,000	$106,900	$100		$231,500	$338,400	154		259		413
2.3. Restore/enhance significant habitat.	Great River Greening	$111,000	$111,000	$0	$115,635	$143,863	$370,498	136	0.00	125	0.06	261
2.4. Habitat restoration/enhance grants.	DNR - Metro Greenways	$8,162	$8,162	$0		$21,113	$29,275	4				4
2.5 Scientific & Natural Area (SNA) restoration & enhancement.	DNR - Ecological Services	$61,335	$61,335	$0			$61,335	266				266
SUBTOTAL		$379,497	$379,397	$100	$115,635	$433,204	$928,236	775	0.00	464	0.06	1,239
3. Acquire Significant Habitat												
3.1 Critical Land Protection Program fee title & conservation easement acquisition.	The Trust for Public Land	$475,000	$475,000	$0	$1,510,000	$2,215,000	$4,200,000	8	0.07	62	0.44	70
3.2. Protecting significant habitat by acquiring conservation easements.	Minnesota Land Trust	$225,000	$225,000	$0	$75,000	$634,500	$934,500	960	3.14			960
3.3. Fee acquisition for Mn Valley National Wildlife Refuge.	MN Valley NWR Trust, Inc.	$225,000	$225,000	$0		$197,985	$422,985	47		41		89
3.4. Grants & acquisition of fee title & conservation easements.	DNR - Metro Greenways	$891,368	$891,328	$40	$3,292,004	$5,924,268	$10,107,600	46	0.30	420	2.40	466
3.5. DNR Fish & Wildlife Acquisition.	DNR - Fisheries & Wildlife	$557,000	$556,388	$612	$774,000	$568,205	$1,898,593	87	0.61	236	2.10	323
3.6. Scientific & Natural Area (SNA) Acquisition.	DNR - Ecological Services	$296,665	$296,665	$0		$114,250	$410,915	35	0.08	13	0.20	48
SUBTOTAL		$2,670,033	$2,669,381	$652	$5,651,004	$9,654,208	$17,974,593	1,183	4.19	773	5.14	1,956
4. Community Conservation Assistance												
4.1 Assist local governments to promote the conservation of natural habitats.	DNR - Metro Greenways	$100,000	$100,000	$0		$71,206	$171,206					-
TOTAL		**$3,150,000**	**$3,149,248**	**$752**	**$5,766,639**	**$10,158,618**	**$19,074,505**	**1,958**	**4.20**	**1,237**	**5.20**	**3,195**

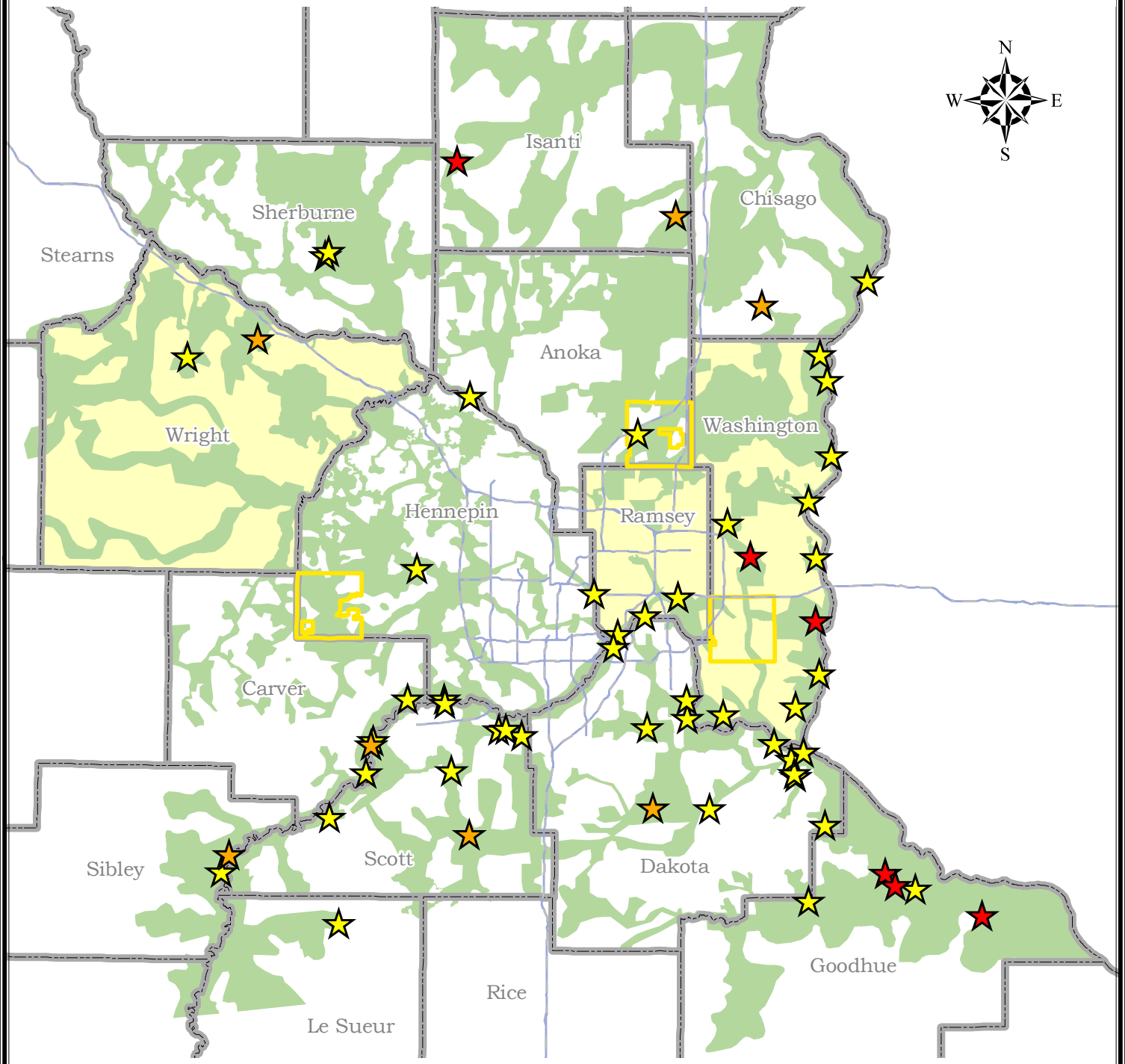
Metro Conservation Corridors 2008- Phase IV
Table B: LCCMR Funding - Budget Detail

Activity	Partners	LCCMR Funding Spent								Budget Explanation (staff/contractservices, development, equipment, other)
		Staff/contract services	Equipm't	Development	Restoration	Acquisition	Travel	Other	Total	
1. Coordinate MeCC Program										
1.1. Coordination of MeCC program & local outreach and implementation assistance for two year project term	DNR Metro Greenways/DNR OMBS	$ 470							$ 470	Staff to manage and coordinate the program. (The workprogram was amended to transfer the remaining balance of $49,530 to Result Area 3.4, Metro Greenways Acquisition.)
2. Restore & Enhance Significant Habitat										
2.1. Restore/enhance significant watershed habitat	Friends of the Mississippi River	$ 91,375			$ 18		$ 607		$ 92,000	Staff/contract services: Conservation Director-.03 FTE, Ecologist- .06 FTE, Accountant-.01 FTE, and private contractors to provide restoration activities such as burns, soil prep., seeding, woody and exotic plant removal, etc.; Restoration: plant material
2.2. Lower Minnesota River Watershed restoration & enhancement project	Friends of Minnesota Valley	$ 67,774			$ 39,126				$ 106,900	Staff/contract services: Conservation Projects Manager (.20 FTE): Project Design, Coordination and Implementation, and Professional/technical contracts (Construction companies for earth work such as building dikes, installing water control structures, breaking drain tile, etc.); Restoration: native prairie seed, trees, water control structures, etc.
2.3. Restore/enhance significant habitat	Great River Greening	$ 70,655	$ 4,930		$ 23,540		$ 1,075	$ 10,800	$ 111,000	Staff: Ecologists (.43 FTE); Field Manager/Technicians (.79 FTE); Volunteer Manager (.15 FTE); Project Administration (.07 FTE); Equipment: chainsaws, brush cutters, sprayers, shovels, loppers, weed wrenches, bow saws, water packs, drip torch, safety equipment. Restoration: site prep, mulch delivery, prairie install, chemical, plants, seeds, gloves, safety glasses, pin flags, flagging tape, stakes, misc. parts. Other: Vol. Event Supplies (approved food and bev., portable toilets, tents, signage, PA system, utilities, POVs
2.4 Habitat restoration/enhance. Grants	DNR - Metro Greenways				$ 8,162				$ 8,162	Grants to local governments & nonprofit organizations for habitat restoration
2.5 Scientific & Natural Area (SNA) restoration & enhancement	DNR - Ecological Services	$ 55,845	$ 2,545				$ 1,214	$ 1,731	$ 61,335	Staff: DNR SNA crew (equvalent to 0.6 FTE for 1 yr) and seasonal burn crew (equivalent to 6 laborers for 2 weeks); Equipment: fleet charges & incidental parts; Development: supplies (e.g. fencing & signs); Restoration: supplies & seedling propogation
SUBTOTAL		$ 285,649	$ 7,475	$ -	$ 70,846	$ -	$ 2,896	$ 12,531	$ 379,397	
3. Acquire Significant Habitat										
3.1 Critical Land Protection Program fee title & conservation easement acquisition	The Trust for Public Land					$ 475,000			$ 475,000	Fee title and conservation easement land acquisition
3.2. Protecting significant habitat by acquiring conservation easements	Minnesota Land Trust	$ 56,201				$ 124,903	$ 1,896	$ 42,000	$ 225,000	Staff: Includes expenses including salaries, benefits (FICA, FUTA. SUI, worker's comp health insurance, 401 (k), etc.) and related costs for approximately .75 FTE for one year as follows: Conservation directors or other land protection staff (approx .50 FTE); Staff attorney and other support staff (approx .25 FTE). Acquisition: includes purchase price of easement(s); title work, title insurance; maps, GIS; film; appraisals, surveys, recording fees, etc. Other: $60,000 for easement stewardship
3.3. Fee acquisition for Mn Valley National Wildlife Refuge	MN Valley NWR Trust, Inc.					$ 225,000			$ 225,000	Fee title acquisition
3.4. Grants & acquisition of fee title & conservation easements	DNR - Metro Greenways					$ 891,328			$ 891,328	Grants to local government units and nonprofit organizations, & direct acquisition of fee title & conservation easements.
3.5. DNR Fish & Wildlife Acquisition	DNR - Fisheries & Wildlife	$ 31,888				$ 524,500			$ 556,388	Land acquisition, associated professional service expenses, and acquisition development
3.6. Scientific & Natural Area (SNA) Acquisition	DNR - Ecological Services	$ 3,058				$ 293,474	$ 133		$ 296,665	Staff/contract services: Unclassified acquisition staff (approx 0.1 FTE; paid exclusively from project funds) and classifed project crews (paid almost exclusively with special project funds) to carry out restoration and enhancement, amounting to approx. 0.6 FTE over the life of the project and seasonal burn crew (approx 6 laborers for 2 weeks), fringe varies from 14.8 -18%; Acquisition: fee title acquisition and real estate transaction costs (e.g. professional services, survey, AC, title, recording, etc)
SUBTOTAL		$ 91,147	$ -	$ -	$ -	$ 2,534,205	$ 2,029	$ 42,000	$ 2,669,381	
4. Community Conservation Assistance										
4.1 Assist local governments to promote the conservation of natural habitats	DNR - Metro Greenways							$ 100,000	$ 100,000	Matching grants to local government units to develop conservation options
TOTAL		**$ 377,266**	**$ 7,475**	**$ -**	**$ 70,846**	**$ 2,534,205**	**$ 4,925**	**$ 54,531**	**$ 3,149,248**	

- METRO CONSERVATION CORRIDORS PARTNERSHIP -

Completed Projects

2008 - PHASE IV



Conservation Easements

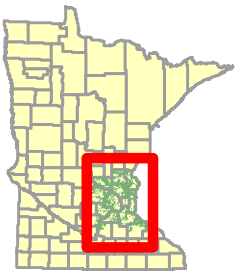
Fee Title Acquisitions

Restorations

CCA Grants - cities

CCA Grants - counties

County Boundaries



2008 Project Abstract
For the Period Ending June 30, 2010

TITLE:	Metro Conservation Corridors – Phase IV Overall Summary
PROJECT MANAGER:	Sarah Strommen
ORGANIZATION:	Minnesota Land Trust
ADDRESS:	2356 University Avenue West, Suite 240 St. Paul, MN 55114
WEB SITE ADDRESS:	www.dnr.state.mn.us/metroconservationcorridors
FUND:	Environmental and Natural Resources Trust Fund
LEGAL CITATION:	Minnesota Laws 2008, Chapter 367, Section 2, Subdivision 3(a)

APPROPRIATION AMOUNT: $3,150,000

OVERALL PROJECT OUTCOME AND RESULTS

During the fourth phase of the Metro Corridors project, the Metro Conservation Corridors Partners continued their work to accelerate protection and restoration of remaining high-quality natural lands in the greater Twin Cities Metropolitan Area by strategically coordinating and focusing conservation efforts within a connected and scientifically-identified network of critical lands. This corridor network stretches from the area's urban core to its rural perimeter, including portions of 16 counties.

The Partners employed a multi-faceted approach, which included accomplishments in four specific result areas.

1. *Partnership and Program Coordination*: Partners met quarterly to review project accomplishments and coordinate activity. With DNR support, the partners also continued efforts to develop an online database to facilitate tracking and reporting of MeCC projects over time.

2. *Restore and Enhance Significant Habitat*: Collectively, the partners restored 775 acres of land. Restoration of an additional 464 acres and 0.06 miles of shoreline was completed using other funds.

3. *Acquire Significant Habitat*: Collectively the partners protected 1,183 acres of land, including more than 4 miles of shoreline through acquisition of fee title and conservation easements and leveraged an additional 773 acres of land and more than 5 miles of shoreline using other funds.

4. *Other Conservation Tools and Incentives*: The Metro Greenways Program assisted three cities, two soil & water conservation districts, and one county with the development and gathering of natural resources information to identify sites for protection or restoration and/or to implement conservation measures.

Since 2003, MeCC partners have protected more than 8,000 acres and restored more than 6,500 acres. These strategic and coordinated efforts address a number of recommendations of the Statewide Conservation and Preservation Plan, including, protecting priority land habitats, protecting critical shorelands of streams and lakes, restoring land, wetlands, and wetland-associated watersheds, and improving connectivity and access to outdoor recreation.

PROJECT RESULTS USE AND DISSEMINATION

As projects were completed, the individual partners were encouraged to publicize accomplishments through press releases, organization newsletters and websites. These efforts resulted in information being distributed to the public through websites, email lists, daily and weekly newspapers, newsletters, and other print materials. Additionally, once the MeCC database development is complete, the partnership plans to incorporate a public web portal, which will display accomplishments.

Trust Fund 2008 Work Program Final Report

Date of Report: October 1, 2010
Date of Work Program Approval: June 10, 2008
Project Completion Date: June 30, 2010

I. PROJECT TITLE: Metro Conservation Corridors (MeCC) Phase IV: Overall Summary

Project Manager: Sarah Strommen
Affiliation: Minnesota Land Trust
Mailing Address: 2356 University Ave. W, Suite 240
City / State / Zip : St. Paul, MN 55114
Telephone Number: 651-647-9590
E-mail Address: sstrommen@mnland.org
FAX Number: 651-647-9769
Web Page address: www.dnr.state.mn.us/metroconservationcorridors or www.mnland.org

Location: Within mapped corridors in the counties of Anoka, Carver, Chisago, Dakota, Goodhue, Hennepin, Isanti, LeSueur, Nicollet, Ramsey, Rice, Scott, Sherburne, Sibley, Washington and Wright. Please see attached map.

Total Trust Fund Project Budget:	**Trust Fund Appropriation:**	**$**	3,150,000
	Minus Amount Spent:	**$**	3,149,248
	Equal Balance:	**$**	752

Legal Citation: ML 2008, Chapter 367, Section 2, Subdivision 3(a)

Appropriation Language:
$3,150,000 is from the trust fund to the commissioner of natural resources for the fourth appropriation for acceleration of agency programs and cooperative agreements. Of this appropriation, $1,915,000 is for Department of Natural Resources agency programs and $1,235,000 is for agreements as follows: $475,000 with the Trust for Public Land; $92,000 with Friends of the Mississippi River; $111,000 with Great River Greening; $225,000 with Minnesota Land Trust; $225,000 with Minnesota Valley National Wildlife Refuge Trust, Inc.; and $107,000 with Friends of the Minnesota Valley for the purposes of planning, restoring, and protecting important natural areas in the metropolitan area, as defined under Minnesota Statutes, section 473.121, subdivision 2, and portions of the surrounding counties, through grants, contracted services, conservation easements, and fee title acquisition. Land acquired with this appropriation must be sufficiently improved to meet at least minimum management standards as determined by the commissioner of natural resources. Expenditures are limited to the identified project corridor areas as defined in the work program. This appropriation may not be used for the purchase of residential structures, unless expressly approved in the work program. All conservation easements must be perpetual and have a natural resource

management plan. Any land acquired in fee title by the commissioner of natural resources with money from this appropriation must be designated as an outdoor recreation unit under Minnesota Statutes, section 86A.07. The commissioner may similarly designate any lands acquired in less than fee title. A list of proposed restorations and fee title and easement acquisitions must be provided as part of the required work program. All funding for conservation easements must include a long-term stewardship plan and funding for monitoring and enforcing the agreement.

II AND III. FINAL PROJECT SUMMARY:

During the fourth phase of the Metro Corridors project, the Metro Conservation Corridors Partners continued their work to accelerate protection and restoration of remaining high-quality natural lands in the greater Twin Cities Metropolitan Area by strategically coordinating and focusing conservation efforts within a connected and scientifically-identified network of critical lands. This corridor network stretches from the area's urban core to its rural perimeter, including portions of 16 counties.

The Partners employed a multi-faceted approach, which included accomplishments in four specific result areas.

1. *Partnership and Program Coordination*: Partners met quarterly to review project accomplishments and coordinate activity. With DNR support, the partners also continued efforts to develop an online database to facilitate tracking and reporting of MeCC projects over time.

2. *Restore and Enhance Significant Habitat*: Collectively, the partners restored 775 acres of land. Restoration of an additional 464 acres and 0.06 miles of shoreline was completed using other funds.

3. *Acquire Significant Habitat*: Collectively the partners protected 1,183 acres of land, including more than 4 miles of shoreline through acquisition of fee title and conservation easements and leveraged an additional 773 acres of land and more than 5 miles of shoreline using other funds.

4. *Other Conservation Tools and Incentives*: The Metro Greenways Program assisted three cities, two soil & water conservation districts, and one county with the development and gathering of natural resources information to identify sites for protection or restoration and/or to implement conservation measures.

Since 2003, MeCC partners have protected more than 8,000 acres and restored more than 6,500 acres. These strategic and coordinated efforts address a number of recommendations of the Statewide Conservation and Preservation Plan, including, protecting priority land habitats, protecting critical shorelands of streams and lakes, restoring land, wetlands, and wetland-associated watersheds, and improving connectivity and access to outdoor recreation.

IV. OUTLINE OF PROJECT RESULTS*:*

Result 1: Partnership and Program Coordination

Description: This result provided the leadership to coordinate the conservation efforts of the partners and to optimize results by focusing and leveraging external resources in the protection and restoration of significant natural habitat threatened by development. The coordinator 1) provided strategic direction for partnership action; 2) facilitated partnership meetings; 3) managed reporting and mapping requirements for LCCMR, 4) participated with partners in outreach with representatives of local communities, other agencies, and organizations; 5) worked with the partners to communicate local project successes; and 6) assisted partners with cartographic needs.

Summary Budget Information for Result 1:	**Trust Fund Budget:**	**$** 470
	Amount Spent:	**$** 470
	Balance:	**$** 0

Deliverable	**Completion Date**	**Budget**	**Status**
1. Program coordination	6/30/2010	$470	Complete

Final Completion Date: 6/30/2010

Final Report Summary:
Responsibilities for partnership coordination were shifted from the DNR to Minnesota Land Trust during this phase of the MeCC grant. Only $470 was required and by DNR for these activities. The remaining funds ($49,530) were transferred to Result 3: Acquire Significant Habitat and were used by Metro Greenways to provide a grant to Wright County for an additional acquisition at the Bertram Chain of Lakes Regional Park project site.

Result 2: Restore and Enhance Significant Habitat

Description: The nine partner organizations originally proposed to restore and/or enhance 293 acres with LCCMR funds and another 156 acres with other funds, for a total of at least 449 acres. During this phase, partner organizations actually restored/enhanced approximately 775 acres of significant habitat with LCCMR funds.

The partnership's restoration work was focused on reconnecting a highly fragmented urban and urbanizing landscape and addressed the pervasive issue of invasive species. Site priorities were key upland or riparian habitats that serve to buffer existing habitat patches and to reconnect significant habitat patches in the regional landscape.

Summary Budget Information for Result 2:	**Trust Fund Budget:**	**$** 379,497
	Amount Spent:	**$** 379,397
	Balance:	**$** 100

Deliverable	**Status**
1. Restore 293 acres	Complete

Final Completion Date: 6/30/2010

Final Report Summary:
The partner organizations restored approximately 775 acres of significant upland and wetland habitat with Phase IV funding, as well as an additional 464 acres and 0.06 miles of shoreline through other funds. Restoration activities have taken place on SNAs, AMAs, USFWS property, and Regional Park lands, as well as other significant lands.

A summary of each sub-result is provided below. For additional information and details on projects and expenditures, please see Table A and the individual work program update reports.

<u>2.1: Restore/Enhance significant watershed habitat – Friends of the Mississippi River</u>
Friends of the Mississippi River restored/enhanced a total of 215 acres with Phase IV funding and an additional 80 acres with non-state funding. FMR exceeded all of their goals committed to in the original proposal by restoring an additional 115 acres with Phase IV funding and leveraging 55 additional acres and $6,728 more than originally proposed.

Restoration work was completed at the following sites:

- Pine Bend Bluffs SNA
- City of Hastings Sand Coulee
- Hastings Sand Coulee Prairie SNA
- Hastings WMA
- Rosemount Wildlife Preserve
- Wilmar Property
- Katharine Ordway Natural History Study Area
- Hastings River Flats Park
- Gores Pool WMA & AMA
- Ravenna Block greenway
- St. Paul Parks

<u>2.2: Lower Minnesota Watershed Restoration and Enhancement Project – Friends of the Minnesota Valley</u>
Friends of the Minnesota Valley successfully restored and enhanced 131 acres of wetlands and 22.5 acres of prairie and oak savanna using Phase IV funding, and restored an additional 259 acres using other funds. Accomplishments include the following:

- Rapids Lake Wetland Restoration/Enhancement: 28 acres (260 acres total)
- Lake Renneberg Restoration: 93 acres (120 acres total)
- Upgrala Prairie Renovation: 3.5 acres
- St. Lawrence Wet Prairie: 9 acres

- Jessenland Unit Restoration: 10 acres
- Rapids Lake Unit Dry Prairie Restoration: 10 acres

2.3: Restore/Enhance significant Habitat – Great River Greening

Great River Greening and 600 volunteers restored/enhanced a total of 261 acres (136 acres with Phase IV funds, 74 acres from leveraged non-state funds, and 51 acres with other state funds) and 360 feet of shoreline (338 feet with other state funds), significantly exceeding their original goal of 90 acres.

Restoration activities were successfully completed at the following sites:

- Pilot Knob Hill – prairie and savanna establishment
- Meeker Dam - riparian forest restoration
- Eagle Creek AMA – prairie and savanna enhancement
- The Landing – oak savanna reconstruction
- Hidden Valley Park – dry prairie management and enhancement
- Spring Lake Regional Park – forest restoration
- Uncas Dunes SNA – oak savanna restoration
- Mississippi West Regional Park – shoreline and riparian restoration
- Indian Mounds Regional Park – oak savanna tree and shrub planting
- OH Anderson Elementary – prairie maintenance
- Arcola Mills Historic Foundation – maple basswood forest restoration
- St. Croix River Valley – early garlic mustard control
- Afton State Park – Henslow's sparrow habitat enlargement
- Robert Ney Memorial Park Reserve – forest reconstruction

2.4: Habitat/Enhancement Grants – DNR Metro Greenways

DNR Metro Greenways grants were used to complete restoration work on 4.3 acres. Restoration activities were successfully completed at Centennial Middle School in Lino Lakes and at Indian Mounds and Cherokee Parks in St. Paul. While working to restore land to native vegetation was the primary objective of both projects, they also had community-building and educational components.

2.5: Scientific & Natural Area Restoration and Enhancement – DNR Ecological Services

DNR Ecological Services successfully completed restoration and enhancement activities on 266.7 acres and constructed 0.4 miles of deer exclosure fencing, resulting in native habitat enhancement at 10 Scientific and Natural Areas (SNA) in six counties:

- Lost Valley SNA – Washington County
- Savage Fen SNA – Scott County
- Seminary Fen SNA – Carver County
- River Terrace Prairie SNA – Goodhue County
- Spring Creek Prairie SNA – Goodhue County
- Uncas Dunes SNA – Sherburne County
- Grey Cloud Dunes SNA – Washington County

- St. Croix Savanna SNA – Washington County
- Wood-Rill SNA – Hennepin County
- Falls Creek SNA – Washington County

Result 3: Acquire Significant Habitat

Description: The nine partner organizations proposed to protect at least 489 acres of regionally significant habitat with LCCMR funds and another 278 acres with other funds. Protection activities were accomplished through acquisition of conservation easements or fee title by the funded Metro Corridors partners, as well as through matching grants to local units of government and/or non-profits qualified to own and manage land. Partners applied a suite of criteria to select and prioritize for sites for funding within the corridors, including: (1) site is located within, buffers, or connects to a regionally significant ecological area; (2) site contains rare species or plant communities, (3) site protects surface and ground water quality and/or supply, (4) site is threatened by development pressure and fragmentation, degradation, or loss, (5) site offers opportunities for compatible public uses, (6) site has a committed landowner who is willing and ready to sell or donate fee title or easement; (7) site has a committed land steward who will purchase fee title or easement and support stewardship and monitoring of the land; (8) site has a feasible funding strategy that leverages non-state funds to protect water quality and natural lands; and (9) site conservation is only possible through a partnership arrangement.

Summary Budget Information for Result 3:	**Trust Fund Budget:**	**$** 2,670,033
	Amount Spent:	**$** 2,669,381
	Balance:	**$** 652

Deliverable	**Status**
1. Acquire 497 acres	Complete

Final Completion Date: 6/30/2010

Final Report Summary:
Six partners acquired fee title or conservation easements on 16 sites, protecting a total of 1,183 acres and 4.19 miles of shoreline. Acquisition of an additional 773 acres and 5.14 miles of shoreline was completed using other funds.

A summary of each sub-result is provided below. For additional information and details on projects and expenditures, please see Table A and the individual work program update reports.

<u>3.1: Critical Land Protection Program fee title & conservation easement acquisition-The Trust for Public Land</u>
The Trust for Public Land (TPL) purchased 70 acres of one of the highest quality natural resources sites in Chisago County, including 1/2 mile of shoreline on Green Lake and oak forests, meadows, and wetlands that provide critical habitat for a variety of wildlife & fish. Eight of these acres were acquired through Phase IV

funding and 62 acres were acquired with other state and non-state funding. TPL conveyed the property to Chisago City for protection and creation of a new regional park (Ojiketa Regional Park).

3.2: Protecting significant habitat by acquiring conservation easements – Minnesota Land Trust

The Minnesota Land Trust completed six perpetual conservation easements that collectively protect 960 acres of land and more than 16,600 feet of shoreline. Two easements were purchased, both at a bargain price, and the remaining four easements were donated. Projects were located in the Rum River area, St. Croix valley, and Mississippi River blufflands around Red Wing.

3.3: Fee Acquisition for the MN Valley National Wildlife Refuge – Minnesota Valley National Wildlife Refuge Trust, Inc.

The Minnesota Valley Wildlife Refuge Trust, Inc. acquired fee title to two parcels containing significant habitat along the Minnesota River for expansion of the Minnesota Valley National Wildlife Refuge, for a total of 88.82 acres. Both of these acquisitions expand upon prior acquisitions funded in part by the Environment and Natural Resources Trust Fund, as recommended by the LCCMR. Both parcels are adjacent to lands already protected by the Minnesota Valley Trust.

3.4: Grants & Acquisition of fee title & conservation easements – Minnesota Department of Natural Resources – Metro Greenways

Four fee title acquisition projects at three project sites were funded and completed through DNR Metro Greenways grants, totaling 466 acres (46 acres protected through 2008 funding). Over 2.7 miles of development-attractive shoreline were protected and all three properties will be designated regional parks:

- St. Catherine's Bluff property - Doyle-Kennefick Regional Park
- Bertram Chain of Lakes property – Bertram Chain of Lakes Regional Park
- Camp Ojiketa property – Ojiketa Regional Park

3.5: DNR Fish & Wildlife Acquisition – Minnesota Department of Natural Resources – Fisheries & Wildlife

DNR Fish & Wildlife successfully completed three fee title acquisition parcels on the Vermillion River in Dakota County. Totals for the three acquisitions equaled 323.3 acres, including 2.7 total miles of shoreline. One of the parcels on the Vermillion River was also paid for with 09 ETF acquisition dollars, resulting in both acres and miles being divided proportionately between the two phases.

3.6: Scientific & Natural Areas (SNA) Acquisition – Minnesota Department of Natural Resources – Ecological Services

DNR Ecological Services acquired fee title on 47.9 acres (34.58 acres with Phase IV funding) of white pine-hardwood forest of high biodiversity significance and 1,450 feet shoreline along Horseshoe Lake in Isanti County. The property was designated as the Twin Lakes SNA on June 29, 2010. An additional $114,250 of federal State Wildlife Grant funds contributed to the landowner payment.

The remainder of the Phase IV appropriation was allocated to a second Twin Lakes acquisition that did not come to fruition. Therefore, an amendment request was made to transfer $157,000 of the funds intended for this acquisition to the DNR Division of Fisheries for one of their Metro Corridors projects.

Result 4: Other Conservation Tools and Incentives

Description: The Metro Greenways Program, with partnership input, proposed to provide matching grants to about 6 communities that lie within the conservation focus areas (12 counties) to assist them in developing and gathering needed natural resources information to identify sites for protection or restoration and/or to implement conservation measures for already identified natural areas. Community selection was based on established selection criteria, including: communities that have remaining high quality land cover types or sensitive wetlands, shore land, or aquatic habitats that are relatively unimpaired; rapid growth and projected increases in impervious surface area; ability to provide cash or in-kind project support; willingness to incorporate project deliverables into local planning and implementation decisions; willingness to work across jurisdictional boundaries to accomplish conservation outcomes. Fast growth communities with high value natural resources that contact the program, seeking assistance with well-conceived projects, were especially desirable recipients for these grants. Likely deliverables include: land cover data (MLCCS) for critical natural areas; natural resources data compilation and assessment for direct application; integration of conservation strategies into comprehensive and other local plans; ordinance revision to afford greater protection of natural resources; and identification of various conservation approaches to be applied locally.

Summary Budget Information for Result 4:	**Trust Fund Budget:**	**$** 100,000
	Amount Spent:	**$** 100,000
	Balance:	**$** 0

Deliverable	**Status**
1. 5-6 community assistance grants to LGU's	Complete

Final Completion Date: 6/30/2010

Final Report Summary:
The Metro Greenways Program awarded six Community Conservation Assistance (CCA) grants to local governments in order to help communities address challenges associated with conserving the remaining natural habitats in rapidly changing landscapes. These grants leveraged almost 75% local match. Of the six projects, three were natural resource inventories, two were ordinance updates, and one was a priority-lands assessment model.

The three inventory projects helped to build a foundation for land use and management decisions and included the following:

1) invasive species mapping in Ramsey County
2) tree canopy mapping in Woodbury
3) natural area land cover inventory in a minor watershed (using MLCCS) in 12 Mile Creek Watershed in Wright County

Both the Lino Lakes and Minnetrista ordinance updates incorporated public values and sensitive resource needs into the proposed design by instituting a process that engages city staff, the developer and local agencies in an early on collaborative process.

Washington County developed a GIS model to prioritize the areas in the county that best meet the protection objectives of the Land and Water Legacy Program. The model includes four modules: surface water, drinking water, ecological and connectivity.

V. TOTAL TRUST FUND PROJECT BUDGET:

Please also see the attached Table B and individual final reports for additional detail.

Staff or Contract Services:	$377,266
Equipment:	$7,475
Development:	$3,000
Restoration:	$70,846
Acquisition, including easements:	$2,534,205
Travel:	$4,925
Other:	$54,531

TOTAL TRUST FUND PROJECT BUDGET: $ 3,150,000 ($3,149,248 spent)

Explanation of Capital Expenditures Greater Than $3,500: N/A

VI. OTHER FUNDS & PARTNERS:

A. Project Partners: The Metro Conservation Corridors partners include: Trust for Public Land, Minnesota Land Trust, Friends of the Mississippi River, Friends of the Minnesota Valley, Minnesota Valley National Wildlife Refuge Trust, Great River Greening, DNR Metro Greenways, DNR Fish and Wildlife, and DNR SNA Program. Other project partners include private landowners, local governments, regional, state, and federal agencies, nonprofits organizations, and citizen groups.

B. Other Funds Spent during the Project Period: Approximately $2,325,000 in other funds were proposed to be spent during the project period. Actual funds spent

or leveraged were: $5,766,639 of other state funds and $10,158,618 of other non-state funds (see Table A).

C. Past Spending:

LCCMR appropriations only:

MeCC Phase I (2003) - $4,500,000 ($4,850,000 appropriated)

MeCC Phase II (2005) - $3,529,655 ($3,530,000 appropriated)

MeCC Phase III (2007) - $2,465,225 ($2,500,000 appropriated)

D. Time: 2 years

VII. DISSEMINATION: As projects were completed, the individual partners were encouraged to publicize accomplishments through press releases, organization newsletters and websites. These efforts resulted in information being distributed to the public through websites, email lists, daily and weekly newspapers, newsletters, and other print materials. Additionally, once the MeCC database development is complete, the partnership plans to incorporate a public web portal, which will display accomplishments.

VIII. REPORTING REQUIREMENTS: Periodic work program progress reports were submitted February 1st and August 1st of each year, beginning February 1, 2009. This is the final work program report.

Metro Conservation Corridors 2008 - Phase IV

Table A: Summary of Funding & Accomplishments **LCCMR Appropriated Dollars: $3,150,000**

Result / Activity	Partner	Project Funding						Accomplishments				
		ENRTF 2008 Funds			Other Funds		Total Project Funds Spent *(ENRTF, Other State Funds & Non-State Funds combined)*	ENRTF		Other Funds		Total Project Acres Completed *(ENRTF & Other Funds combined)*
		ENRTF 2008 Funds Allocated	ENRTF 2008 Funds Spent	ENRTF 2008 Funds Balance	Other State Funding Spent	Other Non-State Funding Spent		ENRTF 2008 Acres/Miles Completed		Other Funds Acres/Miles Completed		
								ACRES	MILES	ACRES	MILES	
1. Coordinate MeCC Program												
1.1. Coordination of MeCC program, local outreach and conservation implementation assistance for two year project term	All partners below - led by DNR Metro Greenways	$470	$470	$0	$0	$0	$470					-
2. Restore & Enhancement Significant Habitat												
2.1. Restore/enhance significant watershed habitat.	Friends of the Mississippi River	$92,000	$92,000	$0		$36,728	$128,728	215		80		295
2.2. Lower Minnesota River Watershed Restoration & Enhancement Project.	Friends of MN Valley	$107,000	$106,900	$100		$231,500	$338,400	154		259		413
2.3. Restore/enhance significant habitat.	Great River Greening	$111,000	$111,000	$0	$115,635	$143,863	$370,498	136	0.00	125	0.06	261
2.4. Habitat restoration/enhance grants.	DNR - Metro Greenways	$8,162	$8,162	$0		$21,113	$29,275	4				4
2.5 Scientific & Natural Area (SNA) restoration & enhancement.	DNR - Ecological Services	$61,335	$61,335	$0			$61,335	266				266
SUBTOTAL		$379,497	$379,397	$100	$115,635	$433,204	$928,236	775	0.00	464	0.06	1,239
3. Acquire Significant Habitat												
3.1 Critical Land Protection Program fee title & conservation easement acquisition.	The Trust for Public Land	$475,000	$475,000	$0	$1,510,000	$2,215,000	$4,200,000	8	0.07	62	0.44	70
3.2. Protecting significant habitat by acquiring conservation easements.	Minnesota Land Trust	$225,000	$225,000	$0	$75,000	$634,500	$934,500	960	3.14			960
3.3. Fee acquisition for Mn Valley National Wildlife Refuge.	MN Valley NWR Trust, Inc.	$225,000	$225,000	$0		$197,985	$422,985	47		41		89
3.4. Grants & acquisition of fee title & conservation easements.	DNR - Metro Greenways	$891,368	$891,328	$40	$3,292,004	$5,924,268	$10,107,600	46	0.30	420	2.40	466
3.5. DNR Fish & Wildlife Acquisition.	DNR - Fisheries & Wildlife	$557,000	$556,388	$612	$774,000	$568,205	$1,898,593	87	0.61	236	2.10	323
3.6. Scientific & Natural Area (SNA) Acquisition.	DNR - Ecological Services	$296,665	$296,665	$0		$114,250	$410,915	35	0.08	13	0.20	48
SUBTOTAL		$2,670,033	$2,669,381	$652	$5,651,004	$9,654,208	$17,974,593	1,183	4.19	773	5.14	1,956
4. Community Conservation Assistance												
4.1 Assist local governments to promote the conservation of natural habitats.	DNR - Metro Greenways	$100,000	$100,000	$0		$71,206	$171,206					-
TOTAL		**$3,150,000**	**$3,149,248**	**$752**	**$5,766,639**	**$10,158,618**	**$19,074,505**	**1,958**	**4.20**	**1,237**	**5.20**	**3,195**

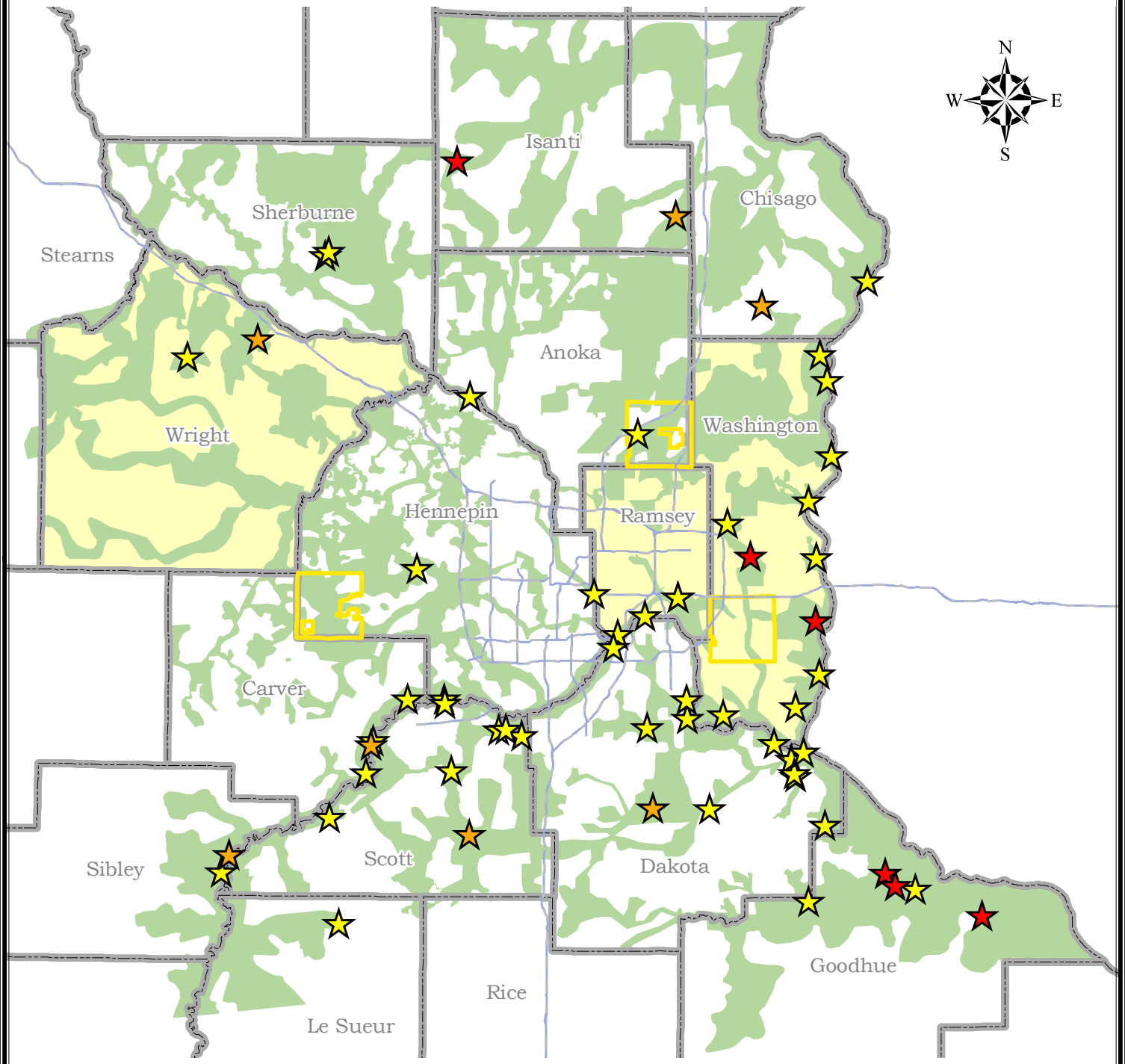
Metro Conservation Corridors 2008- Phase IV
Table B: LCCMR Funding - Budget Detail

Activity	Partners	LCCMR Funding Spent								Budget Explanation (staff/contractservices, development, equipment, other)
		Staff/contract services	Equipm't	Development	Restoration	Acquisition	Travel	Other	Total	
1. Coordinate MeCC Program										
1.1. Coordination of MeCC program & local outreach and implementation assistance for two year project term	DNR Metro Greenways/DNR OMBS	$ 470							$ 470	Staff to manage and coordinate the program. (The workprogram was amended to transfer the remaining balance of $49,530 to Result Area 3.4, Metro Greenways Acquisition.)
2. Restore & Enhance Significant Habitat										
2.1. Restore/enhance significant watershed habitat	Friends of the Mississippi River	$ 91,375			$ 18		$ 607		$ 92,000	Staff/contract services: Conservation Director-.03 FTE, Ecologist- .06 FTE, Accountant-.01 FTE, and private contractors to provide restoration activities such as burns, soil prep., seeding, woody and exotic plant removal, etc.; Restoration: plant material
2.2. Lower Minnesota River Watershed restoration & enhancement project	Friends of Minnesota Valley	$ 67,774			$ 39,126				$ 106,900	Staff/contract services: Conservation Projects Manager (.20 FTE): Project Design, Coordination and Implementation, and Professional/technical contracts (Construction companies for earth work such as building dikes, installing water control structures, breaking drain tile, etc.); Restoration: native prairie seed, trees, water control structures, etc.
2.3. Restore/enhance significant habitat	Great River Greening	$ 70,655	$ 4,930		$ 23,540		$ 1,075	$ 10,800	$ 111,000	Staff: Ecologists (.43 FTE); Field Manager/Technicians (.79 FTE); Volunteer Manager (.15 FTE); Project Administration (.07 FTE); Equipment: chainsaws, brush cutters, sprayers, shovels, loppers, weed wrenches, bow saws, water packs, drip torch, safety equipment. Restoration: site prep, mulch delivery, prairie install, chemical, plants, seeds, gloves, safety glasses, pin flags, flagging tape, stakes, misc. parts. Other: Vol. Event Supplies (approved food and bev., portable toilets, tents, signage, PA system, utilities, POVs
2.4 Habitat restoration/enhance. Grants	DNR - Metro Greenways				$ 8,162				$ 8,162	Grants to local governments & nonprofit organizations for habitat restoration
2.5 Scientific & Natural Area (SNA) restoration & enhancement	DNR - Ecological Services	$ 55,845	$ 2,545				$ 1,214	$ 1,731	$ 61,335	Staff: DNR SNA crew (equvalent to 0.6 FTE for 1 yr) and seasonal burn crew (equivalent to 6 laborers for 2 weeks); Equipment: fleet charges & incidental parts; Development: supplies (e.g. fencing & signs); Restoration: supplies & seedling propogation
SUBTOTAL		$ 285,649	$ 7,475	$ -	$ 70,846	$ -	$ 2,896	$ 12,531	$ 379,397	
3. Acquire Significant Habitat										
3.1 Critical Land Protection Program fee title & conservation easement acquisition	The Trust for Public Land					$ 475,000			$ 475,000	Fee title and conservation easement land acquisition
3.2. Protecting significant habitat by acquiring conservation easements	Minnesota Land Trust	$ 56,201				$ 124,903	$ 1,896	$ 42,000	$ 225,000	Staff: Includes expenses including salaries, benefits (FICA, FUTA. SUI, worker's comp health insurance, 401 (k), etc.) and related costs for approximately .75 FTE for one year as follows: Conservation directors or other land protection staff (approx .50 FTE); Staff attorney and other support staff (approx .25 FTE). Acquisition: includes purchase price of easement(s); title work, title insurance; maps, GIS; film; appraisals, surveys, recording fees, etc. Other: $60,000 for easement stewardship
3.3. Fee acquisition for Mn Valley National Wildlife Refuge	MN Valley NWR Trust, Inc.					$ 225,000			$ 225,000	Fee title acquisition
3.4. Grants & acquisition of fee title & conservation easements	DNR - Metro Greenways					$ 891,328			$ 891,328	Grants to local government units and nonprofit organizations, & direct acquisition of fee title & conservation easements.
3.5. DNR Fish & Wildlife Acquisition	DNR - Fisheries & Wildlife	$ 31,888				$ 524,500			$ 556,388	Land acquisition, associated professional service expenses, and acquisition development
3.6. Scientific & Natural Area (SNA) Acquisition	DNR - Ecological Services	$ 3,058				$ 293,474	$ 133		$ 296,665	Staff/contract services: Unclassified acquisition staff (approx 0.1 FTE; paid exclusively from project funds) and classifed project crews (paid almost exclusively with special project funds) to carry out restoration and enhancement, amounting to approx. 0.6 FTE over the life of the project and seasonal burn crew (approx 6 laborers for 2 weeks), fringe varies from 14.8 -18%; Acquisition: fee title acquisition and real estate transaction costs (e.g. professional services, survey, AC, title, recording, etc)
SUBTOTAL		$ 91,147	$ -	$ -	$ -	$ 2,534,205	$ 2,029	$ 42,000	$ 2,669,381	
4. Community Conservation Assistance										
4.1 Assist local governments to promote the conservation of natural habitats	DNR - Metro Greenways							$ 100,000	$ 100,000	Matching grants to local government units to develop conservation options
TOTAL		**$ 377,266**	**$ 7,475**	**$ -**	**$ 70,846**	**$ 2,534,205**	**$ 4,925**	**$ 54,531**	**$ 3,149,248**	

- METRO CONSERVATION CORRIDORS PARTNERSHIP -

Completed Projects

2008 - PHASE IV



Conservation Easements

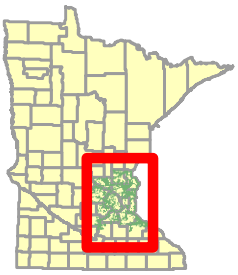
Fee Title Acquisitions

Restorations

CCA Grants - cities

CCA Grants - counties

County Boundaries



2008 Project Abstract
For the Period Ending June 30, 2010

PROJECT TITLE: Metro Conservation Corridors (MeCC) Phase lV-Friends of the Mississippi River (2.1)
PROJECT MANAGER: Tom Lewanski
AFFILIATION: Friends of the Mississippi River
MAILING ADDRESS: 360 North Robert Street, Suite 400
CITY/STATE/ZIP: St. Paul, MN 555101
PHONE: 651-222-2193 ext. 12
E-MAIL: tlewanski@fmr.org
WEBSITE: www.fmr.org
FUNDING SOURCE: Environment and Natural Resources Trust Fund
LEGAL CITATION: ML 2008, Chap. 367, Sec. 2, Subd. 3(a)2.1

APPROPRIATION AMOUNT: $ 92,000

Overall Project Outcome and Results

The Twin Cities contains significant natural areas. There is a concerted effort to identify, protect, and improve these areas. FMR's goal with this project was to partner with landowners to improve the ecological health of a selected number of protected natural areas. During the course of this phase of the MeCC project, FMR conducted activities at 11 sites. These sites are either public or permanently protected privately owned. A management plan exists for each site, which served as guide for the restoration and enhancement activities. These sites included:

- **Pine Bend Bluffs SNA**. Mowed 2-acres on the installed prairie, and controlled weeds on 24-acres.
- **Katharine Ordway Natural History Study Area**. Controlled buckthorn on 3-acres.
- **City of Hastings Sand Coulee**. Controlled weeds on 4-acres within the City's portion of the prairie.
- **Hastings Sand Coulee Prairie SNA**. Controlled weedy plants on 17 acres. Conducted a prescribed burn on 14-acres.
- **Hastings WMA**. Treated Buckthorn and cut shrubs on 17-acres of the prairie and conducted a prescribed burn on 13-acres.
- **Rosemount Wildlife Preserve**. Controlled buckthorn on 18-acres of woodland.
- **Wilmar Property**. Invasive plant control on 12-acres of woodland and broadcasted prairie seed on 28-acres along the Vermillion River. This private property is permanently protected by a conservation easement through the Dakota County FNAP.
- **St. Paul Parks.** Installed woodland plants and direct seeded acorns in woodland and installed plants and mowed installed prairie for a total of 4 acres within Crosby Park.
- **Hastings Riverflats Park.** Controlled buckthorn over a 40-acre area.
- **Gores Pool Wildlife Management Area and Aquatic Management Area.** Controlled exotic invasive woody plants on 67-acres.
- **Ravenna Block Greenway-Dakota County.** Controlled weedy plants on 12-acres and conducted a prescribed burn on an additional 20 acres. These activities were conducted on two private parcels permanently protected by conservation easements through the Dakota County FNAP.

Project Results Use and Dissemination

FMR disseminates information about our restoration and enhancement projects in a couple of ways. We include stories on our website and in our newsletters about projects. Visit the following webpage for an example: http://www.fmr.org/news/current/crosby_farm_restoration-2008-01. We also organize many tours and stewardship events at the sites at which we conduct restoration activities. We share information about this project with the participants of these events.

Trust Fund 2008 Work Program Final Report and 2009 Work Program

Date of Report: 8/1/10
Final Report

	M.L. 2008	M.L. 2009
Date of Work program Approval:	June 10, 2008	June 16, 2009
Project Completion Date:	June, 30 2010	June 30, 2011

I. PROJECT TITLE: Metro Conservation Corridors (MeCC) Phase lV-Friends of the Mississippi River (2.1)
Metro Conservation Corridors (MeCC) Phase V – Restore and Enhance Significant Watershed Habitat (2.3)

Project Manager: Tom Lewanski
Affiliation: Friends of the Mississippi River
Mailing Address: 360 North Robert Street, Suite 400
City / State / Zip: St. Paul, MN 55101
Telephone Number: 651 222-2193 Ext. 12
E-mail Address: tlewanski@fmr.org
Fax Number: 651 222-6005
Web Page address: www.fmr.org

Location: Within mapped focus area in the counties of Dakota, Goodhue, Hennepin, Ramsey, Anoka, and Washington.

Total Trust Fund Project Budget:	**M.L. 2008**	**M.L. 2009**	**Total**
Trust Fund Appropriation:	**$92,000**	**$90,000**	**$182,000**
Minus Amount Spent:	**$92,000**	**$3661.60**	**$95,661.60**
Equal Balance:	**$0**	**$86,338.40**	**$86,338.40**

Legal Citation: ML 2008, Chap. 367, Sec. 2, Subd. 3(a)2.1

2008 Appropriation Language:

$3,150,000 is from the trust fund to the commissioner of natural resources for the fourth appropriation for acceleration of agency programs and cooperative agreements. Of this appropriation, $1,915,000 is for Department of Natural Resources agency programs and $1,235,000 is for agreements as follows: $475,000 with the Trust for Public Land; $92,000 with Friends of the Mississippi River; $111,000 with Great River Greening; $225,000 with Minnesota Land Trust; $225,000 with Minnesota Valley National Wildlife Refuge Trust, Inc.; and $107,000 with Friends of the Minnesota Valley for the purposes of planning, restoring, and protecting important natural areas in the metropolitan area, as defined under Minnesota Statutes, section 473.121, subdivision 2, and portions of the surrounding counties, through grants, contracted services, conservation easements, and fee title acquisition. Land acquired with this appropriation must be sufficiently improved to meet at least minimum management standards as determined by the commissioner of natural resources. Expenditures are limited to the identified project corridor areas as defined in the work program. This appropriation may not be used for the purchase of residential structures, unless expressly approved in the work program. All

conservation easements must be perpetual and have a natural resource management plan. Any land acquired in fee title by the commissioner of natural resources with money from this appropriation must be designated as an outdoor recreation unit under Minnesota Statutes, section 86A.07. The commissioner may similarly designate any lands acquired in less than fee title. A list of proposed restorations and fee title and easement acquisitions must be provided as part of the required work program. All funding for conservation easements must include a long-term stewardship plan and funding for monitoring and enforcing the agreement.

Legal Citation: M.L. 2009, Chp. 143, Sec. 2, Subdivision 4(f)2.3

2009 Appropriation Language:

$3,375,000 is from the trust fund to the commissioner of natural resources for the fifth appropriation for acceleration of agency programs and cooperative agreements. Of this appropriation, $2,185,000 is for Department of Natural Resources agency programs and $1,190,000 is for agreements as follows: $380,000 with the Trust for Public Land; $90,000 with Friends of the Mississippi River; $155,000 with Great River Greening; $250,000 with Minnesota Land Trust; $225,000 with Minnesota Valley National Wildlife Refuge Trust, Inc.; and $90,000 with Friends of the Minnesota Valley for the purposes of planning, restoring, and protecting important natural areas in the metropolitan area, as defined under Minnesota Statutes, section 473.121, subdivision 2, and portions of the surrounding counties, through grants, contracted services, technical assistance, conservation easements, and fee title acquisition. Land acquired with this appropriation must be sufficiently improved to meet at least minimum management standards as determined by the commissioner of natural resources. Expenditures are limited to the identified project corridor areas as defined in the work program. This appropriation may not be used for the purchase of residential structures, unless expressly approved in the work program. All conservation easements must be perpetual and have a natural resource management plan. Any land acquired in fee title by the commissioner of natural resources with money from this appropriation must be designated as an outdoor recreation unit under Minnesota Statutes, section 86A.07. The commissioner may similarly designate any lands acquired in less than fee title. A list of proposed restorations and fee title and easement acquisitions must be provided as part of the required work program. All funding for conservation easements must include a long-term stewardship plan and funding for monitoring and enforcing the agreement. To the maximum extent practical, consistent with contractual easement or fee acquisition obligations, the recipients shall utilize staff resources to identify future projects and shall maximize the implementation of biodiverse, quality restoration projects in the project proposal into the first half of the 2010 fiscal year.

II. PROJECT SUMMARY AND RESULTS:

M.L. 2009

FMR will work with both public and private landowners to restore and/or enhance 50 acres of significant habitat using MeCC phase V funding. This funding will enable FMR to leverage non-state funding to restore an additional 30 acres of significant habitat.

III. PROGRESS SUMMARY AS OF *(02/01/09)*:

M.L. 2009

N.A.

PROGRESS SUMMARY AS OF *(08/01/09)*:

M.L. 2009

FMR has not begun any restoration or enhancement projects using the 2009 appropriation as of the date of this report. Much of the funding has been allocated to specific projects but work has not yet commenced.

PROGRESS SUMMARY AS OF *(02/01/10)***:**
M.L. 2009
FMR has not begun any restoration projects utilizing M.L. 2009 funding. However, we have identified several projects that we will begin once we have completed phase IV or upon receiving permission to begin phase V before completing phase IV.

PROGRESS SUMMARY AS OF *(08/01/10)***:**
M.L. 2009
During this time period FMR conducted a prescribed burn on 20 acres of prairie on the City of Hastings' property in the Sand Coulee. In addition, we mowed and conducted weed control activities on 13-acres of the Hastings Sand Coulee SNA. Utilizing non-state leveraged funds we mowed 15-acres of prairie at the Pine Bend Bluffs SNA.

M.L. 2008 II and III. Final Project Summary

The Twin Cities contains significant natural areas. There is a concerted effort to identify, protect, and improve these areas. FMR's goal with this project was to partner with landowners to improve the ecological health of a selected number of protected natural areas. During the course of this phase of the MeCC project, FMR conducted activities at 11 sites. These sites are either public or permanently protected privately owned. Management Plan is in place for each site, which served as guides for the restoration and enhancement activities. These sites included:

- **Pine Bend Bluffs SNA**. Mowed 2-acres on the installed prairie, and controlled weeds on 24-acres.
- **Katharine Ordway Natural History Study Area**. Controlled buckthorn on 3-acres.
- **City of Hastings Sand Coulee**. Controlled weeds on 4-acres within the City's portion of the prairie.
- **Hastings Sand Coulee Prairie SNA**. Controlled weedy plants on 17 acres. Conducted a prescribed burn on 14-acres.
- **Hastings WMA**. Treated Buckthorn and cut shrubs on 17-acres of the prairie and conducted a prescribed burn on 13-acres.
- **Rosemount Wildlife Preserve**. Controlled buckthorn on 18-acres of woodland.
- **Wilmar Property**. Invasive plant control on 12-acres of woodland and broadcasted prairie seed on 28-acres along the Vermillion River. This private property is permanently protected by a conservation easement through the Dakota County FNAP.

- **St. Paul Parks.** Installed woodland plants and direct seeded acorns in woodland and installed plants and mowed installed prairie for a total of 4 acres within Crosby Park.
- **Hastings Riverflats Park.** Controlled buckthorn over a 40-acre area.
- **Gores Pool Wildlife Management Area and Aquatic Management Area.** Controlled exotic invasive woody plants on 67-acres.
- **Ravenna Block greenway-Dakota County.** Controlled weedy plants on 12-acres and conducted a prescribed burn on an additional 20 acres. These activities were conducted on two private parcels permanently protected by conservation easements through the Dakota County FNAP.

IV. OUTLINE OF PROJECT RESULTS*:*
Result 1: N/A (see Overall Work Program Summary)

Result 2: Restore & Enhance Significant Habitat:
Description:
M.L. 2008
FMR worked with both public and private landowners to restore and/or enhance 215 acres of significant habitat using MWC IV funding and an additional 80 acres of significant habitat using other funding for a total of 295 acres, which included the restoration and/or enhancement of prairie, oak savanna, and deciduous forest communities. Techniques that were employed to restore and enhance these areas were based on the specific requirements of each project site to chosen, but included: soil preparation (spraying, burning, disking, dragging), seed drilling, mowing, prescribed burning, spot spraying, installation of native plants, and removal of invasive plant species.

These restoration and/or enhancement activities were targeted to: See Exhibit 1 for a list of targeted projects and associated activities.

M.L. 2009
FMR will work with both public and private landowners to restore and/or enhance 50 acres of significant habitat using MeCC phase V funding. This funding will enable FMR to leverage non-state funding to restore an additional 30 acres of significant habitat.

Specific habitat types that may be restored and/or enhanced include prairie, oak savanna, deciduous forest and/or wetland communities. Techniques that will be employed to restore and enhance these areas will be based on the specific requirements of each project site to be chosen, but may include: soil preparation (spraying, burning, disking, dragging), seed drilling or broadcasting, mowing, prescribed burning, spot spraying, installation of native plants, and removal of invasive plant species. Vendors will complete some of the restoration techniques. Vendor contracts will be awarded on a competitive and performance basis. We will consider contracting with the Minnesota Conservation Corps when appropriate.

Guidelines for project selection will include but will not be limited to: ecological importance of site (based on size, habitat quality, buffering of existing high quality habitat, water quality benefits, & connectivity to other natural areas), matching funds, and partner interest and commitment. Priority will be given to projects on public land and on private land that has been permanently protected through a conservation easement. Prior to the initiation of restoration activities on private land, a landowner agreement will be secured.

Selection of native plants and seeds will follow the LCCMR's guidelines as outlined in the brochure: Native Plant Material-Local vegetation ecotype sequencing. Seed mix selection will be based on the DNR's native plant community field guides.

Ecological management plans will be developed prior to initiation of restoration activities. These management plans contain information regarding existing conditions & issues, goals, activities designed to pursue these goals, preliminary costs associated with the activities, and a timeline.

These restoration and/or enhancement activities will be targeted to: See Exhibit 1 for a list of targeted projects and associated activities.

Summary Budget Information for Result 2:

	M.L. 2008	**M.L. 2009**	**Total**
Trust Fund Budget:	**$92,000**	**$90,000**	**$182,000**
Amount Spent:	**$92,000**	**$3661.60**	**$95,661.60**
Balance:	**$0**	**$86,338.40**	**$86,338.40**

Deliverable	**Completion Date**	**Budget**	**Status**
1. **M.L. 2008-**100 acres restored and/or enhanced (*partner acres and other funding not counted here)*	6/30/2010	$92,000	Completed
2. **M.L. 2009**- 50 acres restored and/or enhanced (*partner acres and other funding not counted here)*	6/30/2011	$90,000	In progress

Final Completion Date: M.L. 2008 = 6/30/2010; M.L. 2009 = 6/30/2011

Result Status as of 2/1/2009:
M.L. 2009
N/A

Result Status as of 8/1/2009:

M.L. 2009
FMR has not begun any restoration projects utilizing M.L. 2009 funding. However, we have identified several projects that we will begin once we have completed phase IV or upon receiving permission to begin phase V before completing phase IV.

Result Status as of 2/1/2010:

M.L. 2009
FMR has not begun any restoration projects utilizing M.L. 2009 funding. However, we have identified several projects that we will begin once we have completed phase IV or upon receiving permission to begin phase V before completing phase IV.

M.L. 2008 Final Report Summary (June 30, 2010):

FMR conducted the following restoration and/or enhancement activities during the time frame of this grant:

- **Pine Bend Bluffs SNA**. We mowed 2-acres on the installed prairie, and spot sprayed & mowed weeds on 24-acres all within the SNA.
- **Katharine Ordway Natural History Study Area**. Cut, treated, and chipped buckthorn on 3-acres (2-acre ETF-MeCC funding & 1-acre with leveraged, non-state funds).
- **City of Hastings Sand Coulee**. Treated buckthorn resprouts and knapweed on 4-acres within the City's portion of the Sand Coulee Prairie. These enhancement activities were conducted utilizing ETF-MeCC funds.
- **Hastings Sand Coulee Prairie SNA**. Mowed Russian thistle and lawn encroachment on 2 acres of the SNA and treated cypress spurge, spot mowed and sprayed on 15 acres of the SNA. We also conducted a prescribed burn on 14-acres of the SNA. These enhancement activities were conducted utilizing ETF-MeCC funds.
- **Hastings WMA**. Treated Buckthorn resprouts and cut and treated shrubs on 17-acres of the prairie portion of the WMA. We also conducted a prescribed burn on 13-acres of the WMA. These enhancement activities were conducted using ETF-MeCC funds.
- **Rosemount Wildlife Preserve**. Oversprayed buckthorn resprouts on 18-acres of woodland in the Preserve utilizing ETF -MeCC funds.
- **Wilmar Property**. Exotic invasive plant control on 12-acres of riparian woodland and broadcasted prairie seed on 28-acres along the Vermillion River (8-acres utilizing ETF-MeCC funds and 32-acres using leveraged funds).This private property is permanently protected by a conservation easement through the Dakota County Farmland and Natural Area Program.
- **St. Paul Parks.** Installed woodland plants and direct seeded acorns in woodland and installed plant species and mowed installed prairie for a total of

4 acres within Crosby Park (1-acre ETF-MeCC funding & 3-acres with leveraged funds).

- **Hastings Riverflats Park.** Conducted basal herbicide treatment on buckthorn over a 40-acre area, utilizing LCCMR-MeCC funds.
- **Gores Pool Wildlife Management Area and Aquatic Management Area.** Cut, treated, and burned exotic invasive woody plants from 67-acres of the WMA/AQA (23-acres utilizing ETF-MeCC funds and 44-acres utilizing leveraged, non-state funds).
- **Ravenna Block greenway-Dakota County.** Cut and treated exotic invasive woody plants on 12-acres and conducted a prescribed burn on and additional 20 acres. These activities were conducted on two private parcels that are permanently protected by conservation easements through the Dakota County Farmland and Natural Area Program.

In our proposal we committed to working with both public and private landowners to restore and/or enhance 100 acres of significant habitat using EFT-MeCC funding and an additional 25 acres of significant habitat using other funding for a total of 125 acres. During the timeframe of this grant, FMR was able to conduct restoration and enhancement activities on 215-acres using EFT-MeCC funding. Leveraged funds enabled us to conduct restoration and enhancement activities on an additional 80-acres for a total of 295-acres. Furthermore, in our proposal we estimated that we would be able to leverage $30,000 in non-state funding. We were able to exceed this by leveraging $36,728 in non-state funding for these habitat restoration/enhancement activities.

There were two sites that we included in our original potential project list that we did not conduct restoration or enhancement activities on. For the St. Croix River site, the property in question was not able to be permanently protected via conservation easement during the timeframe of this grant and therefore FMR chose not to conduct restoration activities on the site using ETF funding. In the second case, we were not able to coordinate with the landowners and put systems in place in order to begin restoration activities.

Amendment request: FMR is requesting a budget change that seeks to reallocate $307.00 from the Other direct operating costs line of the budget to Travel expenses in Minnesota line. In addition, FMR is seeking to reallocate $1,675 from the Other direct operating costs and $877.00 from Contracts to the Personnel line. The original amount in the budget in the Other category was for plant material. St. Paul Parks paid for the plant material that was used at Crosby Park. The $877.00 in the Contracts category was not needed to complete the work.

Amendment approval.

M.L. 2009 **Result Status as of** 8/1/2010:

During this time period FMR conducted a prescribed burn on 20 acres of prairie on the City of Hastings' property in the Sand Coulee. In addition, we mowed and conducted weed control activities on 13-acres of the Hastings Sand Coulee SNA. Utilizing non-state leveraged funds we mowed 15-acres of prairie at the Pine Bend Bluffs SNA.

Resut Status as of 2/1/2011:
Final Report Summary (June 30, 2011):

V. TOTAL TRUST FUND PROJECT BUDGET:

M.L. 2008
Staff or Contract Services: $8,000
Equipment:
Development: $
Restoration: $ 83,700 (for contractor services, plants, seeds, and supplies)
Other: travel: $300
Acquisition, including easements: $
TOTAL 2008 TRUST FUND PROJECT BUDGET: $ 92,000

M.L. 2009
Personnel: $12,420.00
Contracts: $77,000.00
Equipment/Tools/Supplies:
Acquisition, including easements:
Travel: $580.00
Other:
TOTAL 2009 TRUST FUND PROJECT BUDGET: $90,000

VI. OTHER FUNDS & PARTNERS/ PROJECT STRATEGY:

A. Project Partners:

M.L. 2008
Metro Conservation Corridor partners, private landowners, local governments, and regional, state and federal agencies.
M.L. 2009
Metro Conservation Corridor partners, private landowners, local governments, and regional, state and federal agencies.

B. Other Funds Proposed To Be Spent During The Project Period:

M.L. 2008
We estimate that FMR will leverage approximately $30,000 in non-state funds from landowners and project funding partners and $50,000 in other state funding.
M.L. 2009
We estimate that FMR will leverage approximately $70,000 in non-state funds during this phase of the project. FMR will bring $30,000 in private funds, $30,000 in federal funds, and $10,000 from LGUs and/or landowners.

C. Spending History:
M.L. 2008: Metro Wildlife Corridors I, II & III - $235,000

M.L. 2009: Metro Wildlife Corridors I, II, III, IV - $327,000

D. Time:

M.L. 2008: 2 years. June 10, 2008 – June 30, 2010

M.L. 2009: 2 years. June xx, 2009 – June 30, 2011

E. Project Impact and Long-term Strategy:

FMR will conduct restoration activities on 100 acres (utilizing M.L. 2008 Metro Wildlife Corridors funding) and 50 acres (utilizing M.L. 2009 Metro Wildlife Corridors funding) of significant habitat. FMR is a placed based conservation organization that focuses its conservation work in the south metro area. Our goal is assist both MeCC and other partners in protecting, restoring, and enhancing important wildlife areas in the Twin Cities Metro Area. We practice retail conservation. That is, we reach out to individual private and public landowners in the designated corridors and engage them in the broader goal of developing a system of interconnected habitat corridors in the Metro area and throughout the state. Because FMR is focused in theTwin Cities we can build strong, long-standing relationships with conservation partners and landowners. Our goal is to stay engaged in all of our projects over the long-term to ensure continuity and that the habitat values are maintained and improved over time.

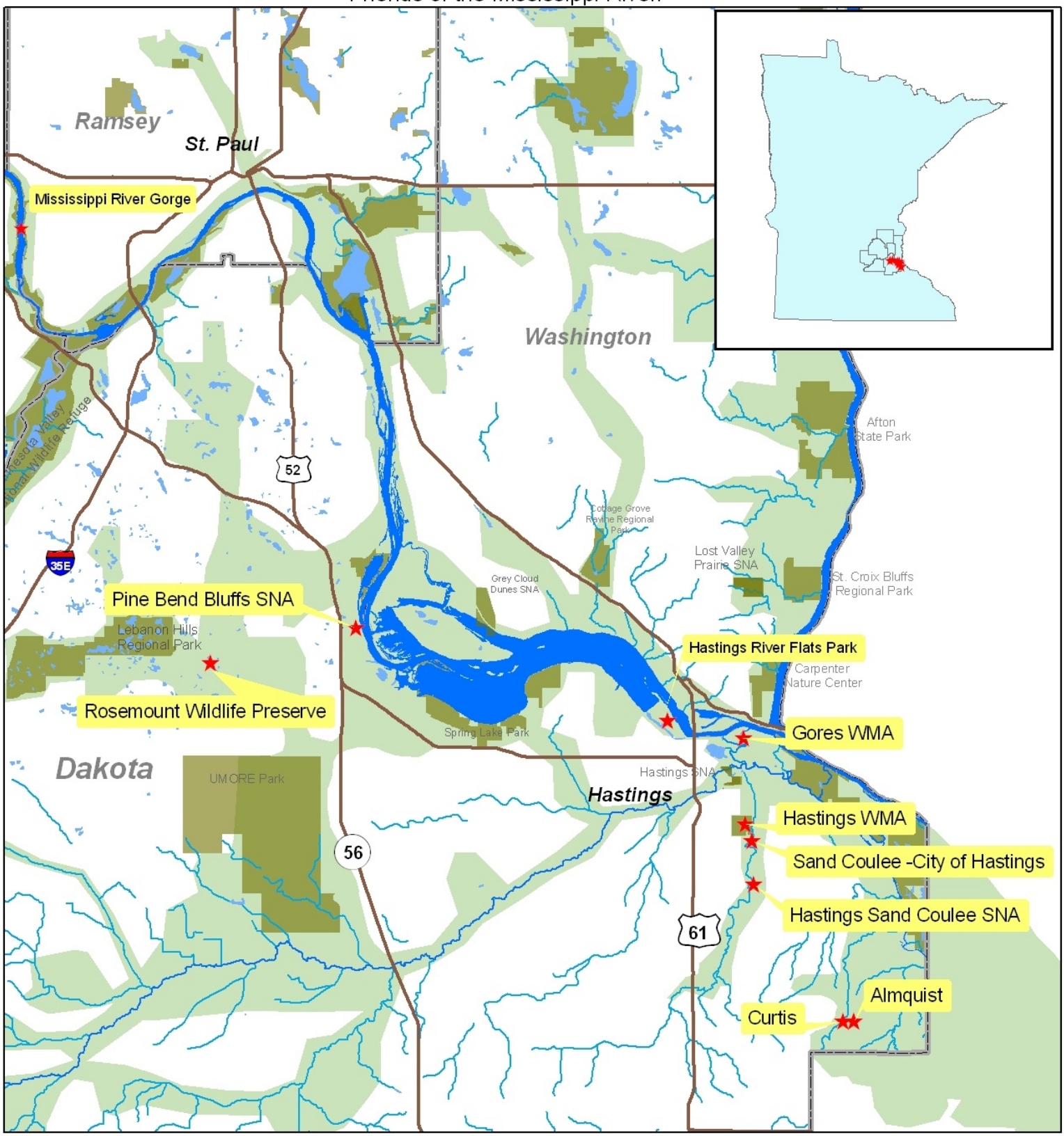
VII. DISSEMINATION: Metro Corridors will periodically distribute information about the program through the widely broadcasted emails to people on the Embrace Open Space (EOS) database, through the EOS quarterly meetings and jointly held county meetings, and on the MeCC website. FMR will also highlight projects on its website, through local media, through its monthly electronic newsletter, and through its periodic print newsletter.

VIII. REPORTING REQUIREMENTS: Periodic work program progress reports will be submitted not later than February 1st and August 1st each year, starting with February 1, 2009. A final work program report and associated products will be submitted between June 30 and August 1, 2010 for the 2008 appropriation as requested by the LCCMR and a final work program report and associated products for the 2009 appropriation will be submitted no later than August 1, 2011.

Attachment A: Budget Detail for 2009 Projects -			
Project Title: *Metro Conservation Corridors (MeCC) Phase V – Restore and Enhance Significant Watershed Habitat (2.3)*			
Project Manager Name: *Tom Lewanski*			
Trust Fund Appropriation: $ *90,000*			
2009 Trust Fund Budget	**Result 2 Budget:**	**Amount Spent** *(August 1, 2010)*	**Balance** *(August 1, 2010)*
BUDGET ITEM	Restore & Enhance Significant Habitat:		
PERSONNEL: wages and benefits *(List individual names, amount budgeted and %FTE; add rows as needed)*			
Conservation Director (2% FTE)	$2,850.00	$0.00	$2,850.00
Ecologist (2) (6% FTE)	$8,481.00	$0.00	$8,481.00
Business Manager (.5% FTE)	$1,089.00	$0.00	$1,089.00
Total Personnel	$12,420.00	$0.00	$12,420.00
Contracts			
Professional/technical. *Vendors to provide restoration activities such as burns, soil prep., seeding, woody and exotic plant removal, etc. (Vendor contracts will be awarded on a competitive and performance basis.)*	$77,000	$3,662	$73,338.40
Travel expenses in Minnesota	$580	$0	$580.00
COLUMN TOTAL	**$90,000**	**$3,662**	**$86,338**

2008-2010 LCCMR Projects
PROJECT TITLE: MeCC4
Restore and Enhance Significant Watershed Habitat

Friends of the Mississippi River.



FMR project sites
Parkland, WMA's
Metro Conservation Corridors

1:215,000

0 1 2 4 6 Miles

N

2008 Project Abstract
For the Period Ending June 30, 2010

PROJECT TITLE: Metro Conservation Corridors-Phase IV-Friends of the Minnesota Valley (2.2)
PROJECT MANAGER: Lori Nelson
AFFILIATION: Friends of the Minnesota Valley
MAILING ADDRESS: 10800 Lyndale Avenue South, Suite #120
CITY/STATE/ZIP: Bloomington, MN 55420
PHONE: 952-881-9065
E-MAIL: lnelson@friendsofmnvalley.org
WEBSITE: www.friendsofmnvalley.org
FUNDING SOURCE: Environment and Natural Resources Trust Fund
LEGAL CITATION: M.L. 2008, Chp. 367, Sec. 2, Subd. 3(a)

APPROPRIATION AMOUNT: $107,000

Overall Project Outcome and Results
Friends of the Minnesota Valley (FMV) undertook restoration of habitat for the Lower Minnesota River Watershed portion of the Metropolitan Conservation Corridors Project (MeCC) as a continuation of our wildlife habitat restoration within the Minnesota Valley National Wildlife Refuge and Wetland Management District (Refuge) and within the Lower Minnesota River Watershed. FMV sought to restore native habitats within the Refuge and to work in concert with the Minnesota Valley National Wildlife Refuge Trust and other partners on newly-acquired lands slated for addition to the Refuge.

The Friends' objectives were to complement and connect habitat restoration and management of Refuge lands with that being done by other entities. Restoration sites were selected to address primary management issues and challenges, including the need to restore hydrology and manage water levels to maximize benefits to waterfowl and other wetland-dependent species and restore native oak savanna and wet and dry prairies. Public access to restored lands for recreation and education and the assurance of permanent protection were also primary factors.

FMV was able to successfully restore and enhance 460 acres of permanently-protected wetland during MeCC Phase IV. We also completed 22.5 acres of native prairie and oak savanna restoration on three Refuge Units. Work included replacement of water control structures, breaking drain tile, shallow scraping, construction of earthen dams, tree removal, and planting of native seed. Minnesotans will be able to access and appreciate the restored sites through the access and education provided to Minnesota Valley National Wildlife Refuge visitors. Our project data is publicly accessible by contacting the Friends, through information disseminated through our newsletter and on our website, and through information provided by the MeCC Partnership. We are also currently planning a guided tour of Phase IV restoration sites for interested parties.

Project Results Use and Dissemination
As projects were completed, Friends of the Minnesota Valley publicized project accomplishments through the Friends' quarterly newsletter, in our annual reports, and on our website. Other dissemination of information has been through the Metro Corridors partnership, Embrace Open Space, and on the Metro Corridors website.

Trust Fund 2008 Work Program Final Report

Date of Report: August 1, 2010
Final Report
Date of Work program Approval:
Project Completion Date: June 30, 2010

I. PROJECT TITLE: **Metro Conservation Corridors – Phase IV – Friends of the Minnesota Valley (2.2)**

Project Manager:	Lori Nelson
Affiliation:	Friends of the Minnesota Valley
Mailing Address:	10800 Lyndale Avenue South, Suite 120
City / State / Zip:	Bloomington, MN 55420
Telephone Number:	952-881-9065
E-mail Address:	lnelson@friendsofmnvalley.org
FAX Number:	952-881-3174
Web Page address:	www.friendsofmnvalley.org

Location: Minnesota River Valley within Carver, LeSueur, Scott and/or Sibley Counties within the Metro Corridors. See Figure 1

Total Trust Fund Project Budget:	**Trust Fund Appropriation:**	**$**	**107,000**
	Minus Amount Spent:	**$**	**106,900**
	Equal Balance:	**$**	**100**

Legal Citation: M.L. 2008, Chp. 367, Sec. 2, Subd. 3(a)

Appropriation Language: (a) Metro Conservation Corridors (MeCC) - Phase IV $3,150,000 is from the trust fund to the commissioner of natural resources for the fourth appropriation for acceleration of agency programs and cooperative agreements. Of this appropriation, $1,915,000 is for Department of Natural Resources agency programs and $1,235,000 is for agreements as follows: $475,000 with the Trust for Public Land; $92,000 with Friends of the Mississippi River; $111,000 with Great River Greening; $225,000 with Minnesota Land Trust; $225,000 with Minnesota Valley National Wildlife Refuge Trust, Inc.; and $107,000 with Friends of the Minnesota Valley for the purposes of planning, restoring, and protecting important natural areas in the metropolitan area, as defined under Minnesota Statutes, section 473.121, subdivision 2, and portions of the surrounding counties, through grants, contracted services, conservation easements, and fee title acquisition. Land acquired with this appropriation must be sufficiently improved to meet at least minimum management standards as determined by the commissioner of natural resources. Expenditures are limited to the identified project corridor areas as defined in the work program. This appropriation may not be used for the purchase of residential structures, unless expressly approved in the work program.

All conservation easements must be perpetual and have a natural resource management plan. Any land acquired in fee title by the commissioner of natural resources with money from this appropriation must be designated as an outdoor recreation unit under Minnesota Statutes, section 86A.07. The commissioner may similarly designate any lands acquired in less than fee title. A list of proposed restorations and fee title and easement acquisitions must be provided as part of the required work program. All funding for conservation easements must include a long-term stewardship plan and funding for monitoring and enforcing the agreement.

II. and III. FINAL PROJECT SUMMARY

Overall Project Outcome and Results:

Friends of the Minnesota Valley (FMV) undertook restoration of habitat for the Lower Minnesota River Watershed portion of the Metropolitan Conservation Corridors Project (MeCC) as a continuation of our wildlife habitat restoration within the Minnesota Valley National Wildlife Refuge and Wetland Management District (Refuge) and within the Lower Minnesota River Watershed. FMV sought to restore native habitats within the Refuge and to work in concert with the Minnesota Valley National Wildlife Refuge Trust and other partners on newly-acquired lands slated for addition to the Refuge.

The Friends' objectives were to complement and connect habitat restoration and management of Refuge lands with that being done by other entities. Restoration sites were selected to address primary management issues and challenges, including the need to restore hydrology and manage water levels to maximize benefits to waterfowl and other wetland-dependent species and restore native oak savanna and wet and dry prairies. Public access to restored lands for recreation and education and the assurance of permanent protection were also primary factors.

FMV and our partners were able to successfully restore and enhance 460 acres of permanently-protected wetland during MeCC Phase IV. We also completed 22.5 acres of native prairie and oak savanna restoration on three Refuge Units. Work included replacement of water control structures, breaking drain tile, shallow scraping, construction of earthen dams, tree removal, and planting of native seed. Minnesotans will be able to access and appreciate the restored sites through the access and education provided to Minnesota Valley National Wildlife Refuge visitors. Our project data is publicly accessible by contacting the Friends, through information disseminated through our newsletter and on our website, and through information provided by the MeCC Partnership. We are also currently planning a guided tour of Phase IV restoration sites for interested parties.

IV. OUTLINE OF PROJECT RESULTS*:*

Result 1: Restore and Enhance Significant Habitat

Description: Within the focus areas, Friends of the Minnesota Valley has restored and enhanced 100 acres of regionally-significant habitat (plus another 53.5 acres

through leveraged funds for a total of 153.5 acres). Friends of the Minnesota Valley and its partners took steps to restore and enhance native plant species of significant biological and habitat communities throughout the Expanded Minnesota River Focus Area on public and private lands.

Restoration work included, but was not be limited to: wetland restorations, native prairie restorations and plantings, floodplain habitat restoration, exotic species removal, woody plant removal, and all other activities associated will these restoration projects.

Project List:

Rapids Lake Wetland Restoration/Enhancement

Lake Renneberg Restoration

Upgrala Prairie Renovation

St. Lawrence Wet Prairie

Jessenland Unit Restoration

Rapids Lake Unit Dry Prairie Restoration

Summary Budget Information for Result 1:	**Trust Fund Budget:**	**$107,000**
	Amount Spent:	**$106,900**
	Balance:	**$100**

Deliverable	**Completion Date**	**Budget**	**Status**
1. 100 acres restored	6/30/10	$107,000	Complete

Completion Date: June 30, 2010

Final Report Summary:

Rapids Lake Wetland Restoration/Enhancement

Friends of the Minnesota Valley along with the USFWS, MN DNR, MN Valley Trust, and Carver County SWCD successfully designed and installed a water control structure on the outlet to Rapids Lake, a large 260 acre Type IV riverine wetland within the Minnesota Valley National Wildlife Refuge near the City of Carver, MN. The water control structure will restore the hydrology of the wetland and will enable the USFWS to manage water levels to maximize benefits to wetland dependant

plant and animal species. The restoration work will be protected and managed in perpetuity by the USFWS. The majority of the project costs were paid for with Friends of the MN Valley 2007 Phase III funding. The remaining costs were paid utilizing this phase of funding for a total of 28 acres worth of the restoration project. Match dollars from partners includes NRCS ($191,917) and USFWS ($5,000).

Lake Renneberg Restoration

Friends of the Minnesota Valley along with the USFWS, LeSueur County, and the McKnight Foundation successfully completed the restoration work on Lake Renneberg in Derrynane Township of Le Sueur County. This 120 acre shallow lake, drained by a county ditch, was restored by installing a variable crest water control structure. The structure will allow temporary draw-downs of water levels to stimulate plant germination and invertebrate populations. The All restoration work will be permanently protected and managed by Le Sueur County. Restoration acres were prorated based on percent of funding for the project. Phase IV funding accounted for 78% of the total project costs, 93 acres. Match dollars from partners includes NAWCA ($9,658), USFWS ($2,000.50), Joint Powers Board/ RC&D – Area 10 ($13,000), and FMV ($5,000).

Upgrala Prairie Restoration

Friends of the Minnesota Valley, along with the USFWS, restored 3.5 acres of native dry prairie remnant at the Upgrala Unit of the Minnesota Valley National Wildlife Refuge through woody species removal and treatment. The remaining anticipated 4.6 acres were not completed in Phase IV due to fragile site conditions and eagle nests. This restoration site will be completed in MeCC Phases V & V Supplemental. The project site is permanently protected and will continue to be managed in perpetuity by the USFWS. Phase IV funding accounted for 100% of the total project costs, 3.5 acres. Partner match includes USFWS ($800).

St. Lawrence Wet Prairie Restoration

Friends of the Minnesota Valley and the USFWS restored 9 acres of wet prairie. The full 30 anticipated acres were not completed due to poor site conditions, increasing costs and follow-up needs. Additional acres will be completed under MeCC Phase V & Phase V Supplemental for oak savanna and prairie restoration. The restored acreage is permanently protected and will continue to be managed in perpetuity by the USFWS. Phase IV funding accounted for 100% of the total project costs, 9 acres. Partner match includes USFWS ($2,500).

Jessenland Unit Restoration

Friends of the Minnesota Valley and the USFWS restored 10 acres of wetland habitat by breaking tile, shallow scraping, and the construction of earthen dams. Wetlands will be seeded with native wetland species after July 1, 2010, due to previous Minnesota River flooding conditions. Phase IV funding accounted for 100% of the total project costs, 10 acres. Partner match includes USFWS ($750).

Rapids Lake Dry Prairie Restoration

Friends of the Minnesota Valley and the USFWS completed 10 acres of dry prairie enhancement at the Rapids Lake Unit Environmental and Education Center

near Jordan, Minnesota, primarily through over-snow seeding. The restored prairie will permanently protected and managed in perpetuity by the USFWS, Phase IV funding accounted for 100% of total project costs, 10 acres. Partner match includes USFWS ($874).

V. TOTAL TRUST FUND PROJECT BUDGET:

Staff or Contract Services: $8,000 (Director of Conservation Programs, Project Design, Coordination and Implementation .20 FTE). Total expended during grant period: $8,000.
Equipment: NA
Development: NA
Restoration: $99,000 (supplies, seed and tree purchase, field preparation, prescribed burns, contractor services for installing earthen berms or water control structures for wetland restorations, engineering, and all other activities as needed for the restoration of 100 acres). Total expended during grant period: $98,900.
Acquisition, including easements: NA
Other: NA

TOTAL TRUST FUND PROJECT BUDGET: $107,000
Total expended during project period: $106,900.

Explanation of Capital Expenditures Greater Than $3,500: NA

VI. OTHER FUNDS & PARTNERS:

A. Project Partners The Friends of the MN Valley worked in cooperation with Metro Conservation Corridor partners (see Table A), private landowners, local governments including Soil and Water Conservation Districts, regional, state and federal agencies such as the NRCS and the USFWS, nonprofit organizations and local citizen groups**.**

B. Other Funds Proposed to be Spent during the Project Period:
Original anticipated match was $54,000. Other funds actually spent during the grant period totalled $231,499.50.

C. Past Spending: ETF - 2001: $ 0; 2003: $ 18,000 (BRP); 2005: $ 40,000 (MeCC) 2007: $34,000
Other Funds - : $ 0; 2003: $ 0; 2005: $ 5,000 (MeCC)

D. Time: Friends of the Minnesota Valley has expended these funds within 12-15 months of their availability. July 1, 2008 – June 30, 2010.

VII. DISSEMINATION: As projects were completed, Friends of the Minnesota Valley publicized project accomplishments through the Friends' quarterly newsletter, in our annual reports, and on our website. Other dissemination of information has

been through the Metro Corridors partnership, Embrace Open Space, and on the Metro Corridors website.

VIII. REPORTING REQUIREMENTS:
Periodic work program progress reports have been submitted not later than February 1st and August 1st of each year. A final work program report and associated products has been submitted as of August 1, 2010 as requested by the LCCMR.

IX. RESEARCH PROJECTS: NA

Attachment A: Budget Detail for 2008 Projects

Project Title: Metro Conservation Corridors – Phase IV – Friends of the Minnesota Valley (2.2)

Project Manager Name: Scott Sparlin

Trust Fund Appropriation: $ *107,000*

1) See list of non-eligible expenses, do not include any of these items in your budget sheet

2) Remove any budget item lines not applicable

2008 Trust Fund Budget	**Result 1 Budget:**	**Amount Spent**	**Balance**	**TOTAL BUDGET**	**TOTAL BALANCE**
	Restore and Enhance Significant Habitat				
BUDGET ITEM					
PERSONNEL: *Conservation Projects Manager (.20 FTE): Project Design, Coordination and Implementation*	8,000	8,000	0	8,000	0
Contracts			0	0	0
Professional/technical *(Construction companies for earth work such as building dikes, installing water control structures, breaking drain tile, and other activities that require heavy equipment, survey and engineering work, field prep, prairie installation, etc.)*	59,874	59,774	100	59,874	100
Other land improvement *(native prairie seed, trees, water control structures, etc.)*	39,126	39,126	0	39,126	0
COLUMN TOTAL	**$107,000**	**$106,900**	**$100**	**$107,000**	**$100**

U.S. Fish and Wildlife Service

Jessenland Unit MeCC Project

Legend

- Wetland_Restored
- township
- Refuge
- county

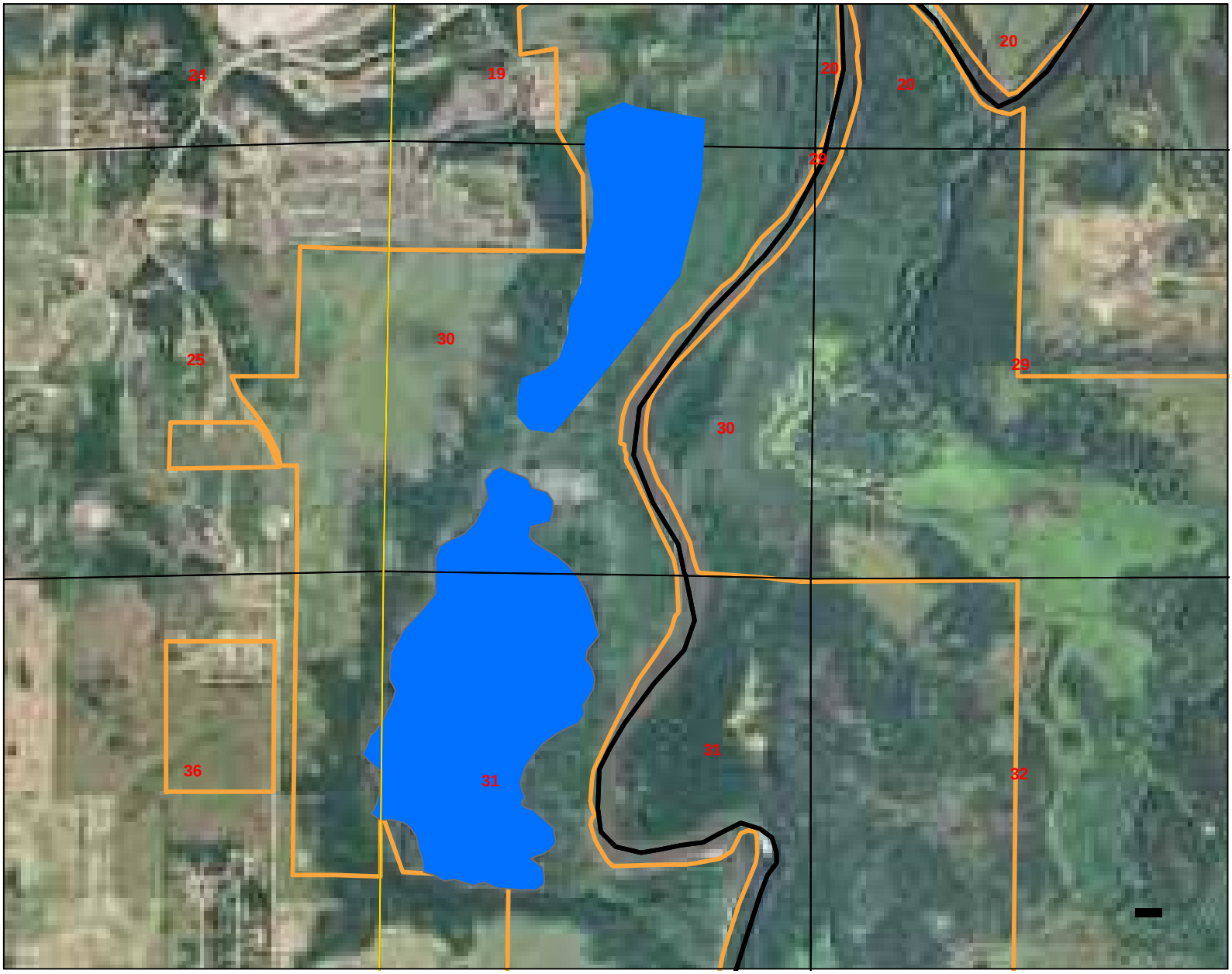
0 0.01 0.02 0.04 0.06 0.08 Miles

Sibley County
Jessenland Township
Section 13

Minnesota Valley NWR/ WMD
Please call 952.854-5900 or visit http://midwest.fws.gov/minnesotavalley

U.S. Fish and Wildlife Service

Rapids Lake MeCC Project



Legend

- Wetland_Restored
- township
- Refuge
- county

0 0.05 0.1 0.2 0.3 0.4 Miles

Carver County
San Francisco Township
Section 31

U.S. DEPARTMENT OF THE INTERIOR
U.S. Fish and Wildlife Service
NATIONAL WILDLIFE REFUGE SYSTEM

Minnesota Valley NWR/ WMD
Please call 952.854-5900 or visit http://midwest.fws.gov/minnesotavalley

U.S. Fish and Wildlife Service

Rapids Lake Unit MeCC Project

Legend

- Grassland_resto
- township
- Refuge
- county

0.00.0510.020.030.04 Miles

Carver County
San Francisco Township
Section 6

Minnesota Valley NWR/ WMD
Please call 952.854-5900 or visit http://midwest.fws.gov/minnesotavalley

U.S. Fish and Wildlife Service

Renneberg Lake MeCC Project

Legend

- Wetland_Restored
- township
- Refuge
- county

0 0.025 0.05 0.1 0.15 0.2
Miles

Le Sueur County
DerrynaneTownship
Section 14

Minnesota Valley NWR/ WMD
Please call 952.854-5900 or visit http://midwest.fws.gov/minnesotavalley

U.S. Fish and Wildlife Service

St Lawrence Unit MeCC Project

Legend

- Grassland_resto
- Township
- Refuge
- County

0 0.025 0.05 0.1 Miles

Scott County
St Lawrence Township
Section 27

Minnesota Valley NWR/ WMD
Please call 952.854-5900 or visit http://midwest.fws.gov/minnesotavalley

U.S. Fish and Wildlife Service

Upgrala Unit MeCC Project

Legend

- Grassland_resto
- Township
- Refuge
- County

0 0.015 0.03 0.06 Miles

Hennepin County
Eden Prairie Township
Section 23 & 28

U.S. DEPARTMENT OF THE INTERIOR
U.S. Fish and Wildlife Service
NATIONAL WILDLIFE REFUGE SYSTEM

Minnesota Valley NWR/ WMD
Please call 952.854-5900 or visit http://midwest.fws.gov/minnesotavalley

2008 Project Abstract
For the Period Ending June 30, 2010

PROJECT TITLE: Restore/Enhance Significant Habitat: MeCC Phase IV
PROJECT MANAGER: Wiley Buck
AFFILIATION: Great River Greening
MAILING ADDRESS: 35 W. Water St.
CITY/STATE/ZIP: St. Paul, MN 55107
PHONE: 651-665-9500
E-MAIL: wbuck@greatrivergreening.org
WEBSITE: www.greatrivergreening.org
FUNDING SOURCE: Environment and Natural Resources Trust Fund
LEGAL CITATION: M.L. 2008, Chap. [367], Sec. [2], Subd. 3(a)2.3

APPROPRIATION AMOUNT: $111,000

Overall Project Outcome and Results

Great River Greening and 600 of our volunteers restored/enhanced 211 acres (136 ENRTF acres plus 74 acres using leveraged non-state funds) and 22' of shoreline, plus another 51acres and 338' of shoreline with other state funds, significantly exceeding our goal of 90 acres. Through these restorations, we improved habitat for rare wildlife species, such as Henslow's sparrow, Louisiana waterthrush, red-shouldered hawk, Blanding's turtle, Leonard's skipper, Uncas skipper, and gopher snake, as well as rare plant species, including kittentails, Hill's thistle, cattail sedge, and small-leaved pussytoes. Plant communities restored include high quality maple basswood forest, dry sand-gravel prairie, and dry oak savanna. Projects were focused in the Anoka Sandplain, and along the St. Croix, Minnesota, and Mississippi River valleys. In addition to ecological significance, projects were chosen based on landowner commitment including match, and importance to the local community.

Activities included invasive species control including early detection/rapid response, large scale woody encroachment removal, seeding/planting including prairie reconstructions and forest reconstruction via direct hardwood seeding, and shoreline restoration using cedar revetments. The 14 restorations undertaken were:

- Pilot Knob Hill – Prairie and savanna establishment
- Meeker Dam - Riparian forest restoration
- Eagle Creek AMA – Prairie and savanna enhancement
- The Landing – Oak savanna reconstruction
- Hidden Valley Park – Dry prairie management and enhancement
- Spring Lake Regional Park – Forest restoration
- Uncas Dunes SNA – Oak savanna restoration
- Mississippi West Regional Park – Shoreline and riparian restoration
- Indian Mounds Regional Park – Oak savanna tree and shrub planting
- OH Anderson Elementary – Prairie maintenance
- Arcola Mills Historic Foundation – Maple basswood forest restoration
- St. Croix River Valley – Early garlic mustard control
- Afton State Park – Henslow's Sparrow habitat enlargement
- Robert Ney Memorial Park Reserve – Forest reconstruction

Greening leveraged over $140,000 in non-state cash match (1.3:1 ratio) for these restorations.

Project Results Use and Dissemination

In January, 2010, Great River Greening included a feature article on the ENRTF, LCCMR, and the Metro Conservation Corridors program and projects in our e-postcard, circulation 3200. In addition, project descriptions and funder acknowledgement are included in our volunteer recruitment efforts to all the volunteers in our database. In addition, Greening is in active partnership with landowners and other land managers, resulting in a dynamic and timely exchange of information and results.

Trust Fund 2008 Work Program Final Report

Date of Report: 1 August 2010
Final Report
Date of Work program Approval: 12/26/07
Project Completion Date: 6/30/10

I. PROJECT TITLE: **Restore/Enhance Significant Habitat: MeCC Phase IV**

Project Manager: Wiley Buck
Affiliation: Great River Greening
Mailing Address: 35 W. Water St., Ste. 201
City / State / Zip : St. Paul MN 55107
Telephone Number: 651-665-9500
E-mail Address: wbuck@greatrivergreening.org
Fax Number: 651-665-9409
Web Page address: www. greatrivergreening.org

Location: Several potential sites within mapped Focus Area in the counties of Anoka, Carver, Chisago, Dakota, Goodhue, Hennepin, Isanti, LeSueur, Nicollet, Ramsey, Rice, Scott, Sherburne, Sibley, Washington and Wright. See Figure 1

Total Trust Fund Project Budget:	**Trust Fund Appropriation:**	**$**	111,000
	Minus Amount Spent:	**$**	111,000
	Equal Balance:	**$**	0

Legal Citation: M.L. 2008, Chap. [367], Sec. [2], Subd. 3(a)2.3

Appropriation Language:

$3,150,000 is from the trust fund to the commissioner of natural resources for the fourth appropriation for acceleration of agency programs and cooperative agreements. Of this appropriation, $1,915,000 is for Department of Natural Resources agency programs and $1,235,000 is for agreements as follows: $475,000 with the Trust for Public Land; $92,000 with Friends of the Mississippi River; $111,000 with Great River Greening; $225,000 with Minnesota Land Trust; $225,000 with Minnesota Valley National Wildlife Refuge Trust, Inc.; and $107,000 with Friends of the Minnesota Valley for the purposes of planning, restoring, and protecting important natural areas in the metropolitan area, as defined under Minnesota Statutes, section 473.121, subdivision 2, and portions of the surrounding counties, through grants, contracted services, conservation easements, and fee title acquisition. Land acquired with this appropriation must be sufficiently improved to meet at least minimum management standards as determined by the commissioner of natural resources. Expenditures are limited to the identified project corridor areas as defined in the work program. This appropriation may not be used for the purchase of residential structures, unless expressly approved in the work program. All conservation easements must be perpetual and have a natural resource management plan. Any land acquired in fee title by the commissioner of natural resources with money from this appropriation must be designated as an outdoor recreation unit under Minnesota Statutes, section 86A.07. The commissioner may similarly designate any lands acquired in less than fee title. A list of proposed restorations and fee title and easement acquisitions must be provided as part of the required work

program. All funding for conservation easements must include a long-term stewardship plan and funding for monitoring and enforcing the agreement.

II. and III. FINAL PROJECT SUMMARY

Great River Greening and 600 of our volunteers restored/enhanced 211 acres (136 ENRTF acres plus 74 acres using leveraged non-state funds) and 22' of shoreline, plus another 51acres and 338' of shoreline with other state funds, significantly exceeding our goal of 90 acres. Through these restorations, we improved habitat for rare wildlife species, such as Henslow's sparrow, Louisiana waterthrush, red-shouldered hawk, Blanding's turtle, Leonard's skipper, Uncas skipper, and gopher snake, as well as rare plant species, including kittentails, Hill's thistle, cattail sedge, and small-leaved pussytoes. Plant communities restored include high quality maple basswood forest, dry sand-gravel prairie, and dry oak savanna. Projects were focused in the Anoka Sandplain, and along the St. Croix, Minnesota, and Mississippi River valleys. In addition to ecological significance, projects were chosen based on landowner commitment including match, and importance to the local community.

Activities included invasive species control including early detection/rapid response, large scale woody encroachment removal, seeding/planting including prairie reconstructions and forest reconstruction via direct hardwood seeding, and shoreline restoration using cedar revetments. The 14 restorations undertaken were:

- Pilot Knob Hill – Prairie and savanna establishment
- Meeker Dam - Riparian forest restoration
- Eagle Creek AMA – Prairie and savanna enhancement
- The Landing – Oak savanna reconstruction
- Hidden Valley Park – Dry prairie management and enhancement
- Spring Lake Regional Park – Forest restoration
- Uncas Dunes SNA – Oak savanna restoration
- Mississippi West Regional Park – Shoreline and riparian restoration
- Indian Mounds Regional Park – Oak savanna tree and shrub planting
- OH Anderson Elementary – Prairie maintenance
- Arcola Mills Historic Foundation – Maple basswood forest restoration
- St. Croix River Valley – Early garlic mustard control
- Afton State Park – Henslow's Sparrow habitat enlargement
- Robert Ney Memorial Park Reserve – Forest reconstruction

Greening leveraged over $140,000 in non-state cash match (1.3:1 ratio) for these restorations.

IV. OUTLINE OF PROJECT RESULTS*:*

Result 2: Restore/enhance significant habitat

Final Report Summary:

The 14 restorations undertaken were:

- Pilot Knob Hill – Prairie and savanna establishment
- Meeker Dam - Riparian forest restoration
- Eagle Creek AMA – Prairie and savanna enhancement
- The Landing – Oak savanna reconstruction
- Hidden Valley Park – Dry prairie management and enhancement
- Spring Lake Regional Park – Forest restoration
- Uncas Dunes SNA – Oak savanna restoration
- Mississippi West Regional Park – Shoreline and riparian restoration
- Indian Mounds Regional Park – Oak savanna tree and shrub planting
- OH Anderson Elementary – Prairie maintenance
- Arcola Mills Historic Foundation – Maple basswood forest restoration
- St. Croix River Valley – Early garlic mustard control
- Afton State Park – Henslow's Sparrow habitat enlargement
- Robert Ney Memorial Park Reserve – Forest reconstruction

The locations of these restorations are shown in Figure 1. Detailed descriptions of the projects follow.

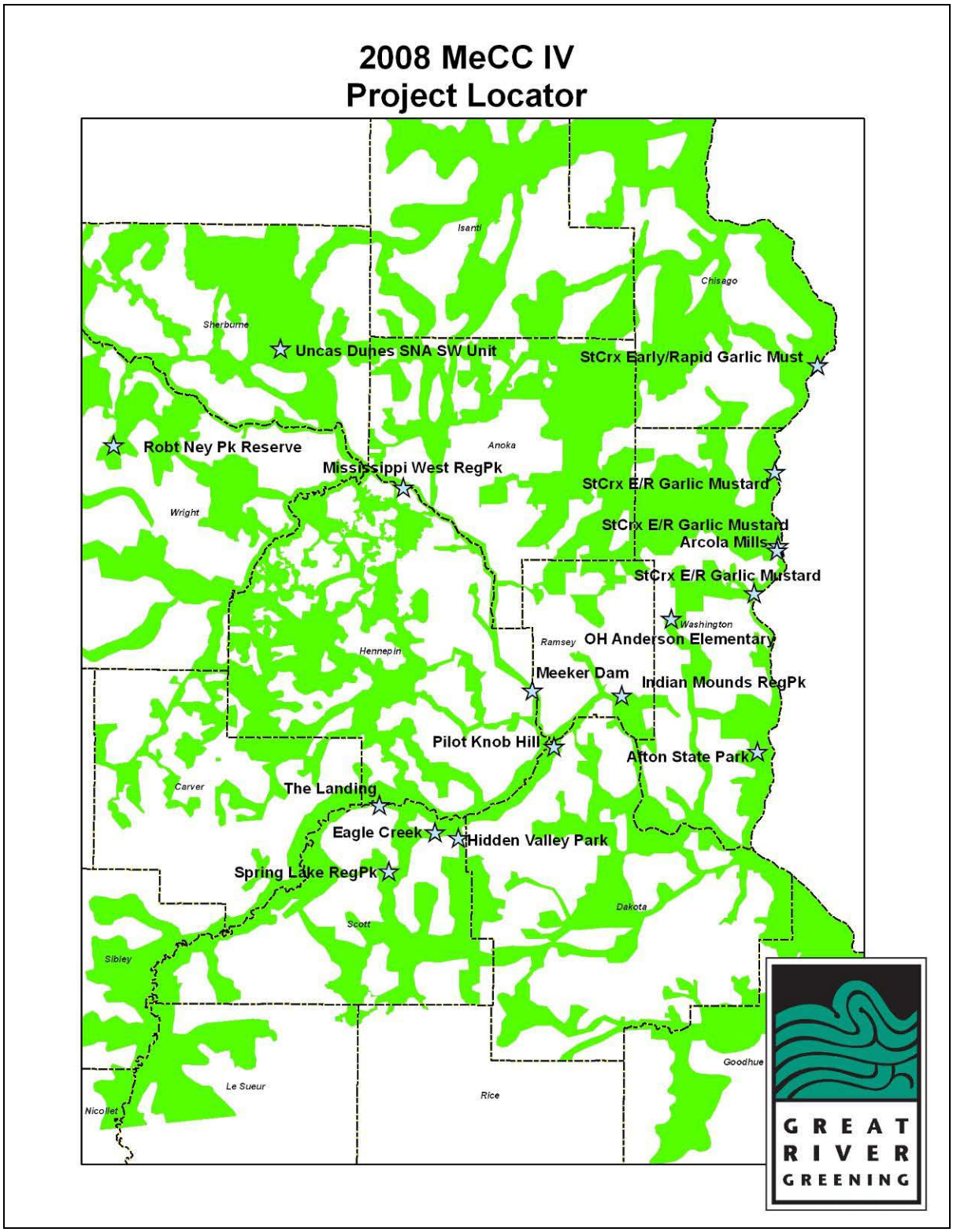


Figure 1: Location of Greening's 2008 MeCC IV Restore/Enhance Significant Habitat projects.

At Pilot Knob Hill, which is in a top tier township for wildlife Species of Greatest Conservation Need, the 12 acre Phase II area was prepped, seeded, and establishment was advanced for prairie and oak savanna reconstruction; the state's first 'biofuels for restoration' grant was applied to the clearing of 3 acres. In addition, establishment and invasive species control on the 8ac Phase I portion advanced significantly. Specifically for wildlife, a snake hibernaculum was created and snags have been managed throughout the process. The site is a draw for volunteers, with two public events and several small group events. Matching funds were provided by City of Mendota Heights, and state biofuels grant.

At Meeker Dam, maintenance and enhancement of the existing MeCC project included the second wave of buckthorn control. Matching funds were provided by private sources including the St. Paul Foundation.

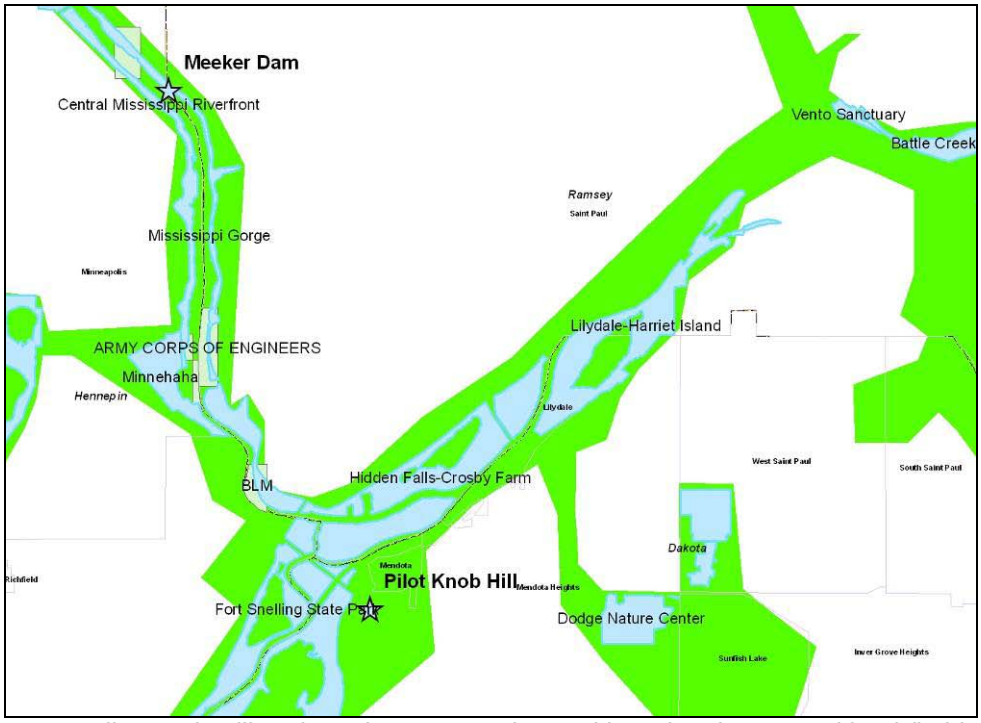


Figure 2: Pilot Knob Hill and Meeker Dam projects with regional protected land (in blue).

At Eagle Creek AMA, herbivory protection of the planted oaks and shrubs were maintained, and invasive species controlled with volunteers. Matching funds were provided by DNR Fisheries.

At The Landing, fka Historic Murphy's Landing, intensive site prep and clearing of invasive understory was followed by prairie and savanna grass and forb seeding. Throughout the process, invasive species control has been undertaken, including some buffer work on buckthorn. Supplemental plugging occurred in May 2010 with volunteers. Matching funds were provided by the Shakopee Mdewakanton Sioux (Dakota) Community, state's Sesquicentennial Foundation, and Three Rivers Park District.

At Hidden Valley Park, a protected City of Savage park, invasive species were controlled on the high diversity dry prairie that hosts kittentails and Hill's thistle. In addition, maintenance and supplemental plugging of the raingarden with volunteers was undertaken. Matching funds were provided by City of Savage.

At Scott Co's Spring Lake Regional Park, buckthorn and other woody invasives were removed from the high quality Maple-basswood forest and surrounding areas. The restoration was primarily low density removal (and therefore a high acreage project) with a few pockets of higher density where the material was removed with volunteers. Matching funds were provided by Scott County Parks.

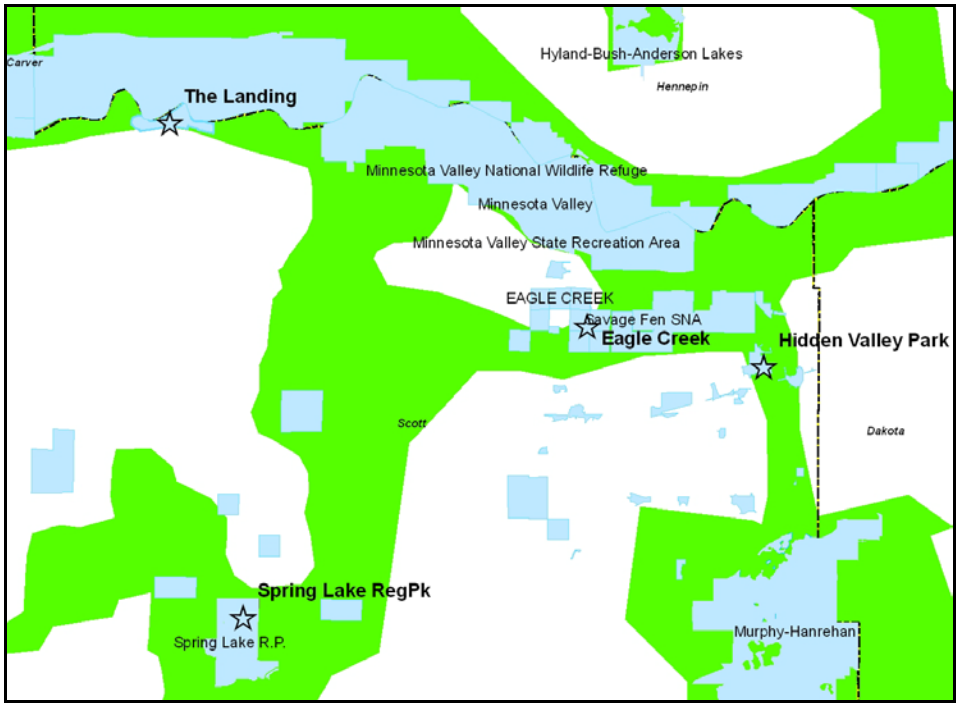


Figure 3: Eagle Creek, The Landing, Hidden Valley Park, and Spring Lake Regional Park project locations with regional and municipal protected land (in blue).

At Uncas Dunes SNA, a 30 acre restoration in the western portion of the SNA's south unit has been undertaken. Intensive clearing of the understory and thinning of the canopy at this site, needed due to fire suppression, has occurred using heavy equipment, crew, and volunteers. Using other funds, seed collection and fall sowing is now underway to complete the restoration. Matching funds provided by BWSR Native Buffer, state biofuels grant, and National Fish and Wildlife Foundation. This SNA is a highly rated oak savanna that provides habitat for Leonard's skipper, Uncas skipper and gopher snake, and hosts small-leaved pussytoes.

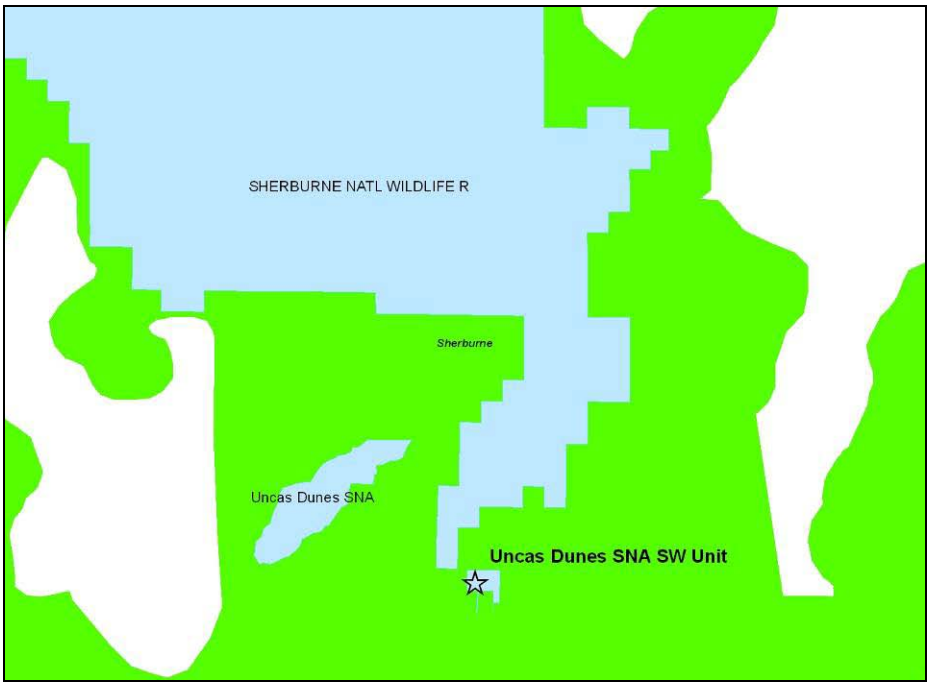


Figure 4: Uncas Dunes SNA 'SW Unit' restoration location, with regional protected land (in blue).

A second restoration in the Anoka Sandplain occurred at Mississippi West Regional Park, where upland habitat was restored via invasive species control and plug planting with volunteers, as well as riparian habitat and Mississippi River shoreline restoration including cedar revetment.

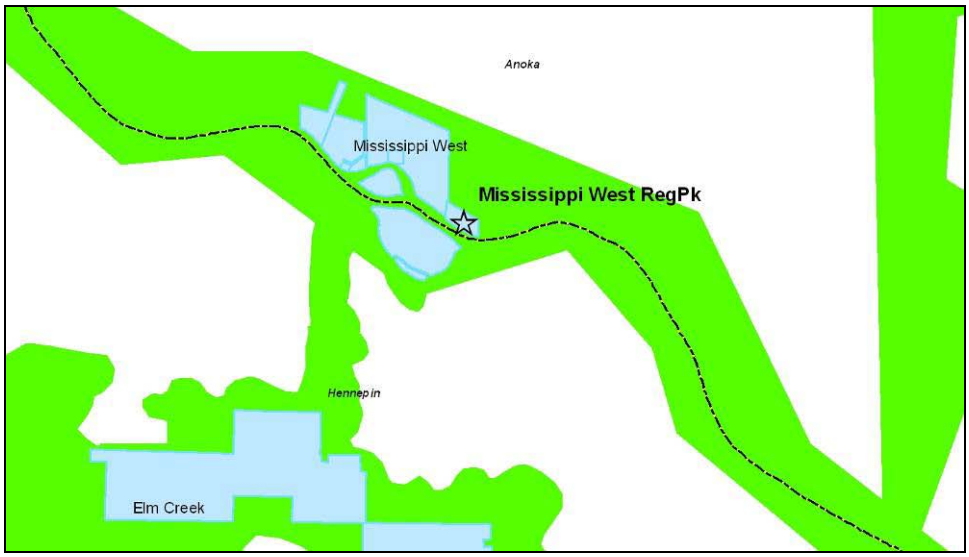


Figure 5: Mississippi West Regional Park restoration location, with regional protected land (in blue).

At Indian Mounds Regional Park in St. Paul, oak trees and native shrubs were planted as part of an oak savanna restoration. St. Paul Parks and Rec cleared buckthorn and thinned the canopy, and Greening followed with tree and shrub planting, with a large volunteer group, and maintenance. Matching funds provided by Corporate Volunteer Council, St. Paul Garden Club, and the St. Paul Foundation.

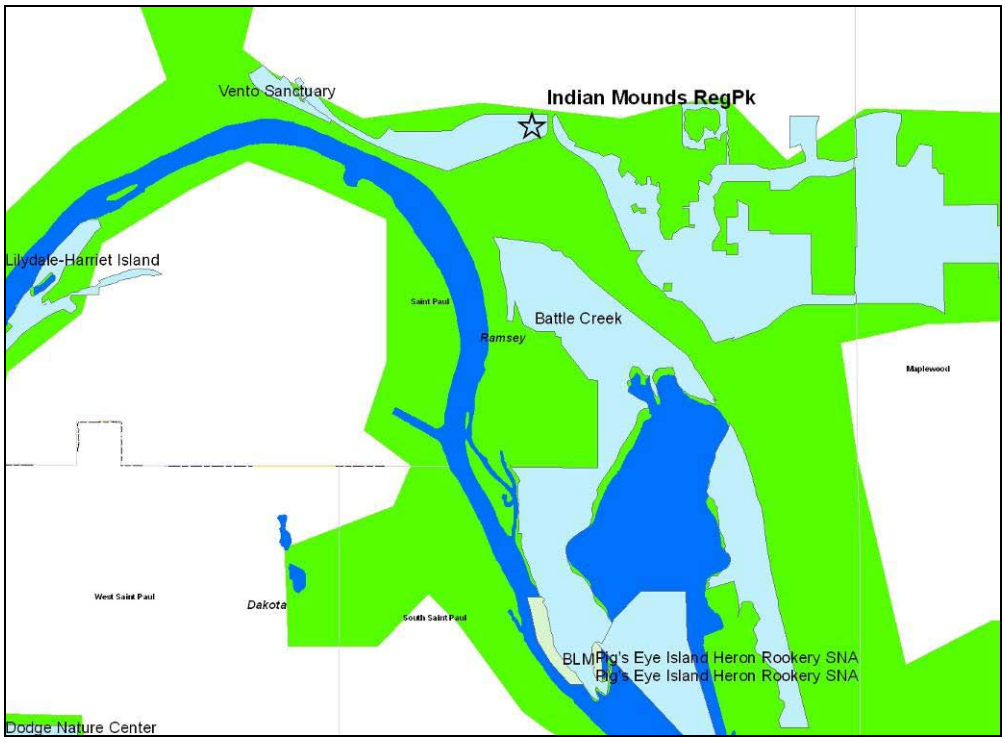


Figure 6: Indian Mounds Regional Park restoration location, with regional protected land (in light blue) and Mississippi River (dark blue).

At OH Anderson Prairie, the reconstructed prairie was maintained via invasive species control, and enhanced with plug planting by students. Matching funds were local funds raised by the school district.

At Arcola Mills Historic Foundation, private land protected by a Metro Greenways/Washington Co easement, a second wave of buckthorn and other woody invasive control was completed. Most areas are medium-low density with pockets of more severe infestation. An early outbreak of garlic mustard was also treated several times at Arcola Mills, and is being tracked as one of the St. Croix Garlic Mustard sites (see below). Matching funds were provided by Arcola Mills and BWSR funds administered by the conservation district.

Early detection and rapid response to garlic mustard outbreaks in the St. Croix River Valley proceeded with treatment and tracking at four sites, including NPS fee title land near Taylor's Falls, NPS scenic easement land near Copas, Arcola Mills, and Boom Site landing. Because the main garlic mustard threat remains the vectoring potential, techniques are being used that minimize spread, including boot covers, boot scrapers, scouting priorities, and smothering seed banks. Coordination with NPS, St. Croix Watershed Research Station, and DNR Parks and Trails was initiated. This program is continuing into MeCC V. Cash matching funds continue to be pursued so that the full vision of this regional effort can be achieved.

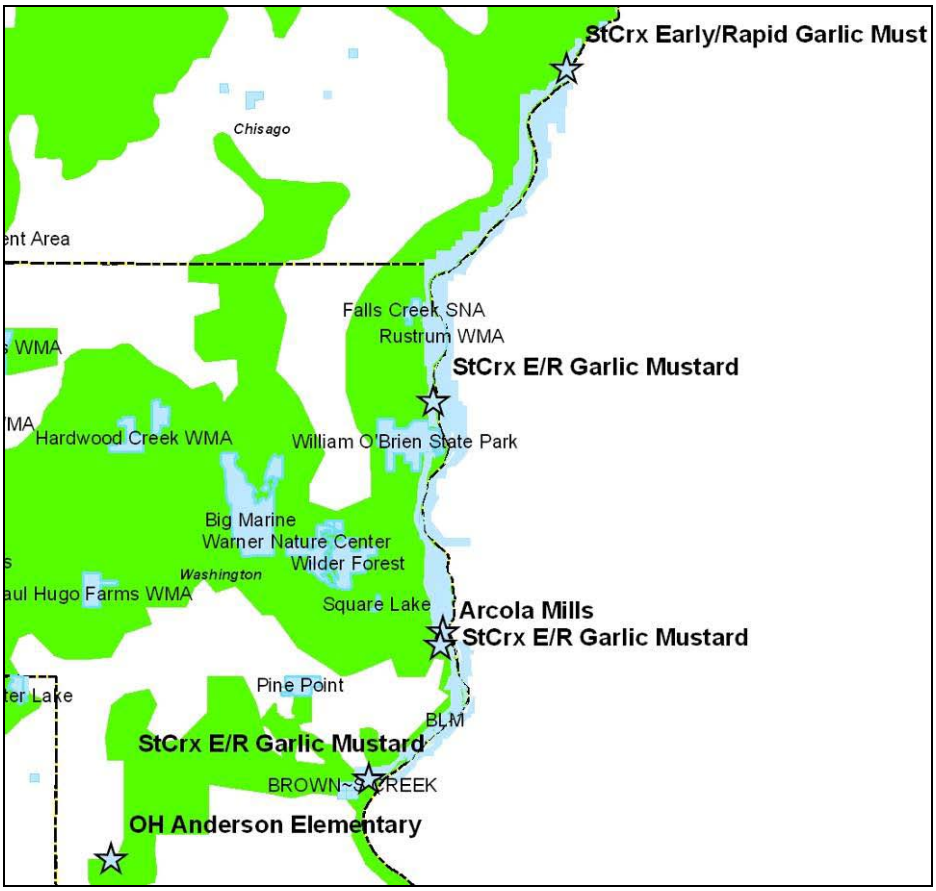


Figure 7: OH Anderson Elementary, Arcola Mills, and four St. Croix Early Detection/Rapid Response to Garlic Mustard restoration locations, with regional protected land (in blue).

At Afton State Park, a tree line and other scattered trees were removed to improve the habitat for the Henslow's sparrows documented at the site. Through these activities, Henslow's habitat was enlarged by 20ac. Matching funds were provided by Patagonia, Inc. In addition, the existing MeCC III forest reconstruction was enhanced with the addition of basswood and hackberry, two important species that are difficult to propagate in direct hardwood seeding, as well as supplemental acorn planting in select gap areas.

Figure 8: Afton State Park restoration location, with regional protected land (in blue).

At Robert Ney Memorial Park Reserve, a 40 acre direct hardwood tree and shrub seeding took place as part of a ‘big woods’ reconstruction. This restoration is part of the hardwood seeding program for the entire park totaling 141 acres, which will add to the existing core of 300+ acre second growth forest/wetland mosaic.

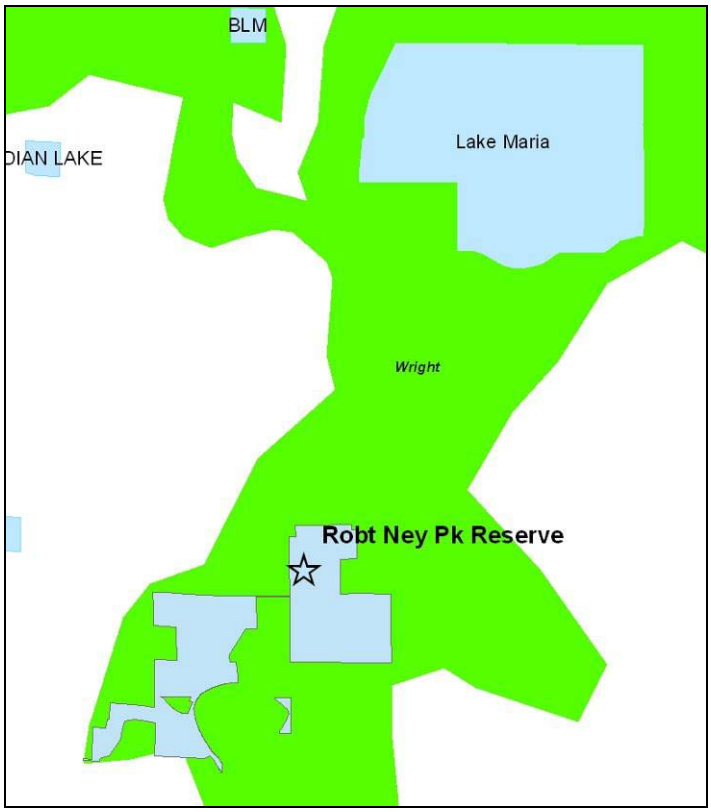


Figure 9: Robert Ney Memorial Park restoration location, with regional protected land (in blue).

Combined, these restoration projects improved habitat for rare species, restored high quality natural areas and reconstructed others in key locations, restored some of Minnesota’s most threatened native plant communities including oak savanna, and by involving volunteers, helped to ensure the stewardship of these areas into the next generation.

Summary Budget Information for Result 2:	**Trust Fund Budget:**	**$111,000**
	Amount Spent:	**$111,000**
	Balance:	**$ 0**

Deliverable	**Completion Date**	**Budget**	**Status**
1. 25 acres improved /restored/enhanced	11/1/08	$35,000	
2. 75 total ac. improved /restored/enhanced	6/30/09	$95,000	
3. 90 total ac. improved/ restored/enhanced	6/30/10	$111,000	

V. TOTAL TRUST FUND PROJECT BUDGET:

Staff or Contract Services: $39,800
Equipment: $4,930
Development: $ 0
Restoration: $ 54,395
Acquisition, including easements: $ 0
Other: $11,875 (Vol. Event Supplies (approved food and bvg, portable toilets, tents, signage, PA system), mileage POVs.)

TOTAL TRUST FUND PROJECT BUDGET: $111,000

Explanation of Capital Expenditures Greater Than $3,500:

VI. OTHER FUNDS & PARTNERS:

A. Project Partners: Project partners were:

- all Metro Conservation Corridor partner organizations, particularly SNA;
- State partners including DNR Parks; DNR west metro Fisheries; Biofuels for Restoration program.
- Local government units including Scott County Parks; Three Rivers Park District; City of Mendota Heights; City of Savage; OH Anderson Elementary; Sherburne National Wildlife Refuge; St. Paul Parks and Rec; City of Ramsey; Conservation Districts.
- Private sources including Corporate Volunteerism Council; Arcola Mills Historic Foundation; 600 Greening Volunteers.

B. Other Funds Proposed to be Spent during the Project Period: Funding partners were:

- Private sources including St. Paul Foundation; Patagonia, Inc.; Arcola Mills Historic Foundation; St. Paul Garden Club; Corporate Volunteerism Council; Shakopee Mdewakanton Sioux (Dakota) Community.
- Local government sources including City of Mendota Heights; Mahtomedi Independent School District; City of Savage; Three Rivers Park District; Scott County Parks.
- Federal sources including National Fish and Wildlife Foundation.
- State sources including biofuels grants; BWSR; Sesquicentennial Foundation; DNR Fisheries.

C. Past Spending:

- LCCMR 2007 appropriation of $60,000 for Metropolitan Area Conservation Corridors – Phase III.
- LCMR 2005 appropriation of $100,000 for Metropolitan Area Conservation Corridors – Phase II.
- LCMR 2003 appropriation of $124,000 for Metropolitan Wildlife Corridors - Phase I.
- LCMR 2003 appropriation of $255,000 for Bucks and Buckthorn: Engaging Young Hunters in Restoration
- LCMR appropriation during the 2002 - 2003 biennium of $910,000 to build on the successful Big Rivers Partnership, matched by $1.9 million from non-state public and private sources.
- Big Rivers Partnership (BRP) first funded by an $800,000 appropriation from the LCMR during the 1999 - 2001 biennium, and matched by $550,000.
- $300,000.00 RIM Critical Habitat Match - Environmental Trust Fund and Future Resource Fund, matched by $2.2 million foundation, corporate, and private contributions.

D. Time: 2 years

VII. DISSEMINATION: In January, 2010, Great River Greening included a feature article on the ENRTF, LCCMR, and the Metro Conservation Corridors program and projects in our e-postcard, circulation 3200. In addition, project descriptions and funder acknowledgement are included in our volunteer recruitment efforts to all the volunteers in our database. In addition, Greening is in active partnership with landowners and other land managers, resulting in a dynamic and timely exchange of information and results.

VIII. REPORTING REQUIREMENTS:

Periodic work program progress reports will be submitted not later than February 1, 2009, August 1, 2009, and February 1, 2010. A final work program

report and associated products will be submitted between June 30 and August 1, 2009 or 2010 as requested by the LCCMR

IX. RESEARCH PROJECTS: N/A

J:\SHARE\WORKFILE\ML2008\Work Program Information\2008WPTemplateblank.doc

Attachment A: Budget Detail for 2008 Projects - Summary and a Budget page for each partner (if applicable)

Project Title: *Metro Conservation Corridors – Phase IV – Great River Greening (2.3)*

Project Manager Name: *Wiley Buck*

Trust Fund Appropriation: $ *111,000*

1) See list of non-eligible expenses, do not include any of these items in your budget sheet

2) Remove any budget item lines not applicable

2008 Trust Fund Budget	**Revised Result 2 Budget** *2/26/2010*	**Amount Spent** 6/30/2010	**Balance** *6/30/2010*	**TOTAL BUDGET**	**TOTAL BALANCE**
	Restore/Enhance Significant Habitat				
BUDGET ITEM			0	0	0
PERSONNEL: *Staff: Ecologists (.43 FTE); Field Manager/Technicians (.79 FTE); Volunteer Manager (.15 FTE); Project Administration (.07 FTE);*	39,800	39,800	0	39,800	0
Contracts			0	0	0
Professional/technical *(with whom?, for what?)*			0	0	0
Other contracts: *Restoration: site prep, prairie install, direct hardwood seeding by e.g. Minn. Native Landscapes, North Am. Prairies, PRI, Zumbro Valley Forestry, Outback Nursery, farmers and other local partners*	30,855	30,855	0	30,855	0
Other direct operating costs: *Restoration supplies and materials:mulch, plants, seeds.*	23,540	23,540	0	23,540	0
Equipment / Tools: *chainsaws, brush cutters, sprayers, shovels, loppers, weed wrenches, bow saws, water packs, drip torch, safety equipment, glvoes, glasses, flagging, stakes, erosion control blanket, etc.*	4,930	4,930	0	4,930	0
Office equipment & computers - NOT ALLOWED unless unique to the project			0	0	0
Other Capital equipment *(list specific items)*			0	0	0
Land acquisition			0	0	0
Land rights acquisition *(less than fee)*			0	0	0
Professional Services for Acq.			0	0	0
Printing			0	0	0
Other Supplies *(list specific categories)Other: Vol. Event Supplies (approved food and bev., portable toilets, tents, signage, PA system)*	10,800	10,800	0	10,800	0
Travel expenses in Minnesota, *mileage POVs.*	1,075	1,075	0	1,075	0
Travel outside Minnesota *(where?)*			0	0	0
Construction *(for what?)*			0	0	0
Other land improvement *(for what?)*			0	0	0
Other *(Describe the activity and cost) be specific*			0	0	0
COLUMN TOTAL	**$111,000**	**$111,000**	**$0**	**$111,000**	**$0**

Appendix B
2008 Subd. 3(a)2.3 Greening Phase IV Metro Conservation Corridors FINAL REPORT
Date: 7/30/2010

2009 Subd. 4(f)2.5 Greening Phase V Metro Conservation Corridors

SITE: Name, Owner, Location	Ecological Significance	Native Communities and Restoration Goals	Project Description	Ph	Proposed Restoration Activities	Acreage (*after pro-rate with 'other state').	Status of phase-specific deliverables
St. Croix Valley Early Detection Garlic Mustard. NPS fee title, NPS scenic easement, DNR	Very early stages of invasion	Forest	Early detection/rapid response to garlic mustard	IV	Garlic mustard location, mapping, smothering, cutting, spraying	4 ENRTF&non-state	Complete
				V	Sustained garlic mustard effort; coordinate with regional managers	4	Underway
Afton State Park	Large site with extensive natural communities incl. rare prairie and forest interior species	1) Mesic oak-hardwood forest reconstruction 2) Henslow's sparrow (MN END) habitat enlargement	1) Direct hardwood seeding with enhancements. 2) Surrogate Grassland: Enlarge treeless area	III	III: Site prep; direct hardwood seeding	56* + 29 using other state	Complete
				IV	Remove grassland tree line and scattered trees for Henslow habitat. Plant Hackberry and basswood seedlings; volunteers plant acorns in gaps.	20 ENRTF&non-state	Complete
Uncas Dunes SNA (Anoka Sandplain), Sherburne Co.	CBS quality plant community with rare species. SNA.	Oak savanna	Woody encroachment removal	IV	Removal with volunteer stacking event; volunteer seed collection; seeding	3.5 ENRTF&non-state 26.5 other state	Complete (incl. Biofuels grant)
Miss West Regional Park (Anoka Sandplain), Ramsey	Large park on Mississippi R.	Shoreline/Riparian	Shoreline revetment. Invasive species control	IV	Install cedar revetment; Invasive species removal including volunteer event	1ac+22' shoreline ENRTF&non-state 17ac+338' other state	Complete
Ney Regional Park, Wright Co near Maple Lake, and 2 miles to	Lg CBS quality Maple Basswood	M-B forest; reconstruct tree layer.	Seed the ag field, with oaks as major component.	IV	Site prep, seed procurement and fall seeding.	40 ENRTF&non-state	Complete
St Croix Savanna SNA, Bayport.	Extremely high quality savanna	Oak Savanna, prairie	High School youth conducting invasive species control thru our Natural Areas Teen Network program.	V	Sumac cutting; knapweed pulling	1	Begins in May 2010.
Meeker Dam (Maintenance), St. Paul	Forested shoreline on Miss River	Riparian Forest	Forest restoration	II	Buckthorn clearing; volunteer planting event	3	Complete
				IV	2nd wave of buckthorn control	2 ENRTF&non-state	Complete
Indian Mound Regional Park, St. Paul	Large native plant communities on Miss River; kittentails.	Savanna	Tree and shrub layer reconstruction	IV	Site prep; volunteer planting ; herbivory protection; establish	1 ENRTF&non-state	Complete
OH Anderson Elementary, Mahtomedi	Nature classroom site in Corridor connecting Lake Elmo RP to Square/Carnelia n Lakes complex	Prairie	Prairie reconstruction	I - III	Site prep; prairie seeding; 1st year est. mow and knapweed control; plug planting	3	Complete
				IV	Invasive species control, woody encroachment control, plug planting	3 ENRTF&non-state	Complete
				V	First Rx burn (Maintenance/ Enhancement)	2	Scheduled Sp10
Arcola Mills Historic Foundation, Stillwater	CBS quality forest with 0.5 mile shoreline and rare species. (Protected private)	Forest	Invasive species control, pine planting, erosion control; garlic mustard control.	I - III	1st wave woody invasives; pine planting; raingarden; ravine erosion control; garlic mustard control	50,6	Complete
				IV	Garlic mustard control; follow up buckthorn control;	26 ENRTF&non-state 4 Other State	Complete

Pilot Knob Hill, Mendota Heights	Located in top tier township for SGCN opportunities/needs. Adjacent to Ft Snelling SP in MN River Valley	Prairie/Savanna	Reconstruction; non-game habitat.	II	Phase I site prep, seeding. Volunteer event.	8	Complete
				IV	Phase I establishment mow, spray. Phase II site prep, seeding, snake hibernaculum, snag creation. Volunteer event.	20 ENRTF&non-state 2 Other State	Complete
				V	Establishment, maintenance, and enhancement; volunteer events.	24	Late stages of development
Eagle Creek AMA, Savage	Metro Trout stream	Prairie, Savanna, Woodland	Tree layer reconstruction; invasive spp control	III	Oak planting with herbivory protection, using volunteers	4*	Complete
				IV	Maintanence. Prairie invasive species control	2 ENRTF&non-state 1 other state	Complete
Spring Lake Regional Park, Prior Lake	Large park with large CBS quality M-B forest	M-B forest	Low density buckthorn control; volunteer events; isolated patches of high density b.t.; siberial elm and other woody invasives	IV	Buckthorn control; volunteer stacking.	81 ENRTF&non-state	Complete
				V	Low density and high density b.t. control; volunteer event(s);	30 est	Underway
The Landing (fka Murphy's Landing), 3RPD, Shakopee	Large native plant communities on MN River	Oak savanna, woodland	Restoration from highly degraded condition	III-IV	Intensive buckthorn control; herbaceous seeding; supplemental plug planting	3.5 ENRTF&non-state 1 other state	Complete (III and IV funds per amendment with results in IV)
Hidden Valley City Park, Savage	CBS quality prairie with kittentails, on Credit River	Prairie	Prairie restoration; raingarden b/w parking lot and River	I-III	Woody and herbaceous inv species control; Rx burn; raingarden; volunteers	5	Complete
				IV	Invasive species control; supplemental plugs; volunteers.	3 ENRTF&non-state	Complete
Pond Dakota Mission City Park, Bloomington	Part of large native plant communities on MN River	Oak savanna, woodland	Reconstruction from forest and turf.	IV-V	Site prep, seeding	6 est	Underway 2/10/10
Lost Valley SNA, Denmark Township	CBS quality remnant prairie with rare	Prairie	Prairie restoration	V	Woody removal	5 est	Scheduled Sp 2010
Snail Lake Regional Park, Shoreview	'Grass Lake' portion with Blanding's turtle and red-shouldered hawk	Oak savanna	Restoration	V	First wave patchy buckthorn and woody encroachment removal	26 est	Late stages of development
Belwin Conservancy, Afton. Lake Edith LE1 LE3 and LE2 units	100+ acre natural area undergoing intensive restoration, in Valley Ck watershed priority area	Oak Savanna, prairie	Reconstruction of herbaceous layer.	n/a	Woody removal with 'biofuels' grant.		Complete
				V	Site prep including spraying and soil prep (woody removal already completed), seeding, weed control.	30 to 62. TBD by amt of federal match; LE1 LE3 savanna is priority over LE2 prairie.	Late stages of development

2008 Project Abstract
For the Period Ending June 30, 2010

PROJECT TITLE:	Metro Conservation Corridors Phase IV – Metro Greenways (2.4, 3.4, 4.1)
PROJECT MANAGER:	Marybeth Block
AFFILIATION:	DNR Eco Waters
MAILING ADDRESS:	1200 Warner Road
CITY/STATE/ZIP:	St. Paul, MN 55106
PHONE:	651.259.5835
E-MAIL:	Marybeth.block@state.mn.us
WEBSITE:	http://www.dnr.state.mn.us/nrplanning/cca/index.html
FUNDING SOURCE:	Environment and Natural Resources Trust Fund
LEGAL CITATION:	M.L. 2008, Chap. 367, Sec. 2, Subd. 3(a) 2.4, 3.4, 4.1

APPROPRIATION AMOUNT: $999,530

Overall Project Outcome and Results

The DNR Metro Greenways strives to ***protect, connect and restore*** natural areas in the state's growth corridor by supporting local conservation efforts with matching grants. This 2008 appropriation supported eleven projects and leveraged nearly 4:1 local/regional match.

Two projects received $8,162 to implement restoration activities on 4.3 acres. At the Centennial Middle School boy scouts, a community business and the City of Lino Lakes partnered to remove invasive plants and reintroduce oak savanna species. The City will maintain the site and students will track the landscape's ecological changes over time. St. Paul enhanced two remnant prairies on about 2.2 acres at Mounds and Cherokee Parks. Prescribed burns, seed collection, invasive species removal and planting local ecotype seedlings and seeds was accomplished by volunteers, city staff and contractors. This project also helped to build the City's capacity to grow local genotype plant plugs that are more likely to survive the establishment phase of the restoration.

Three projects received $891,328 from the Environment and Natural Resources Trust Fund (ENRTF) that enabled protection of 46 acres of open space and high-value ecological areas and leveraged additional dollars from other funding partners to protect an additional 420 acres – for a total of 466 acres combined. A combined 2.7 miles of development-attractive shoreline has been protected at these sites (0.30 miles ENRTF; 2.4 miles other funds), and all 3 projects are (or will be) Regional Parks: Bertram Chain of Lakes Regional Park, located in Monticello and Wright County; Ojiketa Regional Park in Chisago City; and St. Catherine's Bluff addition to the proposed Doyle- Kennefick Regional Park in Scott County.

Six local governments received grants to develop tools and policies that will help them address the challenges associated with conserving remaining natural habitats in rapidly changing landscapes. Three projects conducted a natural resource inventories, two updated their Planned Unit Development Ordinance, and one developed a model to prioritize land for protection. Both ordinances incorporate public values and sensitive resource needs into the proposed design by instituting a process that engages city staff, the developer and local agencies in an early on collaborative process.

Project Results Use and Dissemination

Press releases were sent to local newspapers where projects were funded. The DNR convened all of the Community Conservation Assistance (CCA) project managers in November of 2009 to share the objectives and experiences of their projects. CCA Project Profiles were drafted and posted on the DNR website. Protection and restoration project information will be available through the public map generated from the MeCC database.

Trust Fund 2008 Work Program Final Report

Date of Report: August 13, 2010
Date of Next Status Report: Final Report
Date of Work program Approval: 6/10/2008
Project Completion Date: 6/30/10

I. PROJECT TITLE: **Metro Conservation Corridors Phase IV – Metro Greenways (2.4, 3.4, 4.1)**

Project Manager: Marybeth Block
Affiliation: DNR Central Region
Mailing Address: 1200 Warner Road
City / State / Zip : St. Paul, MN 55106
Telephone Number: 651-259-5835
E-mail Address: Marybeth.block@dnr.state.mn.us
Fax Number: 651-772-7799
Web Page address: http://www.dnr.state.mn.us/greenways/index.html

Location: Within mapped focus areas in 12 counties that are in DNR's Central Region

Total Trust Fund Project Budget:		
	Trust Fund Appropriation:	$ 999,490
	Minus Amount Expended:	$ 999,490
	Equal Balance:	$ 0

Legal Citation: M.L. 2008, Chap. 367, Sec. 2, Subd. 3(a) 2.4, 3.4, 4.1

Appropriation Language:

$3,150,000 is from the trust fund to the commissioner of natural resources for the fourth appropriation for acceleration of agency programs and cooperative agreements. Of this appropriation, $1,915,000 is for Department of Natural Resources agency programs and $1,235,000 is for agreements as follows: $475,000 with the Trust for Public Land; $92,000 with Friends of the Mississippi River; $111,000 with Great River Greening; $225,000 with Minnesota Land Trust; $225,000 with Minnesota Valley National Wildlife Refuge Trust, Inc.; and $107,000 with Friends of the Minnesota Valley for the purposes of planning, restoring, and protecting important natural areas in the metropolitan area, as defined under Minnesota Statutes, section 473.121, subdivision 2, and portions of the surrounding counties, through grants, contracted services, conservation easements, and fee title acquisition. Land acquired with this appropriation must be sufficiently improved to meet at least minimum management standards as determined by the commissioner of natural resources. Expenditures are limited to the identified project corridor areas as defined in the work program. This appropriation may not be used for the purchase of residential structures, unless expressly approved in the work program. All conservation easements must be perpetual and have a natural resource management plan. Any land acquired in fee title by the commissioner of natural resources with money from this appropriation must be designated as an outdoor recreation unit under Minnesota Statutes, section 86A.07. The commissioner may similarly designate any lands acquired in less than fee title. A list of proposed restorations and fee title and easement acquisitions must be provided as part of the required work program. All funding for conservation easements must include a long-term stewardship plan and funding for monitoring and enforcing the agreement.

II. and III. FINAL REPORT SUMMARY

The DNR Metro Greenways strives to ***protect, connect and restore*** natural areas in the state's growth corridor by supporting local conservation efforts with matching grants. This 2008 appropriation supported eleven projects and leveraged nearly 4:1 local/regional match.

Two projects received $8,162 to implement restoration activities on 4.3 acres. At the Centennial Middle School boy scouts, a community business and the City of Lino Lakes partnered to remove invasive plants and reintroduce oak savanna species. The City will maintain the site and students will track the landscape's ecological changes over time. St. Paul enhanced two remnant prairies on about 2.2 acres at Mounds and Cherokee Parks. Prescribed burns, seed collection, invasive species removal and planting local ecotype seedlings and seeds was accomplished by volunteers, city staff and contractors. This project also helped to build the City's capacity to grow local genotype plant plugs that are more likely to survive the establishment phase of the restoration.

Three projects received $891,328 that, when combined with dollars from other funding partners, protected 466 acres of open space and high-value ecological areas. A combined 2.7 miles of development-attractive shoreline has been protected at these sites, and all 3 projects are (or will be) Regional Parks: Bertram Chain of Lakes Regional Park, located in Monticello and Wright County; Ojiketa Regional Park in Chisago City; and St. Catherine's Bluff addition to the proposed Doyle-Kennefick Regional Park in Scott County.

Six local governments received grants to develop tools and policies that will help them address the challenges associated with conserving remaining natural habitats in rapidly changing landscapes. Three projects conducted a natural resource inventories, two updated their Planned Unit Development Ordinance, and one developed a model to prioritize land for protection. Both ordinances incorporate public values and sensitive resource needs into the proposed design by instituting a process that engages city staff, the developer and local agencies in an early on collaborative process.

IV. OUTLINE OF PROJECT RESULTS*:*

Result 1: Restore and Enhance Significant Habitat

Final Report Description: The Metro Greenways Program request for proposals for restoration projects generated two applications. The balance of the money originally earmarked for Result 1 was transferred, via an amendment, to Result 2. While working to restore land to native vegetation on 4.25 acres was a primary objective of both projects, they also had community-building and educational component.

Centennial School District (CSD) partnered with the City of Lino Lakes to restore 2 acres to an oak savanna – the pre settlement cover type described in land surveys from the 1600's. The site had been overtaken by box elder, Siberian elm and buckthorn. The City of Lino Lakes conducted a burn in the fall of 2008, and Rivard Tree Removal donated their services to remove and chip the trees. Boy Scouts planted the forb and grass seed, and oak seedlings donated by the DNR. Lino Lakes has agreed to mow and chemically treat undesirable plants while the site is in the establishment phase. The evolution of the parcel will be studied by students in science and geography classes who will track changes over time. The Metro Greenways reimbursed the CSD a total of $2,415.

The City of St. Paul enhanced two remnant prairies with local ecotype plants – 1.25 acres at Mounds Park and 1 acre at Cherokee Park. Engaging volunteers and building the City's capacity to grow local genotype plant material was an important objective of this project. 194 volunteers devoted 561

hours collecting seed, removing invasive species, burning the sites, and sowing the seed. Natural Resources Restoration, Inc oversaw the prescribed burn operations using volunteers from the University of Minnesota and Minnesota Conservation Corps. 2.5 acres at Mound Park and 0.25 acre at Cherokee Park were successfully burned. Sixty deep cell native grasses and forb seedlings (98 plants per flat) were grown from seed collected at these sites. The 3 to 5" rooted plants are more likely to survive in sandy soils and reduce watering requirements during the establishment phase. The City hopes to establish and ongoing, volunteer-powered program to raise local ecotype seeds, and did engage 150 youth volunteers to seed the flats. Both parks have current Ecological Inventory and Management Plans that guided the enhancement activities. The Metro Greenways reimbursed St. Paul a total of $5,747.

Summary Budget Information for Result 1:

Trust Fund Budget:	**$**	$8,162
Amount Encumbered		0
Amount Expended:	**$**	$8,162
Balance:	**$**	0

Deliverable	**Completion Date**	**Budget**	**Status**
1. 4.3 acres restored	6/30/2010	$8,162	completed

Completion Date: 6/30/2010

Grant Recipient	Project Name	Location	Description	Ac	Total Cost $	Metro Greenways $	Other Funds $
Result 1: Restore and Enhance Significant Habitat							
Centennial Middle School	Oak Savanna Restoration	Lino Lakes	Restore a school-owned oak savanna for use as an environmental study area.	2.1	$10,190+	$2,415	$700 cash match from donations and $7,075 in kind from city of Lino Lakes and Boy Scouts
City of St. Paul	Indian Mounds and Cherokee Parks	St. Paul	Collection and propagation of local ecotype seed from the parks' savanna remnants and site preparation of planting areas.	2.25	$19,000	$5,747	City of STP cash $500, Inkind (city and volunteers) $12,750
TOTAL				4.35	$29,275	**$8,162**	

Result 2: Acquire Significant Habitat

Summary Budget Information for Result 2:		
	Trust Fund Budget	**$** 891,328
	Amount Encumbered	**$** 0
	Amount Expended	**$ 891,328**
	Balance:	**$** 0

Deliverable	**Completion Date**	**Budget**	**Status**
1. 46.7 acres acquired	6/30/2010	$891,328	completed

Final Report Description: The DNR Metro Greenways Program, in partnership with local and regional governments, the Trust from Public Land and private parties, protected 466 acres of regionally important habitat by acquiring the title to the properties. The program provided about 10 percent of the total funds needed to acquire 3 properties (46 acres protected with this appropriation.)

Two of the projects originally selected for funding did not go forward, one because the financial difficulties facing the local governments, and one due to a change of ownership. The balance in result 1 ($88) and the MeCC Coordination Fund ($49,490) was combined with the canceled project money ($500,000) and awarded to Wright County for another acquisition at the Bertram Chain of Lakes Regional Park project site. The 2009 Metro Greenways Protection Review Committee recommended additional funds (should they become available) be spent on this project. Wright County secured the required match and they acquired an additional 51.4 acres increasing the acres of Bertram Chain of Lakes Regional Park to 370.4 encompassing about 31 percent of the entire project area.

Over 2.7 miles of development-attractive shoreline has been protected at these 3 project sites. All will be designated Regional Parks: St. Catherine's Bluff in Scott County will become park of the planned Doyle-Kennefick Regional Park; Ojekita Regional Park on the shores of Green Lake in Chisago City and the Bertram Chain of Lakes Regional Park in Wright County and Monticello.

Individual project descriptions

Grant Recip-ient	Project Name	Land Report to LCCMR	Description	Ac MG%]	Total Cost $	Metro Greenway$	Other Funds $
Result 2: Protect Significant Habitat							
Scott County	St. Cather-ine's Bluff	Nov. 7, 2008	Fee title acquisition comprised of bluff-top maple-basswood forest and 3500' of shoreline. (note: $236,960 of Phase 3 funding was applied to this project)	48 [1.7]	1,201K	$41,740	$236,960 2007 MG ENRTF; $170,044 from other ENT fund $759,680 reg/local
Wright County	Bertram Chain of Lakes	Jan. 15, 2009	Fee title acquisition comprised of 6280' undeveloped lakeshore on long lake and adjacent upland. {MLCCS}	319 [17.5]	3,600K	$200,000	See attachment B
Wright County	Bertram Chain of Lakes	June 24, 2010	Fee title acquisition comprised of 1250' undeveloped lakeshore on long lake and adjacent uplands{MLCCS}	51.4 [25.7]	1,099K	$549,588	See attachment B
Chisago City	Camp Ojiketa	Mar. 25, 2009	Fee title acquisition of 3100' shoreland (Green Lake) and wetland non-forest habitat types.	48 [1.8]	4,200K	$100,000	Other ERNF $885,000; Other state $1,000K; Regl/local 1,510K; np 160K; donation $545K
TOTAL				466.4 [46.7]	$1,010K	**$891,328**	

Result 3: Other Conservation Tools and Incentives

Description:

Summary Budget Information for Result 3:

Trust Fund Budget	**$**	100,000
Amount Encumbered	**$**	**0**
Amount Spent	**$**	**100,000**
Balance	**$**	**0**

Deliverable	**Completion Date**	**Budget**	**Status**
1. 6 community	6/30/2010	$100,000	Completed

Completion Date: 6/30/2010

Final Report Description: The Metro Greenways Program awarded 6 Community Conservation Assistance (CCA) grants to local governments helping communities address challenges associated with conserving the remaining natural habitats in rapidly changing landscapes. These grants leveraged almost 75% local match. Of the 6 projects 3 were natural resource inventories, 2 were ordinance updates and one was a priority-lands assessment model.

The inventory projects focused on: 1) invasive species mapping in Ramsey County, 2) tree canopy mapping in Woodbury and 3) anatural area land cover inventory in a minor watershed (using MLCCS) in 12 Mile Creek Watershed in Wright County. All of the inventory work builds a foundation for land use and management decisions.

Lino Lakes and Minnetrista updated their planned unit ordinances to incorporate natural resource protection. Lino Lakes delineated a zoning district to protect Environmentally Sensitive Areas (ESAs). The City wanted to encourage low impact development design practices in the ESA zone and city-wide. Their approach evolved to create a new Site Layout Performance Standard that applies everywhere but includes special requirements for the ESAs. The City updated other sections of their ordinance, including the Planned Unit Development (PUD) process requiring the collaborative process involving the city, developer and other appropriate agencies and allows flexibility and opportunities to offer incentives for good design.

Minnetrista also incorporated the collaborative track process into their PUD as one way to carry out their priority to conserve and protect natural resources. They were able to utilize this process with a large development and mend previously tenuous relationships with various regional agencies because they were able to bring them to the table and engage them in the collaborative track process that maximized the public values for this large development. The collaborative track process was piloted on the Woodland Cove development proposal while it was being crafted. The resulting concept plan that has: 1) a minimum 140 acres of open space, 2) 44% of the maple basswood forest stand preserved and 3) 30% of the Minnetonka shoreline footage in a commonly-held out lot. It also includes $1 million investment in a regional trail connection through the development and partnerships with the Minnehaha Creek Watershed District to go beyond their stormwater regulatory requirements and provide enhanced preservation. The project did request, and was granted, an additional $6,000 to the $12,000 originally appropriated (for a total of $18,000.)

Washington County developed a GIS model to prioritize the areas in the county that best meet the protection objectives of the Land and Water Legacy Program. The model includes four modules: surface water, drinking water, ecological and connectivity. A technical advisory committee helped define the criteria used in the analysis. The foundation of the model is the MN Land Cover Classification inventory. The project manager requested an additional $10,000 to the original $19,000 grant, and was awarded $5,000 for a total grant of $24,000.

On November 23, 2009 CCA grant project managers were convened to share the goals and outcomes of their projects. All of the projects were represented. The opportunity for peer- to-peer exchanged was highly valued by participants many of who explicitly remarked at how much they had learned that day.

Individual project descriptions

Grant Recipient	Project Type	Description	Area	Total Cost $	Metro Greenway $	***Other Funds***
Result 3: Provide Community Conservation Assistance						
City of Lino Lakes	Natural Resource Ordinance	Revised City ordinances to address environmentally sensitive areas planned unit development (PUD), low impact development (LID), and conservation subdivision design.	City wide	71,555	25,000	City in-kind $18,495 City cash $26,530
City of Minnetrista	Natural Resource Ordinance	Revised the Planned Unit Ordinance to incorporate public conservation values and natural resource protection.	City wide	52,000	18,000	City In Kind $24,000
Ramsey SWCD	Natural Resources Inventory	Map and monitor emerging invasive plants in Ramsey County	County wide	11,928	5,000	Ramsey Consv. District $5000 cash, Ramsey Co $1,928 in-kind
Washington County	Natural Resource Plan	Develop a Conservation Plan to guide the implementation of the Land and Water Legacy Program to protect lands critical to creating an interconnected network of high quality natural areas.	County wide	82,000	24,000	Washington County In kind $27,000
Woodbury*	Natural Resource Inventory	Conduct an urban tree canopy inventory	City Wide	23,800	8,000	City in-kind totals 4,800. 2009 Metro Greenways funding of $11,000 (Project still in progress. Funded in 2009)
Wright SWCD	Natural Resource Inventory	Conduct a land cover study (level 4 or 5) to assist in assessing, modeling, protecting and enhancing the natural resources in the Twelve Mile Creek Watershed.	Sub-watershed	40,000	20,000	Wright County SWCD $10,000 in kind; Wright County Planning and Zoning $10,000 in kind
TOTAL				$281,223	**$100,000**	

V. TOTAL TRUST FUND PROJECT BUDGET:

Staff or Contract Services:
Equipment: 0
Development: $ 0(improvement to land or building)
Restoration: $ 8,162 for 4.3 acres
Acquisition, including easements: $ 891,328 for 466 acres total (46.7 acres Metro Greenways)
Other: $ 100,000 for 6 community conservation projects

TOTAL TRUST FUND PROJECT BUDGET: $ 999,490

Explanation of Capital Expenditures Greater Than $3,500: *n/a*

VI. OTHER FUNDS & PARTNERS:

A. Project Partners: Local, regional and state units of government and conservation nonprofits.

B. Other Funds Spent during the Project Period: $4,818,460 regional/local; $2,000,000 state (origin other than Environmental & Natural Resources Trust Fund.)

C. Past Spending: In the past 8 years, Metro Greenways has received the following direct appropriations: 1998 bonding: $4,000,000, 2000 Bonding: $1,500,000, 2001 LCMR: $2,730,000 2003 LCMR/Phase1 MWC: $1,089,000 appropriation, 2005 LCMR/Phase2 MWC: $1,200,000, 2007 LCCMR/Phase 3 MeCC: $944,000. In addition, since inception of the program, over $6 of non-state funds for every LCMR dollar has been directly leveraged towards the projects funded by Metro Greenways.

D. Time: 2 years

VII. DISSEMINATION: The DNR will disseminate information through its field staff and other joint efforts with agencies and communities. The protection and restoration projects will be available to the public via the MeCC Project Map (and data base.) The DNR website will display profiles of all of the community conservation assistance projects, including contact information for the local project manager and links to local government websites containing the products developed with these grants.

VIII. REPORTING REQUIREMENTS:

Periodic work program progress reports were submitted by managers February 1st and August 1st of each year, beginning 2/1/09. This final work program report is being submitted on August 16, 2010.

IX. RESEARCH PROJECTS: *not applicable.*

Attachment B Final Report
Wright County/City of Monticello
Bertram Chain of Lakes Regional Park Acquisition

Past and Current Funding Efforts

Project Phase	Date of Funding	State Allocation	Local Match	Other Funding Source	Funding Source Description	Activity/Notes	Acres
I	July 2008	$1,000,000			LCCMR - Environment and Natural Resources Trust Fund (ENRTF)		88.6
I	July 2008	$200,000			Metro Greenway Grant - ENRTF		17.7
I	December 2008		$2,400,000		Local Contribution For Phase I		212.7
	TOTALS	**$1.2 Million**	**$2.4 Million**	**0**		**$3.6 Million**	**319 Acres**
II	July 2009		($296,202)	$266,250	Non Metro Regional Park Grant (Federal LAWCON) Thru DNR		23
II	January 2010	$400,000	($445,000)		DNR Legacy Park Grant - Legacy funds		35
II	February 2010	$549,588	$549,588		Metro Greenway Grant (ENRTF)		51.4
II					Local Contribution For Phase II		90
	TOTALS	**$949,588**	**$1,290,790**	**$266,250**		**$2,506,628**	**~199 Acres**

State Funds To Date: $2,149,588 Local and Other Funds To Date: $3,957,040 = $6,106,628

Attachment A: Budget Detail for 2008 Metro Conservation Corridors Metro Greenways

Project Title: Metro Greenways (1,2 and 3)

Project Manager Name: Marybeth Block

Trust Fund Appropriation: $ 999,490

2007 Trust Fund Budget	Result 1 Budget: Restoration	Amount Spent (*8/1/08*)	Balance (*8/1/08*)	Result 2 Budget: Protection	Amount Spent (*8/1/08*)	Balance (*8/1/08*)	Result 3 Budget: Community Assistance	Amount Spent (*8/1/08*)	Balance (*8/1/08*)	TOTAL BUDGET	TOTAL BALANCE
BUDGET ITEM											
Grants to LGUs and NGOs	$ 8,162	$ 8,162	$ -	891,328	891,328	0	$100,000	$100,000	$0	$999,490	0
COLUMN TOTAL			**$0**	**$ 891,328**	**891,328**	**$0**	**$100,000**		$0	**$999,490**	**$0**

2008 Project Abstract
For the Period Ending June 30, 2010

PROJECT TITLE:	**Metro Conservation Corridors – Phase IV – Scientific & Natural Areas (3a) - (2.5 & 3.6)**
PROJECT MANAGER:	Margaret (Peggy) Booth
AFFILIATION:	DNR Division of Ecological Resources
MAILING ADDRESS:	500 Lafayette Rd, Box 25
CITY/STATE/ZIP:	St Paul, MN 55155-4025
PHONE:	651-259-5088
E-MAIL:	peggy.booth@state.mn.us
WEBSITE:	www.dnr.state.mn.us/snas
FUNDING SOURCE:	Environment and Natural Resources Trust Fund
LEGAL CITATION:	M.L. 2008, Chap. 367, Sec. 2, Subd. 3(a) 2.5 & 3.6

Appropriation Language:
$3,150,000 is from the trust fund to the commissioner of natural resources for the fourth appropriation for acceleration of agency programs and cooperative agreements. Of this appropriation, $1,915,000 is for Department of Natural Resources agency programs and $1,235,000 is for agreements as follows: $475,000 with the Trust for Public Land; $92,000 with Friends of the Mississippi River; $111,000 with Great River Greening; $225,000 with Minnesota Land Trust; $225,000 with Minnesota Valley National Wildlife Refuge Trust, Inc.; and $107,000 with Friends of the Minnesota Valley for the purposes of planning, restoring, and protecting important natural areas in the metropolitan area, as defined under Minnesota Statutes, section 473.121, subdivision 2, and portions of the surrounding counties, through grants, contracted services, conservation easements, and fee title acquisition. Land acquired with this appropriation must be sufficiently improved to meet at least minimum management standards as determined by the commissioner of natural resources. Expenditures are limited to the identified project corridor areas as defined in the work program. This appropriation may not be used for the purchase of residential structures, unless expressly approved in the work program. All conservation easements must be perpetual and have a natural resource management plan. Any land acquired in fee title by the commissioner of natural resources with money from this appropriation must be designated as an outdoor recreation unit under Minnesota Statutes, section 86A.07. The commissioner may similarly designate any lands acquired in less than fee title. A list of proposed restorations and fee title and easement acquisitions must be provided as part of the required work program. All funding for conservation easements must include a long-term stewardship plan and funding for monitoring and enforcing the agreement.

APPROPRIATION AMOUNT: $358,000

Overall Project Outcome and Results

A new state Scientific and Natural Area (SNA) unit was acquired and designated as part of the State Outdoor Recreation System and almost 270 acres of restoration and enhancement activities were completed on existing SNAs. Specifically, a 47.9 acre parcel (including funding through the federal State Wildlife Grant, 34.58 acres pro-rated to this appropriation) in southeast Isanti County was acquired and designated as the new Twin Lakes SNA. It features white pine-hardwood forest of high biodiversity significance and 1450' of Horseshoe Lake shoreline and provided habitat for state threatened Blandings turtles and for state special concern red-shouldered hawks. Restoration and enhancement activities (prescribed burning and invasives treatment) were completed on 266.7 acres, plus .4 miles of deer exclosure fencing was reconstructed – resulting in native habitat enhancement at 11 SNAs in 6 counties within the Metro Conservation Corridors.

Trust Fund 2008 Work Program and Trust Fund 2009 Work Program

Date of Report:	January 26, 2011	
Date of Next Status Report:	February 1, 2011	
	M.L. 2008	**M.L. 2009**
Date of Work program Approval:	June 10, 2008	June 16, 2009
Project Completion Date:	June, 30 2010	June 30, 2011

I. PROJECT TITLE: **Metro Conservation Corridors – Phase IV – Scientific & Natural Areas (3a) - (2.5 & 3.6) [M.L. 2008]**
Metro Conservation Corridors – Phase V: Scientific and Natural Area Restoration and Acquisition (4f) – (2.7 & 3.6) [M.L. 2009]

Project Manager: Margaret (Peggy) Booth
Affiliation: DNR Division of Ecological Resources
Mailing Address: 500 Lafayette Rd, Box 25
City / State / Zip : St Paul, MN 55155-4025
Telephone Number: 651-259-5088
E-mail Address: peggy.booth@state.mn.us
FAX Number: 651-296-1811
Web Page address: www.dnr.state.mn.us/snas

Location: Current and proposed Scientific and Natural Areas within mapped Focus Area in the counties of Anoka, Carver, Chisago, Dakota, Goodhue, Hennepin, Isanti, LeSueur, Nicollet, Ramsey, Rice, Scott, Sherburne, Sibley, Washington and Wright. See Figure 1

Total Trust Fund Project Budget:	**M.L. 2008**	**M.L. 2009**	**Total**
Trust Fund Appropriation:	**$358,000**	**~~$410,000~~**	**~~$768,000~~**
		$610,000	**$968,000**
Minus Amount Spent:	**$358,000**	**$395,223**	**$423,951**
Equal Balance:	**$0**	**$215,252**	**$215,252**

Legal Citation:
M.L. 2008, Chap. 367, Sec. 2, Subd. 3(a) 2.5 & 3.6
Appropriation Language:
$3,150,000 is from the trust fund to the commissioner of natural resources for the fourth appropriation for acceleration of agency programs and cooperative agreements. Of this appropriation, $1,915,000 is for Department of Natural Resources agency programs and $1,235,000 is for agreements as follows: $475,000 with the Trust for Public Land; $92,000 with Friends of the Mississippi River; $111,000 with Great River Greening; $225,000 with Minnesota Land Trust; $225,000 with Minnesota Valley National Wildlife Refuge Trust, Inc.; and $107,000 with Friends of the Minnesota Valley for the purposes of planning, restoring, and protecting important natural areas in the metropolitan area, as defined under Minnesota Statutes, section 473.121, subdivision 2, and portions of the surrounding counties, through grants, contracted services, conservation easements, and fee title acquisition. Land

acquired with this appropriation must be sufficiently improved to meet at least minimum management standards as determined by the commissioner of natural resources. Expenditures are limited to the identified project corridor areas as defined in the work program. This appropriation may not be used for the purchase of residential structures, unless expressly approved in the work program. All conservation easements must be perpetual and have a natural resource management plan. Any land acquired in fee title by the commissioner of natural resources with money from this appropriation must be designated as an outdoor recreation unit under Minnesota Statutes, section 86A.07. The commissioner may similarly designate any lands acquired in less than fee title. A list of proposed restorations and fee title and easement acquisitions must be provided as part of the required work program. All funding for conservation easements must include a long-term stewardship plan and funding for monitoring and enforcing the agreement.

Legal Citation: M.L. 2009, Chp. 143, Sec. 2, Subd. 4(f) 2.7 & 3.6

Appropriation Language:

$3,375,000 is from the trust fund to the commissioner of natural resources for the fifth appropriation for acceleration of agency programs and cooperative agreements. Of this appropriation, $2,185,000 is for Department of Natural Resources agency programs and $1,190,000 is for agreements as follows: $380,000 with the Trust for Public Land; $90,000 with Friends of the Mississippi River; $155,000 with Great River Greening; $250,000 with Minnesota Land Trust; $225,000 with Minnesota Valley National Wildlife Refuge Trust, Inc.; and $90,000 with Friends of the Minnesota Valley for the purposes of planning, restoring, and protecting important natural areas in the metropolitan area, as defined under Minnesota Statutes, section 473.121, subdivision 2, and portions of the surrounding counties, through grants, contracted services, technical assistance, conservation easements, and fee title acquisition. Land acquired with this appropriation must be sufficiently improved to meet at least minimum management standards as determined by the commissioner of natural resources. Expenditures are limited to the identified project corridor areas as defined in the work program. This appropriation may not be used for the purchase of residential structures, unless expressly approved in the work program. All conservation easements must be perpetual and have a natural resource management plan. Any land acquired in fee title by the commissioner of natural resources with money from this appropriation must be designated as an outdoor recreation unit under Minnesota Statutes, section 86A.07. The commissioner may similarly designate any lands acquired in less than fee title. A list of proposed restorations and fee title and easement acquisitions must be provided as part of the required work program. All funding for conservation easements must include a long-term stewardship plan and funding for monitoring and enforcing the agreement. To the maximum extent practical, consistent with contractual easement or fee acquisition obligations, the recipients shall utilize staff resources to identify future projects and shall maximize the implementation of biodiverse, quality restoration projects in the project proposal into the first half of the 2010 fiscal year.

II. PROJECT SUMMARY AND RESULTS:

M.L. 2008

About 47 acres of priority native habitat will be acquired as Scientific and Natural Area (SNA), and 20 acres of SNA native communities will be restored/enhanced within the Metro Corridors.

M.L. 2009

This project would protect and perpetuate in an undisturbed natural state as state Scientific and Natural Area those natural features that possess exceptional scientific or education value. Specifically, at least 120 acres of SNAs in the Metro mapped corridors that are threatened or degraded by human impacts, invasives, and/or lack of natural disturbance regimes would be restored or enhanced, or development improvements made for safety or management purposes or to meet minimum standards. Also, about 30 acres of high quality native plant communities, rare plants

and animals and other natural features of statewide importance within the Metro Conservation Corridors mapped corridors would be acquired and designated as state Scientific and Natural Area.

III. PROGRESS SUMMARY AS OF FEBRUARY 1, 2011:

M.L. 2009

The 68.49 acre addition to Savage Fen SNA closed in late November 2010 (pro-rated 6.2 acres with this appropriation. Restoration and enhancement activities were completed 4 sites. Work is in progress on new adaptive management plans for Grey Cloud Dunes, Hastings Sand Coulee, and other SNAs (paid all or in part through this appropriation). The 68.49 acre addition to Savage Fen SNA closed in late November 2010 (pro-rated 6.2 acres with this appropriation – see Attachment B for revised breakdown of sources and amount of landowner payments and donation).

Work Program Amendment Request: to move $200K from Metro Greenways to SNA for purposes of acquiring an addition to the Hastings Sand Coulee or Seminary Fen SNA.

M.L. 2008 – FINAL ABSTRACT

A new state Scientific and Natural Area (SNA) unit was acquired and designated as part of the State Outdoor Recreation System and almost 270 acres of restoration and enhancement activities were completed on existing SNAs. Specifically, a 47.9 acre parcel (including funding through the federal State Wildlife Grant, 34.58 acres pro-rated to this appropriation) in southeast Isanti County was acquired and designated as the new Twin Lakes SNA. It features white pine-hardwood forest of high biodiversity significance and 1450' of Horseshoe Lake shoreline and provided habitat for state threatened Blandings turtles and for state special concern red-shouldered hawks. Restoration and enhancement activities (prescribed burning and invasives treatment) were completed on 266.7 acres, plus .4 miles of deer exclosure fencing was reconstructed – resulting in native habitat enhancement at 11 SNAs in 6 counties within the Metro Conservation Corridors.

PROGRESS SUMMARY AS OF AUGUST 1, 2010:

M.L. 2008

Result 1 previously completed: restoration and enhancement activities (prescribed burning and invasives treatment) were completed on 266.7 acres, plus .4 miles of deer exclosure fencing was reconstructed – resulting in native habitat enhancement at 11 SNAs in 6 counties. Acquisition of the 47.9 acre parcel (34.58 acres prorated to this appropriation) featuring white pine-hardwood forest of high biodiversity significance and 1450' of Horseshoe Lake shoreline in southeast Isanti County using a combination of this appropriation and federal funds closed and was designated as the Twin Lakes SNA on June 28-29, 2010. The offer made in February and a subsequent counter-offer on the other 63-acre parcel at Twin Lakes were rejected by the landowner in May 2010. The remaining $157,000 was then earmarked for acquisition of a ~70-acre addition to Savage Fen SNA underway in cooperation with the Trust for Public Land which has a purchase agreement with the landowner. The SNA program hoped to have by June 2010 a binding agreement with TPL for DNR to acquire the Savage Fen addition, but that project was delayed due to a series of

requests by the county affecting the legal description as well as required changes to the appraisal discovered during the DNR appraisal review process. Thus, the SNA program asked on June 24th to transfer $157,000 to the Division of Fisheries for one of their Metro Corridors projects. Work program amendment approved June 24, 2010.

M.L. 2009
Restoration and enhancement projects totaling 86 acres have been done at 14 sites with accomplishments including 53 acres of prescribed burns completed, 18 acres of woody invasives removed plus another 16 acres of herbaceous invasives treated. An offer was made in February 2010, but not yet accepted by the landowner to acquire a 12.6-acre addition to the Seminary Fen SNA which includes the best quality calcareous fen in the Seminary Fen complex. This 2009 appropriation will be used toward the Savage Fen acquisition (in addition to SNA 2006 bonding and partner-secured funds) and the Seminary Fen addition will be moved to acquisition through the 2010 LCCMR appropriation to the SNA program**.**

PROGRESS SUMMARY AS OF DECEMBER 8, 2009:
M.L. 2008
Result 1 completed: restoration and enhancement activities (prescribed burning and invasives treatment) were completed on 266.7 acres, plus .4 miles of deer exclosure fencing was reconstructed – resulting in native habitat enhancement at 11 SNAs in 6 counties. A pair of sites in southeast Isanti County totaling about 115 acres (using a combination of this appropriation, the 2009 appropriation, and federal funding) are being acquired which would protect tamarack, mixed hardwood swamp and white pine-hardwood forest with high-outstanding biodiversity significance through creation of the new Twin Lakes SNA. Some of this funding may also contribute towards a bigger funding package for acquisition an addition to Pine Bend Bluffs SNA of up to 71 acres including Mississippi River frontage.

M.L. 2009
Restoration and enhancement work was initiated at 7 sites with accomplishments including 14 acres of invasives treatment and over 1 mile of burn breaks completed. In addition to partially funding the 2 Twin Lakes sites noted above, acquisition is underway for an addition to the Seminary Fen SNA of up to 21 acres which includes the best quality calcareous fen in the Seminary Fen complex.

PROGRESS SUMMARY AS OF FEBRUARY 1, 2009:
M.L. 2008
Result 1 previously completed: restoration and enhancement activities (prescribed burning and invasives treatment) were completed on 266.7 acres, plus .4 miles of deer exclosure fencing was reconstructed – resulting in native habitat enhancement at 11 SNAs in 6 counties. Offers have been made on a pair of sites in southeast Isanti County totaling about 112 acres (using a combination of this appropriation, the 2009 appropriation, and federal funding) which would protect tamarack, mixed hardwood swamp and white pine-hardwood forest with high-outstanding biodiversity significance through creation of the new Twin Lakes SNA.

M.L. 2009
Restoration and enhancement work was initiated at 9 sites with accomplishments including 14 acres of invasives treatment and over 1 mile of burn breaks completed. In addition to partially funding one of the Twin Lakes sites noted above, an offer has been made to acquire a 12.6-acre addition to the Seminary Fen SNA which includes the best quality calcareous fen in the Seminary Fen complex.

IV. OUTLINE OF PROJECT RESULTS*:*

Result 1: SNA Restoration & Enhancement
Description: The SNA Program and partners will restore and enhance native habitat on approximately 50 acres (20 acres with M.L. 2008 funding and 30 acres with M.L. 2009 funding; partner acres and other funding not counted here). Any planting will use seeds or plant stock of local ecotype collected within about 20 miles of the restoration. This work will directly contribute towards achievement of restoration of degraded and rare land features (particularly native prairie, savanna, and forest) needed to support Species of Greatest Conservation Need (SGCN) and thereby helps achieve Habitat Recommendation 5 of the SCPP.

Under the 2008 appropriation, work will be targeted to projects on SNAs with critical habitat restoration needs, such as:

- fen restoration (e.g. woody encroachment removal/treatment and prescribed burning) at proposed Seminary Fen SNA (Carver Co), Black Dog Preserve SNA (Dakota Co) and/or Savage Fen SNA (Scott Co);
- prairie and savanna restoration (e.g. woody encroachment removal/treatment and prescribed burning, seed collection, and/or planting) at Grey Cloud Dunes SNA and Lost Valley Prairie (Washington Co), Rice Lake Savanna SNA (Sherburne Co), River Prairie Terrace SNA, Spring Creek Prairie SNA, and Cannon River Turtle Preserve SNA (Goodhue Co); and/or Pine Bend Bluffs SNA and Hastings Sand Coulee SNA (Dakota County); and
- white pine-hard forest restoration (e.g. deer exclosure construction, seed collection, and/or propagation) at Boot Lake SNA (Anoka Co) and/or Falls Creek SNA (Washington Co).

Additional site development and habitat restoration work may be done at SNAs, e.g. Wolsfeld Woods, Wood-Rill, Mary Schmidt Crawford Woods, Clear Lake, Chamberlain Woods, Uncas Dunes, Harry W Cater Homestead Prairie, and those listed above.

Under the 2009 appropriation, all SNAs within the mapped Metro Corridors are candidates for restoration, enhancement, and development work, with the highest priority sites (to date) listed in Table 1 (corrected version submitted 6/2/09) and highlighted in Figure 1.

Activities for restoration, development, and native habitat enhancement purposes and to bring sites acquired up to minimum standards will be carried out by SNA program or other Department crews, Minnesota Conservation Corps (MCC), Sentence to Service personnel, volunteers, and/or contractors. This includes

activities, such as seed collection, site preparation, planting, establishment period maintenance, removal and treatment of exotics, control of woody encroachment, site clean-up, signing, deer exclosures and other fencing, prescribed burns, and updating of management plans or completion of new adaptive management plans for targeted sites. Opportunities will be cultivated to complete cooperative projects with other MeCC partners with results reported for all non-duplicated acres with activities accomplished through these funds (e.g. acres of exotics removed or treated, miles of burn breaks installed or acres of prescribed burns, acres of seed harvest, acres planted, etc. All restoration will use seeds or plants of a local ecotype, collected whenever possible from onsite or within 25 miles.

Summary Budget Information for Result 1:

	M.L. 2008	M.L. 2009	Total
Trust Fund Budget:	**$61,335**	**$60,000**	**$121,335**
Amount Spent:	**$61,335**	**$44,748**	**$106,083**
Balance:	**$0**	**$15,252**	**$15,252**

Deliverable	Completion Date	Budget
1. M.L. 2008: 20 acres restoration activities (includes restoration/reconstruction, invasives species control & woody encroachment removal, prescribed burning, and site development)	June 30, 2009	$61,335
2. M.L. 2009: ~10 acres restoration/reconstruction	June 30, 2011	$11,000
3. M.L. 2009: ~20 acres invasive species control & woody encroachment removal	June 30, 2011	$12,000
4. M.L. 2009: ~120 acres prescribed burning	June 30, 2011	$18,000
5. M.L. 2009: site development at ~ 4 SNAs	June 30, 2011	$7,000
6. M.L. 2009: ~ 2 management plan (updates or new)	March 1, 2011	$11,000

Completion Date: M.L. 2008: June 30, 2009; M.L. 2009: June 30, 2011

Result Status as of February 1, 2009: To date, a total of 9.5 acres of restoration and enhancement activities have been completed including: 4.5 acres of fen restoration at Seminary Fen SNA; 4.5 acres of prairie and savanna restoration (woody encroachment removal) at 5 SNAs in 3 counties (River Terrace Prairie, Spring Creek Prairie, Uncas Dunes, Grey Cloud Dunes, and St. Croix Savanna); 0.5 acres of woodland restoration (buckthorn removal) at Wood-Rill SNA; as well as preparation for spring prescribed burns (including mowing 2 miles of burn breaks) at 8 SNAs. (See Table 1 for a specific list of sites and activities to date.)

Result Status as of December 8, 2009: Result 1 (restoration and enhancement work) under the 2008 funding was completed with improvements to 266 acres. Accomplishments include 17.8 acres of woody encroachment-invasives removal at 6

sites; 213.5 acres of prescribed burns at 5 sites; 35 acres of herbaceous exotics treatment at 3 sites; and reconstructing .4 miles of deer exclosure fencing at 1 site. In addition, 9.4 miles of burn breaks were completed and other prescribed burn preparation done at 3 sites that were not able to be burned in spring 2009. (See list of accomplishments by site in Table 1a).

Restoration and enhancement work was initiated through 2009 funding at 7 sites with accomplishments including 14 acres of herbaceous exotics treatment and over 1 mile of burn breaks completed. (See list of accomplishments by site in Table 1b).

Result Status as of February 1, 2010: To date with the 2009 funding, in total restoration and enhancement work was initiated at 9 sites with accomplishments including 14 acres of herbaceous exotics treatment and over 1 mile of burn breaks completed. (See list of accomplishments by site in Table 1b).

M.L. 2008 Final Report Summary: Restoration and enhancement activities (prescribed burning and invasives treatment) were completed on 266.7 acres, plus .4 miles of deer exclosure fencing was reconstructed – resulting in native habitat enhancement at 11 SNAs in 6 counties – see Table 1b.

Result Status as of August 1, 2010: In FY10 (through June 2010), restoration and enhancement activities were completed on 86 acres at 14 sites. This includes invasive species control projects on 34 acres (18 acres of woody encroachment removal and another 16 acres of herbaceous – including 2 acres completed by MCC crews) at 9 sites and installation of signs along 1 mile of perimeter at the new addition to Lost Valley Prairie SNA. The work necessary before doing prescribed burning was done for burn units at 12 SNAs (e.g. installation of 9 miles of burn breaks, preparation of burn plans for 12 SNAs, coordination with local authorities, etc). However, the weather in spring 2010 was so uncharacteristic and difficult for burning (including burn bans that precluded doing burns at all 5 Anoka and Sherburne County SNAs planned and northern fire danger resulting redeployment of MCC that was to do Metro SNA burns) that only 53 acres of burns at 5 sites were completed. For example, significant work went into preparing to do the first DNR prescribed burns at Seminary Fen and a 6+ person crew and equipment were deployed to the site twice because of favorable weather forecasts, but actual conditions didn't allow any acres to burn.

Result Status as of February 1, 2011: <u>For the remainder of calendar year 2010, restoration and enhancement activities were completed 4 sites – including .85 miles of fence repair at Grey Cloud Dunes SNA to prevent ATV trespass and damage to the dune landscape; and parking lot and site clean-up activities were completed at 3 sites. Work is in progress on new adaptive management plans for Grey Cloud Dunes, Hastings Sand Coulee, and other SNAs (paid all or in part through this appropriation). The remaining funds for this result are primary targeted at prescribed burns and restoration seeding in spring 2011 and completion of management plans.</u>

M.L. 2009 Final Report Summary:

Result 2: SNA Acquisition
Description: Through the M.L. 2008 appropriation, the SNA program will acquire and designate as SNA approximately 47 acres (and leverage about 13 acres of acquisition through partner funds – totaling about 60 acres protected) of high priority habitat, i.e. shoreland, riparian land, and other lands critical to implement the State Wildlife Action Plan and protect water quality and rare features.

Through the M.L. 2009 appropriation, about 30 acres of high quality native habitat within the Metro Corridors mapped corridors will be acquired and designated as Scientific and Natural Area (SNA). This will protect rare and endangered plant and animal species, undisturbed plant communities, and geological features, and provide for their public use for scientific study, education, and nature observation.

Very high priority parcels within sites of biodiversity significance will be targeted for protection that have been identified by the Minnesota County Biological Survey, approved as qualifying as SNA by the Commissioners Advisory Committee, are critical to meeting the SNA Long Range Plan, and which help fulfill Habitat Recommendations 1 and 3 of the Statewide Conservation and Preservation Plan (SCPP). Project sites are selected using two sets of criteria a) importance of site for protecting the rare features (e.g. its rareness on national or state scale; its quality and genetic diversity; degree of threat; and protection status in subsection) and b) practical considerations (e.g. feasibility of managing site; landowner willingness; funding for protection and management; and use for research and education).

Through the M.L. 2008 and 09 funding, all or part of about 2-5 sites would be protected at estimated costs of $5,000 to $15,000/acre depending on appraised land values in the location(s) being acquired. These funds would be targeted at sites that will not be protected through currently available ENRTF and bonding funds within the Metro Conservation Corridors mapped corridors – particularly sites with opportunities for collaboration with other MeCC partners. Specifically, to date the sites have been identified as conservation priorities for potential acquisition under this grant are listed in Table 2 and shown in Figure 1.

Summary Budget Information for Result 1:

	M.L. 2008	M.L. 2009	Total
Trust Fund Budget:	**$296,665**	**~~$350,000~~**	**~~$803,665~~**
		$550,000	**$846,665**
Amount Spent:	**$296,665**	**$350,000**	**$646,665**
Balance:	**$0**	**$200,000**	**$200,000**

Deliverable	Completion Date	Budget
1. M.L. 2008: 34.6 acres acquired & designated SNA *Note: $ reduced to 65% original & acres reduced to 72% original as per work program amendment*	June 30, 2009	$296,665

2. M.L. 2009: ~~6.7~~ 36 acres acquired & designated SNA	June 30, 2011	~~$350,000~~ $550,000

Completion Date: M.L. 2008: June 30, 2009; M.L. 2009: June 30, 2011

Result Status as of February 1, 2009: Acquisition is underway (with help of the Friends of the Mississippi River) of a 35-70 acre addition to the Pine Bend Bluffs SNA whose features include native forest mapped by the Minnesota County Biological Survey and Mississippi River frontage and which lies between two existing portions of the SNA. Various scenarios are being appraised in order to reach the best agreement with the current landowners. The proposed acquisition funding includes non-state funds from the Dakota County Farmland and Natural Area Program as well as state Metro Greenways bonding. The project is expected to close in June 2009.

Result Status as of December 8, 2009: Acquisition is underway on three new projects. An addition to the Seminary Fen SNA of up to 21 acres is in appraisal review which includes the best quality calcareous fen in the Seminary Fen complex. A pair of sites totaling about 115 acres in the Twin Lakes area of Isanti County are in the appraisal review (with proposed funding to include federal State Wildlife Grant funds). The approximately 70-acre tract is mainly composed of tamarack and mixed hardwood swamp plant communities with outstanding biodiversity significance. The approximately 45-acre tract is mostly composed of White Pine-Hardwood Forest with high biodiversity significance. These sites would become the new Twin Lakes SNA which is part of a 1340-acre macrosite in southeastern Isanti County proposed by the state's Natural Heritage Program for land protection and conservation. Work on the previously referenced addition to Pine Bend Bluffs SNA is continuing (an offer was made to the landowner who has not yet decided), but that site, if acquired, will be primarily with bonding funds, supplemented as needed with ENRTF. (See Table 2.)

Result Status as of February 1, 2010: By early February 2010, offers will have been made on the two Twin Lakes and one Seminary Fen projects listed above. The acreages of these offers are a 67 acre and 45 acre tract at Twin Lakes and 12.6 acres (encompassing all of the fen, but not the buffer lands) at Seminary Fen. These projects could utilize all the remaining acquisition funds in these appropriations plus the federal funds noted above. Any funds not needed for these projects would be used towards the Pine Bend Bluffs, Hastings Sand Coulee, or Savage Fen project listed on Table 2.

M.L. 2008 Final Report Summary The final outcome of Result 2 (2008 appropriation) is acquisition of a 47.9 acre parcel (34.58 acres pro-rated to this 2008 appropriation – including all transaction and staff costs spent paid for with this 2008 appropriation for all acquisition projects pursued under this appropriation). Specifically, acquisition of the 47.9 acre parcel featuring white pine-hardwood forest of high biodiversity significance and 1450' of Horseshoe Lake shoreline in southeast Isanti County closed and was designated as the Twin Lakes SNA on June 28-29,

2010. In addition to monies through this 2008 appropriation, $114,250 of federal State Wildlife Grant funds contributed to the landowner payment for the Twin Lakes site.

The remainder of this 2008 appropriation (plus some funds from this 2009 appropriation) were allocated to a second 63-acre Twin Lakes acquisition. The offer made in February and a subsequent counter-offer were rejected by the landowner in May 2010.

Amendment Approved June 24, 2010:
The remaining $157,000 was then earmarked for acquisition of a ~70-acre addition to Savage Fen SNA underway in cooperation with the Trust for Public Land which has a purchase agreement with the landowner. This site includes MCBS mapped wetland communities which are integrally part of the calcareous fen complex, MCBS mapped hardwood forest bluffs above the fen complex, and frontage on the Credit River. TPL submitted its appraisal for this project to the DNR for review in January 2010. The SNA program hoped to have by June 2010 a binding agreement with TPL for DNR to acquire the Savage Fen addition. The Savage City Council passed a resolution for the acquisition and designation of the site as SNA on June 7, 2010. But, final appraisal certification was delayed due to a series of requests by the county affecting the legal description and because the appraisal (as submitted) was rejected by the DNR-hired appraisal reviewer due to its assumptions on the level of development that the city would allow. The landowner, TPL, and the DNR are working on several strategies to achieve a DNR certified appraisal within the next few months. Because the Savage Fen project will not have a binding contract on this project by June 30, 2010, the SNA program asked on June 24, 2010 for a work program amendment to transfer $157,000 to the Division of Fisheries for one of their Metro Corridors projects; LCCMR staff indicated preliminary approval of this work program amendment pending these revisions to the work program.

Result Status as of August 1, 2010: The landowner, TPL, and the DNR are continuing to work on several strategies to achieve a DNR certified appraisal within the next few months. Requests of the county have also been addressed which will result in the county/city receiving prior to state acquisition 6.38 acres of the site for road right-of-way and drainage pond. With these conditions, county board approval was received on August 3, 2010. As a result, 68.89 acres is expected to be acquired and designated as SNA. An amended Savage Fen SNA addition timeline to date and proposed budget are in Attachment B1 and B2.

An offer was made in February 2010, but not yet accepted by the landowner to acquire a 12.6-acre addition to the Seminary Fen SNA which includes the best quality calcareous fen in the Seminary Fen complex. Because of this delay and reallocation of 2008 funds to Fisheries, all the remaining 2009 appropriation will be used toward the Savage Fen acquisition (in addition to SNA 2006 bonding, a smaller amount of the ENRTF 2010 SNA appropriation, and partner-secured funds) and the Seminary Fen addition will be moved to acquisition through the 2010 LCCMR appropriation to the SNA program (although all transaction costs to date were previously charged to the 2009 appropriation).

Result Status as of February 1, 2011: The 68.49 acre addition to Savage Fen SNA closed in late November 2010 (pro-rated 6.2 acres with this appropriation – see Attachment B for revised breakdown of sources and amount of landowner payments and donation).

Work Program Amendment Request – January xx, 2011: Pending approval, $200,000 will be reallocated from the Metro Greenways funding within the same appropriation to SNA acquisition. This funding is proposed to go towards acquisition of an 80-acre Holst property proposed as an addition to the Hastings Sand Coulee SNA (now 83 acres). The appraisal is complete and an offer was made to the landowner in early January 2011 (with this appropriation expected to pay for about 30 acres of this acquisition – pending final option agreement). The long, narrow Hastings Sand Coulee area – totaling almost 500 acres mostly in private ownership – is largest remaining prairie complex in Dakota County and is home to 13 rare species including 3 snakes and 2 butterflies. The 80-acre Holst tract immediately adjoins the 78-acre parcel being transferred from DNR Fish and Wildlife Division (Hastings WMA) to DNR Ecological and Water Resources Division to be added to the Hastings Sand Coulee SNA. The SNA program in cooperation with Metro Corridors partner Friends of the Mississippi is also in the process of acquiring a 25.64-acre parcel from the City of Hastings (that adjoins the WMA parcel and is kitty-corner to the Holst property). The Holst tract has dry sand-gravel prairie next to the WMA parcel as well as large area of oak savanna suffering from woody encroachment. Having these 3 contiguous parcels added to the SNA will greatly increase the ability of DNR and FMR to ecologically manage these sites for their phenomenal ensemble of rare species and unique plant communities.

M.L. 2009 Final Report Summary:

V. TOTAL TRUST FUND PROJECT BUDGET:

M.L. 2008

Staff or Contract Services: $58,903 – unclassified acquisition staff – ≤ 0.1 FTE paid exclusively from project funds; and classified DNR crew – equivalent to 0.8 FTE for 1 year – and seasonal burn crew – approx. 7 laborers for 3 weeks).

Equipment: $2,545 (fleet charges and incidental parts for trucks and field equipment).

Development and Restoration: $1,731 (materials and supplies, such as fencing, signs, etc and instate travel needed for restoration and development work by crews)

Acquisition, including easements: $268,650 (towards fee acquisition of about 34 acres, including $24,824 of related real estate transaction costs for this and other projects with offer made under this appropriation and $133 of acquisition related instate travel expenses – not including personnel listed above)

Other: NA

TOTAL TRUST FUND PROJECT BUDGET: $515,000

M.L. 2009

Personnel: $58,000 ~~$55,500~~ (for classified and unclassified SNA program & other DNR staff paid almost exclusively with special project funds: ~ 0.06 FTE acquisition specialist; up to ~0.04 FTE management plan writer- coordinator – new position; up to ~ 0.2 FTE specialists and technicians; and ~ 0.3 FTE laborers and seasonal crews).

Contracts: $5,500 ~~$4,000~~ (MCC and contractors selected through bid process as needed to complete restoration and development projects and SNA adaptive management plans).

Equipment/Tools/Supplies: $3,000 ~~$6,500~~ (truck & equipment fleet charges & incidental parts; materials and supplies, such as fencing, signs, gloves, PPE, chemical, etc.)

Acquisition, including easements: $542,991 ~~$342,000~~, (towards fee acquisition of about ~~6.7~~ 36 acres to be owned by DNR & designated SNA; including related real estate transaction costs for all projects initiated through this appropriation)

Travel: $509 ~~$2,000~~ (instate travel as needed by land acquisition specialists evaluating site & negotiating with landowners & as needed by project staff for restoration & development work.)

Other:

TOTAL 2009 TRUST FUND PROJECT BUDGET: $610,000 ~~$410,000~~

Explanation of Capital Expenditures Greater Than $3,500: NA

VI. OTHER FUNDS & PARTNERS:

A. Project Partners:

M.L. 2008 & M.L. 2009

SNA will develop and implement its projects in cooperation with Metro Greenways, Friends of the Mississippi River, Friends of the Minnesota Valley, Great River Greening, The Trust for Public Land, and local partners. SNA may also involve the Minnesota Conservation Corps, Sentence to Serve, local groups, and volunteers in project implementation.

B. Other Funds Proposed to be Spent during the Project Period:

M.L. 2008 & M.L. 2009

Restoration/enhancement project work will be supplemented by bonding (estimated at $100,000 not listed as match) and NGO partners using other state or non-state funds (not listed as match). Acquisitions under the M.L. 2008 appropriation are expected to leverage non-state funding and/or landowner donations (estimated at $125,000, listed in Table A of overall Metro Corridors proposal) and be supplemented as needed by state bonding (not listed as match). Funding sources used for acquisition projects done through these appropriations and pro-rated acreages will be reported in work program updates.

C. Spending History:

SNA acquisition, restoration and development project funding targeted at the Metro Corridors received in CY 2005-2008: LCCMR – 2007 SNA Metro Corridors $243K and 2008 SNA Metro Corridors $515K; other State appropriations – RIM Match $78K; federal funds – LAWCON $384K; non-state funds Dakota County $566K and other partner contributions & landowner donations. The SNA program general fund includes approximately $400,000 annually for statewide operations and crew.

D. Time: M.L. 2008: July 1, 2008 – June 30, 2010; M.L. 2009: July 1, 2009 – June 30, 2011.

E. Project Impact and Long-term Strategy:
This project will help protect and perpetuate rare species, SGCNs, and natural features of state significance at 12-17 SNA sites within the Metro mapped corridors the state selected because of their importance and strategic value in protecting these rare resources. As a part of the State Outdoor Recreation system, all of these sites are managed as state SNAs that provide public access and opportunities to the public for nature observation and study.

The SNA Long Range Plan has a goal of protection through SNA designation within each ecological subsection of five occurrences of each native plant community (NPC) and three occurrences of each natural heritage element found in that subsection. The Division of Ecological Resources is in the process of using the recently revised Native Plant Community Classification system to assess the extent of protection for each NPC per subsection – looking at both numbers of occurrences (NPC polygons) and acreage protected. This demonstrates a substantial need for more SNA land acquisition and native habitat restoration/development for at least the next 2 decades. Towards this end, the Division could readily utilize support from the Environment and Natural Resources Trust fund and/or the Lessard Outdoor Heritage Council of $2M to $8M per biennium over this timeframe.

VII. DISSEMINATION: SNA in cooperation with its partners will issue a press release and/or publicize a dedication event for each acquisition completed through this project. Other dissemination of information will be through Metro Corridors partnership, Embrace Open Space, and on the Metro Corridors website.

VIII. REPORTING REQUIREMENTS:
Periodic work program progress reports will be submitted not later than February 1st and August 1st of each year. A final work program report and associated products for M.L. 2008 will be submitted no later than August 1, 2010 as requested by the LCCMR and a final work program report and associated products for M.L. 2009 will be submitted no later than August 1, 2011.

IX. RESEARCH PROJECTS: NA

Attachment A: Budget Detail for 2008 Projects **FINAL** - after amendment to move $s to Fisheries

Project Title: Metro Conservation Corridors - Phase IV - Scientific & Natural Areas - 3(a)2.5 & 3.6

Project Manager Name: Margaret (Peggy) Booth

Trust Fund Appropriation: $358,000

1) See list of non-eligible expenses, do not include any of these items in your budget sheet

2) Remove any budget item lines not applicable

2008 Trust Fund Budget	**Result 1 Budget:**	**Amount Spent** *(12-8-09)*	**Balance** *(12-8-09)*	**FINAL Result 2 Budget:**	**Amount Spent** *(8-3-10)*	**Balance** *(8-3-10)*	**TOTAL BUDGET**	**TOTAL BALANCE**
	SNA Restoration & Enhancement - FINAL			**SNA Acquisition**				
BUDGET ITEM								
PERSONNEL: wages and benefits: Unclassified acquisition staff (approx 0.1 FTE; paid exclusively from project funds) and classifed project crews (paid almost exclusively with special project funds) to carry out restoration and enhancement, amounting to approx. 0.6 FTE over the life of the project and seasonal burn crew (approx 6 laborers for 2 weeks). Fringe varies from 14.8-18%	55,845	55,845	0	3,058	3,058	0	58,903	0
Contracts			0			0	0	0
Professional/technical *(with whom?, for what?)*			0			0	0	0
Other contracts *(with whom?, for what?) list out: personnel, equipment, etc.*			0			0	0	0
Other direct operating costs *(for what? – be specific)*			0			0	0	0
Equipment: car, truck, tractor, trailer & equipment fleet charges & incidental parts for tractor, vehicles, etc.	2,545	2,545	0	0	0	0	2,545	0
Office equipment & computers - NOT ALLOWED unless unique to the project			0			0	0	0
Other Capital equipment *(list specific items)*			0			0	0	0
Land acquisition		0	0	268,650	268,650	0	268,650	0
Land rights acquisition *(less than fee)*			0			0	0	0
Real Estate Transaction Costs (e.g. professional services, survey, AG, title, recording, etc)		0	0	24,824	24,824	0	24,824	0
Printing			0			0	0	0
Other Supplies: e.g. fencing, exclosure matls, signs, seeds, gloves, chemical, etc	1,248	1,248	0		0	0	1,248	0
Travel expenses in Minnesota	1,214	1,214	0	133	133	0	1,347	0
Travel outside Minnesota *(where?)*			0			0	0	0
Construction *(for what?)*			0			0	0	0
Other land improvement: direct expenses not included above for purposes of meeting min. standards & restoration	483	483	0		0	0	483	0
Other *(Describe the activity and cost) be specific*			0			0	0	0
COLUMN TOTAL	**$61,335**	**$61,335**	**$0**	**$296,665**	$296,665	$0	$358,000	$0

Table 2. Potential 2008-09 METRO CORRIDORS Scientific and Natural Area Acquisition

Note: all locations in 2008 work program list are also included in 2009 list. **updated January 2011**

Appr. Year	Location Name	County	Proposed SNA Addition	Proposed New SNA	Estimated Acres	Ecological Features (primary)	Status
2008	Franconia Bluffs	Chisago	x		<1500	forested bluff-floodplain complex along St. Croix R.	32-ac acquisition acquired - with other funding
2008	**Hastings Sand Coulee**	**Dakota**	**x**		**<300**	**dry and-gravel prairie, oak savanna, rare species**	**new 80-acre project candidate for $200K from MGW - offer made in January 2011**
2008	Pine Bend Bluffs	Dakota	x		<200	forested bluff-floodplain, Mississippi R frontage	offer made on addition of up to 71 acres; with majority of funding to be bonding; will close in Dec 2010 but not proposed to include
2008	**Seminary Fen**	**Carver**	**x**		**<100**	**calcareous fen, forested bluff**	**revised offer made on 21 acres - still potential under 2009 MGW $s**
2008	**Twin Lakes**	**Isanti**		**x**	**<800**	**wetland-forest-shallow lake complex**	**47.9 acre site acquired; offer on other acquisition rejected by landowner**
2009	Goodhue Bluffs	Goodhue		x	<1000	forested bluff-floodplain, lower Vermillion R frontage, overlooking Vermillion R bottoms & Mississippi R; is IBA	landowner discussions initated; landowner requests delay in project until plan for proposed trail progresses
2009	**Savage Fen**	**Scott**	**x**		**<370**	**calcareous fen, forested bluff**	**acquisition closed through 3rd party in part with this funding; potential transfer of ~190 acres of USFWS land to SNA in progress**

2008 Project Abstract
For the Period Ending June 30, 2010

PROJECT TITLE: Metro Conservation Corridors (MeCC) Phase lV – The Trust for Public Land Critical Lands Protection Program (3.1)

Project Manager: Becca Nash
Affiliation: The Trust for Public Land
Mailing Address: 2610 University Avenue West, Suite 300
City / State / Zip: Saint Paul, MN 55114
Telephone Number: 651-999-5325 **FAX:** 651-917-2248
E-MAIL: Becca.Nash@tpl.org **WEBSITE:** www.tpl.org
FUNDING SOURCE: Environment and Natural Resources Trust Fund
LEGAL CITATION: ML 2008, [Chap.367], Sec.[2], Subd. 3a.

APPROPRIATION AMOUNT: $475,000

Overall Project Outcome and Results*

In the fourth phase of its Metro Conservation Corridors Critical Lands Protection Program, The Trust for Public Land used $475,000 of Environment and Natural Resources Trust Fund dollars to permanently protect 7.9 acres of land through fee title acquisition as part of a larger purchase of 70 acres of one of the highest quality natural resources sites in Chisago County. The site includes 1/2 mile of shoreline on Green Lake and oak forests, meadows, and wetlands that provide critical habitat for a variety of wildlife & fish, including a number of Species of Greatest Conservation Need such as Bald Eagles, Canada Warblers, and Common Loons, as well as Barred Owls, Downy Woodpeckers, and Red Fox. TPL conveyed the property to Chisago City for protection and creation of a new regional park (Ojiketa Regional Park).

To make the full 70 acre purchase, TPL leveraged the $475,000 in ENRTF dollars with $2,215,000 in non-state funding to protect 36.9 (pro-rated) acres of land. $1,510,000 of this was local funding and $705,000 of this was private ($545,000 in land and $160,00 in cash donated). Additionally, $1,000,000 in state bonding funds were used to protect 16.7 (pro-rated) acres and $510,000 in other ENRTF funds were used to protect 8.5 (pro-rated) acres out of 70 total acres.

*Please note, since two years of ENRTF funding was used for this project, a portion of these results was also reflected in TPL's 2007 MeCC Phase III Final Report.

Project Results Use and Dissemination

TPL distributed information about the Camp Ojiketa protection effort through TPL's "Near You" database (approximately 1,200 email addresses) and provided information to Embrace Open Space for inclusion in its monthly e-newsletter (approximately 800 recipients) and quarterly meetings. Project information was also posted on the TPL website, www.tpl.org; Chisago City's website, www.ci.chisago.mn.us, and the Ojiketa Preservation Society's website http://www.ojiketa.com/2.html. TPL also distributed a press release (attached). The project received wide publicity in the *Pioneer Press*, the *Star Tribune*, local papers and even the *Wall Street Journal* and *USA Today*. The land acquired has been posted.

Trust Fund 2008 Work Program Final Report

Date of Report: 3/26/2010
Trust Fund 2008 Work Program Final Report
Date of Work Program Approval: 6/10/2008
Project Completion Date: 6/30/2010

I. PROJECT TITLE: Metro Conservation Corridors (MeCC) Phase IV – The Trust for Public Land Critical Lands Protection Program (3.1)

Project Manager: Becca Nash
Affiliation: The Trust for Public Land
Mailing Address: 2610 University Avenue West, Suite 300
City / State / Zip: Saint Paul, MN 55114
Telephone Number: 651-999-5325
E-mail Address: becca.nash@tpl.org
FAX Number: 651-917-2248
Web Page address: www.tpl.org

Location: Within mapped Focus Area in the counties of Anoka, Carver, Chisago, Dakota, Goodhue, Hennepin, Isanti, LeSueur, Nicollet, Ramsey, Rice, Scott, Sherburne, Sibley, Washington and Wright. See Figure 1.

Total Biennial Trust Fund Project Budget: Trust Fund Appropriation: $ 475,000
Minus Amount Spent: $ 475,000
Equal Balance: $ 0

Legal Citation: M.L. 2008, Chapter 367, Section 2, Subd. 3a.

Appropriation Language:
Subd. 3. Land and Habitat
(a) Metro Conservation Corridors (MeCC) - Phase IV

$3,150,000 is from the trust fund to the commissioner of natural resources for the fourth appropriation for acceleration of agency programs and cooperative agreements. Of this appropriation, $1,915,000 is for Department of Natural Resources agency programs and $1,235,000 is for agreements as follows: $475,000 with the Trust for Public Land; $92,000 with Friends of the Mississippi River; $111,000 with Great River Greening; $225,000 with Minnesota Land Trust; $225,000 with Minnesota Valley National Wildlife Refuge Trust, Inc.; and $107,000 with Friends of the Minnesota Valley for the purposes of

planning, restoring, and protecting important natural areas in the metropolitan area, as defined under Minnesota Statutes, section 473.121, subdivision 2, and portions of the surrounding counties, through grants, contracted services, conservation easements, and fee title acquisition. Land acquired with this appropriation must be sufficiently improved to meet at least minimum management standards as determined by the commissioner of natural resources. Expenditures are limited to the identified project corridor areas as defined in the work program. This appropriation may not be used for the purchase of residential structures, unless expressly approved in the work program. All conservation easements must be perpetual and have a natural resource management plan. Any land acquired in fee title by the commissioner of natural resources with money from this appropriation must be designated as an outdoor recreation unit under Minnesota Statutes, section 86A.07. The commissioner may similarly designate any lands acquired in less than fee title. A list of proposed restorations and fee title and easement acquisitions must be provided as part of the required work program. All funding for conservation easements must include a long-term stewardship plan and funding for monitoring and enforcing the agreement.

II. & III. FINAL PROJECT SUMMARY:

In the fourth phase of its Metro Conservation Corridors Critical Lands Protection Program, The Trust for Public Land used $475,000 of Environment and Natural Resources Trust Fund dollars to permanently protect 7.9 acres of land through fee title acquisition as part of a larger purchase of 70 acres of one of the highest quality natural resources sites in Chisago County. The site includes 1/2 mile of shoreline on Green Lake and oak forests, meadows, and wetlands that provide critical habitat for a variety of wildlife & fish, including a number of Species of Greatest Conservation Need such as Bald Eagles, Canada Warblers, and Common Loons, as well as Barred Owls, Downy Woodpeckers, and Red Fox. TPL conveyed the property to Chisago City for protection and creation of a new regional park (**Ojiketa Regional Park**).

To make the full 70 acre purchase, TPL leveraged the $475,000 in ENRTF dollars with **$2,215,000** in non-state funding to protect 36.9 (pro-rated) acres of land.

$1,510,000 of this was local funding and $705,000 of this was private ($545,000 in land and $160,00 in cash donated). Additionally, **$1,000,000** in state bonding funds were used to protect 16.7 (pro-rated) acres and $510,000 in other ENRTF funds were used to protect 8.5 (pro-rated) acres out of 70 total acres.

*Please note, since two years of ENRTF funding was used for this project, a portion of these results was also reflected in TPL's 2007 MeCC Phase III Final Report

IV. OUTLINE OF PROJECT RESULTS*:*

Result 1: Acquire Significant Habitat

On December 17, 2008, TPL purchased the 70-acre property on Green Lake in Chisago County known as Camp Ojiketa and conveyed the property to Chisago City to be protected and managed as a new regional park and natural area.

Located in a recognized corridor of significance for wildlife, Camp Ojiketa features over 1/2 mile of shoreline on Green Lake and is one of the highest quality natural resources sites in Chisago County because of its oak forests, meadows, wetlands, and lakeshore.

Protection of Camp Ojiketa now ensures that critical habitat remains intact for a variety of wildlife & fish, including a number of Species of Greatest Conservation Need such as Bald Eagles, Canada Warblers, and Common Loons, as well as Barred Owls, Downy Woodpeckers, and Red Fox. The property's shoreline can continue to provide important spawning habitat for walleye, northern pike, black crappie and other fish species found in Green Lake.

The site's location in a high growth area less than 30 miles from downtown St. Paul makes it an excellent place for people to enjoy nature through hiking, biking, fishing, canoeing, and environmental education close to home. (See map attached.)

For over 80 years, thousands of young people learned about nature and stewardship at Camp Ojiketa on the beautiful shores of Green Lake in Chisago County. There they truly experienced the "sweetness of life" as the name means in Ojibwa. However, to meet financial obligations and reflect changing priorities, Camp Fire USA announced in 2006 that it was putting the property up for sale.

This news, and subsequent news of a proposed commercial or residential development, caused a group of Camp Fire alumni to organize to save the land. Chisago City and the alumni initially attempted to make the land a park, but were unsuccessful. They then turned to TPL for help structuring and funding a deal that would preserve the land for the benefit of the public.

After many months of negotiations, in early 2008, TPL secured an option good through December 31, 2008 to purchase the land.

During the one-year option period, TPL performed all of the necessary due diligence on the property including having the property appraised, having several environmental assessments conducted, causing Camp Fire to clean up a number of

items at the site, conducting title investigation, and working with Camp Fire to cure a number of title issues. TPL led efforts to identify and secure the funds for the purchase of this property, which included applying for public grants, applying for private grants, working with local legislators to seek funding from the legislature, and private fundraising from individuals. TPL also worked with the City to help develop its vision and commitment to the preservation of this site. TPL further worked with the City, camp alumni and local legislators to inform the public about this project, including organizing the support needed for grant-making purposes.

TPL has submitted the Initial Land Acquisition Report to the LCCMR and has notified the City of Chisago of the transfer of this responsibility to them.

The project received wide publicity in the *Pioneer Press*, the *Star Tribune*, local papers and even the *Wall Street Journal* and *USA Today*. Formal supporters included Wild River Audubon, Chisago Soil and Water Conservation District, Green Lake Association, Chisago City, Chisago County, Ojiketa Preservation Society, DNR Fisheries Division, Sen. Rick Olseen, and Rep. Jeremy Kalin. Ultimately, funding came from a variety of sources as is detailed below.

Camp Ojiketa Acquisition, Chisago City MN

Funding Source**	Partner on Camp Ojiketa project	Amount of funding for land acquisition costs	Allocated Acreage	Recipient of Grant Funds (if applicable)
State Funds				
State Bonding - DNR Non-Metro Regional Park Grant Program	DNR	$1,000,000	16.7	Chisago City
ENTF - Metro Wildlife Corridors Phase IV 2008 (TPL)	TPL	$475,000	7.9	TPL
ENTF Metro Wildlife Corridors Phase III 2007 (TPL)	TPL	$410,000	6.8	TPL
ENTF - Metro Greenways (DNR)	DNR	$100,000	1.7	Chisago City
	Sub Total	**$1,985,000**		
Local Government Funds				
City Bonding	Chisago City	$1,500,000	25.0	
Chisago Lakes Lake Improvement District	TPL	$10,000	0.2	Chisago City
	Sub Total	**$1,510,000**		
Private Funds				
Private Fundraised, received directly by TPL*	TPL	$94,800	1.6	TPL
Private Fundraised, received directly by Chisago City*	TPL & Ojiketa Preservation Society	$65,200	1.1	Chisago City
Camp Fire USA-Negotiated reduction in sales price from appraised value	TPL	$545,000	9.1	NA
	Sub Total	**$705,000**		
	TOTAL	**$4,200,000**	**70.0**	

*Donors were given the option to send donations to either the City or TPL

** Please note that total Environment and Natural Resources Trust Fund funding equals $985,000, total other state (bond) funding is $1M, total non-state public funding is $1.510M, total private funding is $705K.

Summary Budget Information for Result 1: **Trust Fund Budget $ 475,000**
Amount Spent: $ 475,000
Balance $ 0

V. TOTAL TRUST FUND PROJECT BUDGET:

All Results: Staff or Contract Services: $ 0
All Results: Equipment: $ 0
All Results: Development: $ 0
All Results: Acquisition, including easements: $ 475,000
All Results: Other: $ 0

TOTAL TRUST FUND PROJECT BUDGET: $ 475,000

Explanation of Capital Expenditures Greater Than $3,500: N/A

VI. OTHER FUNDS & PARTNERS:

A. Project Partners: TPL coordinated its work with other Metro Conservation Corridor partners (See Table A). In addition, project cooperators included Campfire USA, Chisago City, DNR's Metro Greenways Program, DNR's Non-Metro Regional Park Grant Program, Chisago Lakes Lake Improvement District, Wild River Audubon, Chisago Soil and Water Conservation District, Green Lake Association, Chisago County, Ojiketa Preservation Society, DNR Fisheries Division, Sen. Rick Olseen, and Rep. Jeremy Kalin. The Trust for Public Land transferred its interests in the land to Chisago City.

B. Other Funds Spent during the Project Period: As shown in the funding chart under Result 1, **$**985,000 ENRTF funding for the land acquisition leveraged $3.215 million non- ENRTF funds for the land acquisition. These non-ENRTF funds included $1,000,000 other state funds, $1,510,000 local funds, and $705,000 private funds.

C. Past Spending:

Land Protected	ENRTF Appropriation Year	ENRTF Amount Spent by TPL	ENRTF Amount Spent by Partners	Non-ENRTF Amount Leveraged
East Rush Lake AMA/WMA	2005	$100,000	$200,000	$303,000
Horseshoe Lake Regional Park	2005	$100,000	$100,000	$956,000
Franconia Bluffs SNA	2005	$420,000	$0	$105,000
Franconia Bluffs SNA	2007	$ 10,000	$0	
Camp Ojiketa on Green Lake	2007	$410,000	$100,000	$3,215,000

Camp Ojiketa on Green Lake	2008	$475,000		
Total		**$1,515,000**	**$400,000**	**$4,579,000**

D. Time: 2 years, until June 30, 2010.

VII. DISSEMINATION:

TPL distributed information about the Camp Ojiketa protection effort through TPL's "Near You" database (approximately 1,200 email addresses) and provided information to Embrace Open Space for inclusion in its monthly e-newsletter (approximately 800 recipients) and quarterly meetings. Project information was also posted on the TPL website, www.tpl.org; Chisago City's website, www.ci.chisago.mn.us, and the Ojiketa Preservation Society's website http://www.ojiketa.com/2.html. TPL also distributed a press release (attached). The project received wide publicity in the *Pioneer Press*, the *Star Tribune*, local papers and even the *Wall Street Journal* and *USA Today*. The land acquired has been posted.

VIII. REPORTING REQUIREMENTS: Periodic work program progress reports were submitted as required and as requested by the LCCMR.

Attachment A: Budget Detail for 2008 Metro Corridors Project **Date: March 25, 2010**
Title: Metropolitan Area Conservation Corridors Phase IV – The Trust for Public Land Critical Lands Protection Program (3.1)

Partner Project Manager Name: **Becca Nash**

Trust Fund Appropriation: **$475,000**

2008 Trust Fund Budget	Result 1 Budget ($)	Amount Spent (Date) ($)	Balance (Date) ($)	Comments
ACQUISITION				
Land acquisition *(fee title & conservation easement)*	$475,000	$475,000		To protect 70 acres at Green Lake/Camp Ojiketa, a project that also used the remaining balance of TPL's Phase III 2007 MeCC funding
COLUMN TOTAL	$475,000	$475,000	$0	

2008 Project Abstract
For the Period Ending June 30, 2010

TITLE:	Metro Conservation Corridors – Phase IV Protecting Significant Habitat by Acquiring Conservation Easements - 3.2
PROJECT MANAGER:	Sarah Strommen
ORGANIZATION:	Minnesota Land Trust
ADDRESS:	2356 University Avenue West, Suite 240 St. Paul, MN 55114
WEB SITE ADDRESS:	www.mnland.org
FUND:	Environmental and Natural Resources Trust Fund
LEGAL CITATION:	Minnesota Laws 2008, Chapter 367, Section 2, Subdivision 4(c)

APPROPRIATION AMOUNT: $225,000

OVERALL PROJECT OUTCOME AND RESULTS

During the fourth phase of the Metro Corridors project, the Minnesota Land Trust continued to work with landowners throughout the greater metropolitan area to permanently protect lands that are key components of Minnesota's remaining natural areas in the region. Six perpetual conservation easements were completed that collectively protect 960 acres of land and more than 16,600 feet of shoreline. Two easements were purchased, both at a bargain price. The remaining 4 easements were donated. All six projects represent unique opportunities to protect high quality natural habitat, riparian areas, and to build upon prior land protection work by the Land Trust at four priority sites.

Additionally, the Land Trust prepared baseline property reports for each easement, detailing the condition of the property for future monitoring and enforcement. To fund this required perpetual obligation, the Land Trust dedicated funds to its segregated Stewardship and Enforcement Fund for several completed projects. For these projects, we estimated the anticipated annual expenses of each project and the investment needed to generate annual income sufficient to cover these expenses in perpetuity – all in accordance with our internal policies and procedures as approved by LCCMR. We will report to LCCMR annually on the status of the Stewardship and Enforcement Fund and the easements acquired with funds from this grant.

The value is known for only two of the easements, but this value is $781,200, with a known donated value of $306,200. The cost to the State of Minnesota to complete these projects was just over $312 per acre (other State funds came from the Metro Greenways program to purchase one easement).

Cumulatively, across all phases of the Metro Corridors program, the Land Trust has protected 2,533 acres of critical habitat and nearly 42,000 feet of shoreline, at a cost to the State of $578 per acre.

The Land Trust's work on this project demonstrates the continued cost effectiveness of working with conservation easements to protect natural and scenic resources within developed and developing areas, as the cost to the State was well below the cost to purchase land in the Twin Cities region. This grant continued to generate interest among landowners, and therefore, ongoing funding will be important to sustained success. Additionally, our experiences during this phase of the grant continue to indicate that funds to purchase easements will be necessary in the future if work becomes more targeted, selective, and focused on building complexes of protected land.

PROJECT RESULTS USE AND DISSEMINATION

The Land Trust continued to gain more experience with conservation easements, easement management, and issues unique to protecting land in a metropolitan area. This experience and information was shared with our partner organizations, other easement holders, local communities, as well as policy makers. The Land Trust also disseminated information about the specific land protection projects completed under this grant though our newsletter, annual report, web site, and press releases.

Trust Fund 2008 Work Program Final Report and Trust Fund 2009 Work Program and Trust Fund 2010 Work Program

Date of Report: February 1, 2010
Trust Fund 2008 Work Program Final Report

Date of Next 2009 & 2010 Status Report: August 1, 2010

	M.L. 2008	M.L. 2009	M.L. 2010
Date of Work program Approval:	June 10, 2008	June 16, 2009	
Project Completion Date:	June, 30 2010	June 30, 2011	June 30, 2012

I. PROJECT TITLE: Metro Conservation Corridors - Phase IV
Protect Significant Habitat by Acquiring Conservation Easements [M.L. 2008]
Metro Conservation Corridors – Phase V
Protect Significant Habitat by Acquiring Conservation Easements [M.L. 2009]
Metro Conservation Corridors – Phase V Supplemental
Protect Significant Habitat by Acquiring Conservation Easements [M.L. 2010]

Project Manager: Sarah Strommen, Conservation Director, Central Region
Affiliation: Minnesota Land Trust
Mailing Address: 2356 University Avenue West, Suite 240
City / State / Zip : St. Paul, MN 55114
Telephone Number: 651-647-9590
E-mail Address: sstrommen@mnland.org
FAX Number: 651-647-9769
Web Page address: www.mnland.org

Location: Within mapped corridors (see map included with overall work program) in the counties of Anoka, Carver, Chisago, Dakota, Goodhue, Hennepin, Isanti, LeSueur, Nicollet, Ramsey, Rice, Scott, Sherburne, Sibley, Washington and Wright.

Total Trust Fund Project Budget:	**M.L. 2008**	**M.L. 2009**	**M.L. 2010**	**Total**
Trust Fund Appropriation:	**$225,000**	**$250,000**	**$485,000**	**$960,000**
Minus Amount Spent:	**$225,000**	**$32**	**$0**	**$225,032**
Equal Balance:	**$ 0**	**$249,968**	**$485,000**	**$734,968**

Legal Citation:
ML 2008, Chapter 367, Section 2, Subdivision 3(a)

Appropriation Language:
$3,150,000 is from the trust fund to the commissioner of natural resources for the fourth appropriation for acceleration of agency programs and cooperative agreements. Of this appropriation, $1,915,000 is for Department of Natural Resources agency programs and $1,235,000 is for agreements as follows: $475,000 with the Trust for Public Land; $92,000 with Friends of the Mississippi River; $111,000 with Great River Greening; $225,000 with Minnesota Land Trust; $225,000 with Minnesota Valley National Wildlife Refuge Trust, Inc.; and $107,000 with Friends of the Minnesota Valley for the purposes of planning, restoring, and protecting important natural areas in the metropolitan area, as defined under Minnesota Statutes, section 473.121, subdivision 2, and portions of the surrounding counties, through grants, contracted services, conservation easements, and fee title acquisition. Land acquired with this appropriation must be sufficiently improved to meet at least minimum management standards as determined by the commissioner of natural resources. Expenditures are limited to the identified project corridor areas as defined in the work program. This appropriation may not be used for the purchase of residential structures, unless expressly approved in the work program. All conservation easements must be perpetual and have a natural resource management plan. Any land acquired in fee title by the commissioner of natural resources with money from this appropriation must be designated as an outdoor recreation unit under Minnesota Statutes, section 86A.07. The commissioner may similarly designate any lands acquired in less than fee title. A list of proposed restorations and fee title and easement acquisitions must be provided as part of the required work program. All funding for conservation easements must include a long-term stewardship plan and funding for monitoring and enforcing the agreement.

Legal Citation: M.L. 2009, Chapter 143, Section 2, Subdivision 4(f)
Appropriation Language:
$3,375,000 is from the trust fund to the commissioner of natural resources for the sixth appropriation for acceleration of agency programs and cooperative agreements. Of this appropriation, $770,000 is for the Department of Natural Resources agency programs and $2,605,000 is for agreements as follows: $450,000 with Pheasants Forever; $50,000 with Minnesota Deer Hunters Association; $895,000 with Ducks Unlimited, Inc.; $85,000 with National Wild Turkey Federation; $365,000 with the Nature Conservancy; $210,000 with Minnesota Land Trust; $350,000 with the Trust for Public Land; $100,000 with Minnesota Valley National Wildlife Refuge Trust, Inc.; $50,000 with the United States Fish and Wildlife Service; and $50,000 with Friends of Detroit Lakes Watershed Management District to plan, restore, and acquire fragmented landscape corridors that connect areas of quality habitat to sustain fish, wildlife, and plants. The United States Department of Agriculture-Natural Resources Conservation Service is a cooperating partner in the appropriation. Expenditures are limited to the project corridor areas as defined in the work program. Land acquired with this appropriation must be sufficiently improved to meet at least minimum habitat and facility management standards as determined by the commissioner of natural resources. This appropriation may not be used for the purchase of residential structures, unless expressly approved in the work program. All conservation easements must be perpetual and have a natural resource management plan. Any land acquired in fee title by the commissioner of natural

resources with money from this appropriation must be designated as an outdoor recreation unit under Minnesota Statutes, section 86A.07. The commissioner may similarly designate any lands acquired in less than fee title. A list of proposed restorations and fee title and easement acquisitions must be provided as part of the required work program. All funding for conservation easements must include a long-term stewardship plan and funding for monitoring and enforcing the agreement. To the maximum extent practical, consistent with contractual easement or fee acquisition obligations, the recipients shall utilize staff resources to identify future projects and shall maximize the implementation of biodiverse, quality restoration projects in the project proposal into the first half of the 2010 fiscal year.

Legal Citation: M.L. 2010, Chapter ___, Section ___, Subdivision ___
Appropriation Language:

II. PROJECT SUMMARY AND RESULTS:

M.L. 2008 Final Project Summary:
During the fourth phase of the Metro Corridors project, the Minnesota Land Trust continued to work with landowners throughout the greater metropolitan area to permanently protect lands that are key components of Minnesota's remaining natural areas in the region. Six perpetual conservation easements were completed that collectively protect 960 acres of land and more than 16,600 feet of shoreline. Two easements were purchased, both at a bargain price. The remaining 4 easements were donated. All six projects represent unique opportunities to protect high quality natural habitat, riparian areas, and to build upon prior land protection work by the Land Trust at four priority sites.

Additionally, the Land Trust prepared baseline property reports for each easement, detailing the condition of the property for future monitoring and enforcement. To fund this required perpetual obligation, the Land Trust dedicated funds to its segregated Stewardship and Enforcement Fund for several completed projects. For these projects, we estimated the anticipated annual expenses of each project and the investment needed to generate annual income sufficient to cover these expenses in perpetuity – all in accordance with our internal policies and procedures as approved by LCCMR. We will report to LCCMR annually on the status of the Stewardship and Enforcement Fund and the easements acquired with funds from this grant.

The value is known for only two of the easements, but this value is $781,200, with a known donated value of $306,200. The cost to the State of Minnesota to complete these projects was just over $312 per acre (other State funds came from the Metro Greenways program to purchase one easement).

Cumulatively, across all phases of the Metro Corridors program, the Land Trust has protected 2,533 acres of critical habitat and nearly 42,000 feet of shoreline, at a cost to the State of $578 per acre.

The Land Trust's work on this project demonstrates the continued cost effectiveness of working with conservation easements to protect natural and scenic resources within developed and developing areas, as the cost to the State was well below the cost to purchase land in the Twin Cities region. This grant continued to generate interest among landowners, and therefore, ongoing funding will be important to sustained success. Additionally, our experiences during this phase of the grant continue to indicate that funds to purchase easements will be necessary in the future if work becomes more targeted, selective, and focused on building complexes of protected land.

M.L. 2009: The Minnesota Land Trust will protect up to 150 acres of land by acquiring 4-6 conservation easements in various project focus areas.

These acreage and project goals are based on estimates of 25-40 acres per project. Actual project acreages and numbers will vary. Potential projects are identified on the attached list.

We will work with landowners willing to protect their land through perpetual conservation easements drafted to: prohibit land uses that could negatively impact identified important riparian, habitat, or scenic values, require natural resource habitat management plans where appropriate, and direct the use of native vegetation where appropriate in conjunction with any required restoration.

We will work with donated easements whenever possible and will purchase easements where necessary.

The budget incorporates the critical components of an easement program: identifying and negotiating with landowners, drafting and completing easements, documenting property conditions, and monitoring and enforcing easements in perpetuity by dedicating funds for long-term easement stewardship.

Funds will be used for staff time, direct payments to landowners, and transactional expenses such as appraisals, title review, and mapping. Funds also may be requested for the Stewardship and Enforcement Fund to provide for the long-term management and enforcement of easements on a project-by-project basis. We will estimate anticipated annual expenses for each project and the investment needed to generate annual income sufficient to cover expenses in perpetuity--all in accordance with our policies and procedures. The Land Trust will report to LCCMR annually on the status of the Stewardship and Enforcement Fund and the easements acquired with funds from this grant.

M.L. 2010: The Minnesota Land Trust proposes to use its 2010 allocation of $485,000 as a supplement to the 2009 phase of this grant to complete 1-2 urgent projects that require capital funding. The Minnesota Land Trust will protect up to 40-80 acres of high-quality forest and wetland habitats by securing permanent conservation easements and dedicating funds for the perpetual monitoring, management, and enforcement of those easements. One of the easements is anticipated to be co-held with the Anoka Conservation District.

III. PROGRESS SUMMARY AS OF FEBRUARY 1, 2010:

M.L. 2009

2009 Goal: **150 acres**
Number of Easements Completed:
Total Acres of Easements Completed:
Total Acres of Potential Easements: **3,328 acres**

The Land Trust only recently began work on Phase 5 of this grant in December 2009. To date we have continued negotiations with several landowners whose projects were initiated in earlier phases and continued to identify and contact new landowners. An updated project list is attached.

M.L. 2010

2010 Goal: **40-80 acres**
Number of Easements Completed:
Total Acres of Easements Completed:
Total Acres of Potential Easements:

IV. OUTLINE OF PROJECT RESULTS*:*

Result 1: Protect Significant Habitat by Acquiring Conservation Easements

Description: For both the 2008 and 2009 phases of the Metro Conservation Corridors, the Minnesota Land Trust will protect critical habitat the mapped corridors by identifying and contacting interested landowners, negotiating and completing 4-6 permanent conservation easements on up to 150 acres of land, and dedicating funds for the perpetual monitoring, management and enforcement of the easements.

The Land Trust will work in any of the mapped corridors and currently has numerous projects pending. Current potential projects are identified on the attached list and map. We will continually evaluate these projects and pursue those that protect the highest quality habitat, maximize public benefit, and would be most appropriate to complete each of the two phases of the grant. While some of these projects may not be completed at all, new projects will be added as landowners are identified.

The 2010 grant is supplemental to the 2009 grant. With this supplemental funding, the Land Trust will complete 1-2 urgent projects that require capital funding. The Minnesota Land Trust will protect up to 40-80 acres of high-quality forest and wetland habitats by securing permanent conservation easements and dedicating funds for the perpetual monitoring, management, and enforcement of those easements.

Summary Budget Information for Result 1:

	M.L. 2008	M.L. 2009	M.L. 2010	Total
Trust Fund Budget:	**$225,000**	**$250,000**	**$485,000**	**$960,000**
Amount Spent:	**$225,000**	**$32**	**$0**	**$225,032**

Balance:	**$0**	**$249,968**	**$485,000**	**$734,968**

Deliverable	Completion Date	Budget
1. M.L. 2008: Identify and contact landowners	Complete	
2. M.L. 2008: Negotiate, draft, and complete 4-6 easements, including completion of baseline documentation.	Complete	
3. M.L. 2008: Dedicate funds for easement stewardship	Complete	
4. M.L. 2009: Protect up to 150 acres by: a. identifying and contacting landowners b. completing 4-6 conservation easements c. dedicating funds to ensure long-term easement sustainability	June 30, 2011	$250,000 a. included in personnel b. included in CE acquisition costs, travel, and personnel c. estimated at $60,000 All as outlined in Attachment A.
5. M.L. 2010: Protect up to 40-80 acres by: a. completing 1-2 conservation easements b. dedicating funds to ensure long-term easement sustainability	June 30, 2012	$485,000 a. included in CE acquisition costs, and personnel b. estimated at $30,000 All as outlined in Attachment A.

Completion Date: M.L. 2008: June 30, 2010; M.L. 2009: June 30, 2011; M.L. 2010: June 30, 2012

M.L. 2008 Final Report Summary:
Under this phase of the Metro Corridors program, the Land Trust met project goals and exceeded acreage goals by completing 6 conservation easements, which collectively protect 960 acres of land and more than 16,600 feet of shoreline. One of the projects was located in the Northwest Area, two in the East Area, and three in the Southeast Area.

All six projects are located within Land Trust priority sites and build upon prior protection work completed under previous phases of this grant or other Land Trust initiatives. Specifically, these parcels met the following project selection criteria:

1. Habitat: quality and quantity of existing habitat on site; protects riparian areas and buffers water resources
2. Context: proximity and relationship to other protected lands
3. Opportunity: cost-benefit ratio: which landowners will participate now

4. Other Benefits: meeting multiple objectives, including visual and physical access, forestry goals, water quality, etc.

Our average parcel size for projects completed under this phase of the grant was approximately 160 acres. This is significantly higher than our typical average parcel size of 50 acres for Metro area projects and a further demonstration of the unique conservation opportunity represented by the properties protected by the Land Trust under this phase of the grant.

Because of the large number of potential conservation projects involved in this grant and because many projects initiated or worked on under this grant are not actually completed in this phase of the project, the Land Trust does not allocate professional services expenses to specific conservation easement projects. Funding that is attributable to a specific project is described below and on the attached summary of purchased easements.

Descriptions and Results by Area:

Northwest Area: Wright, Sherburne, Isanti and Anoka Counties

Acres protected: 56
Easements completed: 1

Project: Rum River
Description: This 56-acre property in Isanti County is situated along the Rum River and features approximately 1,777 feet of river shoreline. The property contains relatively natural fish and wildlife habitat provided by the Rum River and its associated floodplain forest, along with rolling grasslands, wetlands and agricultural fields. The floodplain forest of the property has been mapped and identified as a high quality native community by the Minnesota County Biological Survey. This parcel is the sixth property that the Land Trust has protected along the Rum River.

The value of this easement is unknown. $12,000 of ENRTF funds were used to cover stewardship on this project. Additionally, the Land Trust received an unsolicited donation of $300 from the landowner for the Land Trust's operating fund. This donation will help cover costs not funded by the ENRTF.

East Area: Chisago and Washington Counties

Acres protected: 269
Easements completed: 2

Project: Sunfish Lake Park
Description: This 256-acre property in Washington County is a public city park within the City of Lake Elmo. The park is used primarily for low-impact recreation, and there is a trail system for walking, hiking, and horseback riding. The property consists mainly of forested rolling hills with cherry, oak, maple, birch, and bittersweet trees. The property also contains a portion of Sunfish Lake, thereby providing an important public access to the lake. This parcel

also lies adjacent to several other properties previously protected by the Land Trust and therefore adds to a larger complex of protected lands. After completing the conservation easement, the City is now working aggressively on restoration and management of the park. The City recently obtained a Metro Greenways grant to assist with restoration.

The value of this easement is unknown. $10,000 to cover stewardship was provided by the landowner.

Project: Valley Creek
Description: This 13-acre property in Washington County is varied in topography and predominately oak woodland. Valley Creek, a designated trout stream, flows through this corner of the property. *Besseya bullii*, a perennial kitten-tail that has been state-listed as "threatened," has been found and documented on the property. The property is bordered to the north and west by Belwin Conservancy property that is protected with a conservation easement held by the Minnesota Land Trust. Valley Creek is an area of focus for the Land Trust, and protection of this parcel is an important piece of this larger effort.

The value of this easement is $180,000. The Land Trust purchased the easement for $150,000 using $75,000 Metro Greenways grant dollars and $75,000 from The Conservation Fund/Doris Duke Charitable Foundation. $15,000 of ENRTF funds were used to cover stewardship on this project. Additional detail is provided in the attached Summary of Purchased Easements.

Southeast Area: Dakota and Goodhue Counties
Acres protected: 635
Easements completed: 3

Project: Bullard Creek
Description: This project in Goodhue protects 193 acres near the City of Red Wing and is the second easement project completed by the same family. The protected property contains relatively undisturbed natural areas with high quality examples of terrestrial communities including hardwood forest and dry bluff prairie. The property also includes 2,957 feet of shoreline along an intermittent stream that flows directly into Bullard Creek, a MN DNR-designated trout stream. Additionally protection of this parcel helps advance a long-standing effort by the Land Trust and the City of Red Wing to protect high priority natural lands in and around the City.

The value of this easement is $601,200. The Land Trust purchased the easement for $325,000 using $100,000 of ENRTF funding from this grant, $150,000 from the Doris Duke Charitable Foundation, and $75,000 from the Minnesota Land Trust Acquisition Fund. $15,000 of ENRTF funds were used to cover stewardship on this project. Additional detail is provided in the attached Summary of Purchased Easements.

Project: Red Wing
Description: This 414-acre property in Goodhue County features approximately 5,275 linear feet of shoreline on Spring Creek, a designated trout stream, which meanders through the central portion of the property. The property also contains small openings of dry prairie bedrock bluff, as well as hillsides covered in hardwood forest. The Protected Property contains several sites identified and listed as significant archeological sites for pre-settlement Native Americans, as identified by the Minnesota Institute of Archaeology. Additionally, protection of this parcel helps advance a long-standing effort by the Land Trust and the City of Red Wing to protect high priority natural lands in and around the City.

The value of this easement is unknown. $18,000 for easement stewardship is being provided by the landowner.

Project: Red Wing
Description: This 28-acre property in Goodhue County is located in the City of Red Wing. It is close to the Cannon River and is situated between two noncontiguous parcels of the Cannon River Turtle Preserve Scientific and Natural Area. The entire property consists of Silver Maple-Green Ash-Cottonwood Terrace floodplain forest. This forest type is considered rare or uncommon in Minnesota and provides habitat for a variety of species in greatest conservation need. Additionally, protection of this parcel helps advance a long-standing effort by the Land Trust and the City of Red Wing to protect high priority natural lands in and around the City.

The value of this easement in unknown. Funding for easement stewardship is being provided by the landowner and is included in the amount for the above listed project.

Result Status as of February 1, 2010:

M.L. 2009: The Land Trust only recently (December 2009) commenced this phase of the grant. We are continuing to work on several projects started under previous phases. We anticipate three projects to close by June 30, 3010. Additionally, we continue to identify new landowners. An updated project list is attached.

M.L. 2010: This phase is pending action from the Minnesota Legislature.

Result Status as of August 1, 2009:

M.L. 2009: We have not yet started the 2009 phase of this grant.

Result Status as of May 1, 2009:

M.L. 2009: We have not yet started the 2009 phase of this grant.

Result Status as of August 1, 2010:

Result Status as of February 1, 2011:

M.L. 2009 Final Report Summary:

Result Status as of August 1, 2011:

Result Status as of February 1, 2012:

M.L. 2010 Final Report Summary:

V. TOTAL TRUST FUND PROJECT BUDGET:

M.L. 2008

Staff or Contract Services: $56,201 to cover a portion of the salaries and related benefits of staff working on projects funded under this grant--approximately .50 FTE conservation program staff and .25 FTE conservation, legal and other support staff.
Acquisition, including easements: $124,903 to acquire 6 conservation easements held by the Minnesota Land Trust. $100,000 was spent on the direct cost of acquiring an easement where the landowner was not be able to donate the full value of the easement. The remaining funds were used for related transaction costs such as for appraisals, surveys, title work, mapping, etc.
Stewardship: $42,000 dedicated to the Stewardship and Enforcement Fund. Actual amounts committed for stewardship were calculated on a project-by-project basis depending on the number and nature of specific projects and the availability of other funds. We did not need to use this grant to cover all stewardship costs for completed projects due to landowner contributions.
Travel: $1,896 to cover mileage and related travel expenses within Minnesota.
TOTAL 2008 TRUST FUND PROJECT BUDGET: $ 225,000

M.L. 2009

Personnel: $70,000 to cover a portion of the salaries and related benefits of staff working on projects funded under this grant—approximately .75 FTE conservation program staff and .25 legal and other support staff.
Acquisition, including easement: $118,000 to acquire 4-6 conservation easements protecting up to 150 acres of land to be held by the Minnesota Land Trust. A limited amount may be used for the direct cost of acquiring easements where landowners are not be able to donate the full value of an easement. The remaining funds will be used for related transaction costs such as for appraisals, surveys, title work, mapping, etc. NOTE: Exact amounts are not known at this time. Transaction costs are higher for purchases than donations and amounts will be allocated as specific projects are identified for completion under this grant.
Travel: $2,000 to cover mileage and related travel expenses in Minnesota.
Stewardship: $60,000 to be dedicated to the Stewardship and Enforcement Fund. Actual amounts committed for stewardship will depend upon the number and nature

of specific projects completed and the availability of other funds. Currently, typical stewardship fund requests are approximately $12,000-15,000 per project.
TOTAL 2009 TRUST FUND PROJECT BUDGET: $ 250,000

M.L. 2010
Personnel: $20,000 to cover a portion of the salaries and related benefits of staff working on projects funded under this grant
Acquisition, including easements: $435,000
Stewardship: $30,000 to be dedicated to the Stewardship and Enforcement Fund. Actual amounts committed for stewardship will depend upon the number and nature of specific projects completed and the availability of other funds. Currently, typical stewardship fund requests are approximately $12,000-15,000 per project.
TOTAL 2010 TRUST FUND PROJECT BUDGET: $485,000

Explanation of Capital Expenditures Greater Than $3,500: N/A

VI. OTHER FUNDS & PARTNERS:

A. Project Partners: Project partners for 2008, 2009, and 2010 include Metro Conservation Corridors partners (please see overall MeCC work program for list of project partners) and private landowners, local governments, regional, state and federal agencies, nonprofit organizations and citizen groups.

B. Other Funds Spent/Proposed to be Spent during the Project Period: By working to acquire donated conservation easements, or easements through bargain purchases, the Minnesota Land Trust again was able to protect lands at a fraction of what it would cost to purchase comparable lands in fee. The known donated value of easements completed in the 2008 phase is $306,200, but values are known for only two of the six easements completed. Additional funds were spent by the Minnesota Land Trust to cover costs associated with the project not covered by the grant.

The value of donated easements is difficult to predict, but we expect at least one million dollars in leverage for 2009. For 2010, the Land Trust, working with Anoka County, has secured $200,000 through the Metro Greenways Program.

C. Past Spending: The Minnesota Land Trust has received the following from past Metro Corridors grants: $ 230,000 in 2003; $ 230,000 in 2005; $134,000 in 2007; $225,000 in 2008; and $250,000 in 2009.

D. Time: For the 2008 phase, work was initiated in October 2008 and was completed in January 2010. For the 2009 phase, funds will extend over the two years of the grant, starting approximately July 1, 2009 until June 30, 2011. For the 2010 phase, funds are anticipated to be spent in one year, starting approximately July 1, 2010. The 2008, 2009, and 2010 phases are a continuation of the Minnesota Land Trust's exisiting Metro Conservation Corridors Partnership project. Components were designed to be overlapping so that activities could continue seamlessly. For example, we may initiate work with a landowner in one phase of the grant, but the project may not be completed until the next phase.

E. Project Impact and Long-Term Strategy: This project is part of the Land Trust's long-term, strategic conservation agenda. The conservation agenda sets out the specific conservation focus of the Minnesota Land Trust. This focus includes natural habitats for wildlife, fish and plants, lakeshores, rivers and streams, and scenic landscapes accessible or visible to the public. The conservation agenda also identifies a suite of critical landscapes throughout Minnesota that embody the natural and cultural features that make Minnesota unique. The Metropolitan Conservation Corridors is one of the Land Trust's identified critical landscapes – one that addresses the unique conservation challenges that exist in a largely developed area.

VII. DISSEMINATION: For 2008 projects, the Land Trust completed a newsletter article press release for the Valley Creek project (attached) and plans to complete press releases for the Red Wing and Rum River projects. We also held an event in August 2009 to celebrate completion of the Valley Creek project and generate additional interest in conservation in that area. For 2009 and 2010 the Land Trust will continue to disseminate results in our publications and on our web page. We will work to publicize completed projects in the media, targeting communities in which projects are located. Additionally, we will participate when possible in broader efforts of the Metro Conservation Corridors Partnership. These efforts may include emails to people on the Embrace Open Space (EOS) database, through the EOS quarterly meetings and jointly held county meetings, and on the partnership website.

VIII. REPORTING REQUIREMENTS:
For the 2008 appropriation, periodic work program progress reports were submitted February 1st and August 1st of each year, starting with February 1, 2009. This is the final work program report.

For the 2009 and 2010 appropriations, periodic work program progress reports will continue to be submitted February 1st and August 1st of each year. A final work program report and associated products for the 2009 appropriation will be submitted not later than August 1, 2011. A final work program report and associated products for the 2010 appropriation will be submitted not later than August 1, 2012.

IX. RESEARCH PROJECTS: N/A

Attachment A: Budget Detail for 2008 Projects

Project Title: *Metro Conservation Corridors - Phase IV: Minnesota Land Trust*

Project Manager Name: *Sarah Strommen*

Trust Fund Appropriation: $ *225,000*

2008 Trust Fund Budget	**Result 1 Budget: August 2009**	**Result 1 Final Adjusted Budget**	**Amount Spent** *as of January 2010*	**Balance** *as of January 2010*
	Aquiring Conservation Easements			
BUDGET ITEM				
Personnel: wages and benefits: Staff expenses including salaries, benefits (FICA,FUTA. SUI, worker's comp health insurance, 401 (k), etc.) and related costs for approximately .75 FTE for one years as follows:	50,000	56,201	56,201	0
Conservation directors or other land protection staff (aproximately .50 FTE)				
Staff attorney and other support staff (approximately .25 FTE)				
Conservation Easement Acquisition Costs *(less than fee)*	123,000	124,903	124,903	0
Purchase price of conservation easement(s)				
Title work, insurance, etc.				
Maps, GIS (including project mapping by Community GIS)				
Film				
Other (including appraisals, survey, recording fees, etc.)				
Travel (mileage and related travel expenses in Minnesota)	2,000	1,896	1,896	0
Easement Stewardship: (funds dedicated to perpetually monitoring, managing, and enforcing acquired easements)	50,000	42,000	42,000	0
COLUMN TOTAL	**$225,000**	**$225,000**	**$225,000**	**$0**

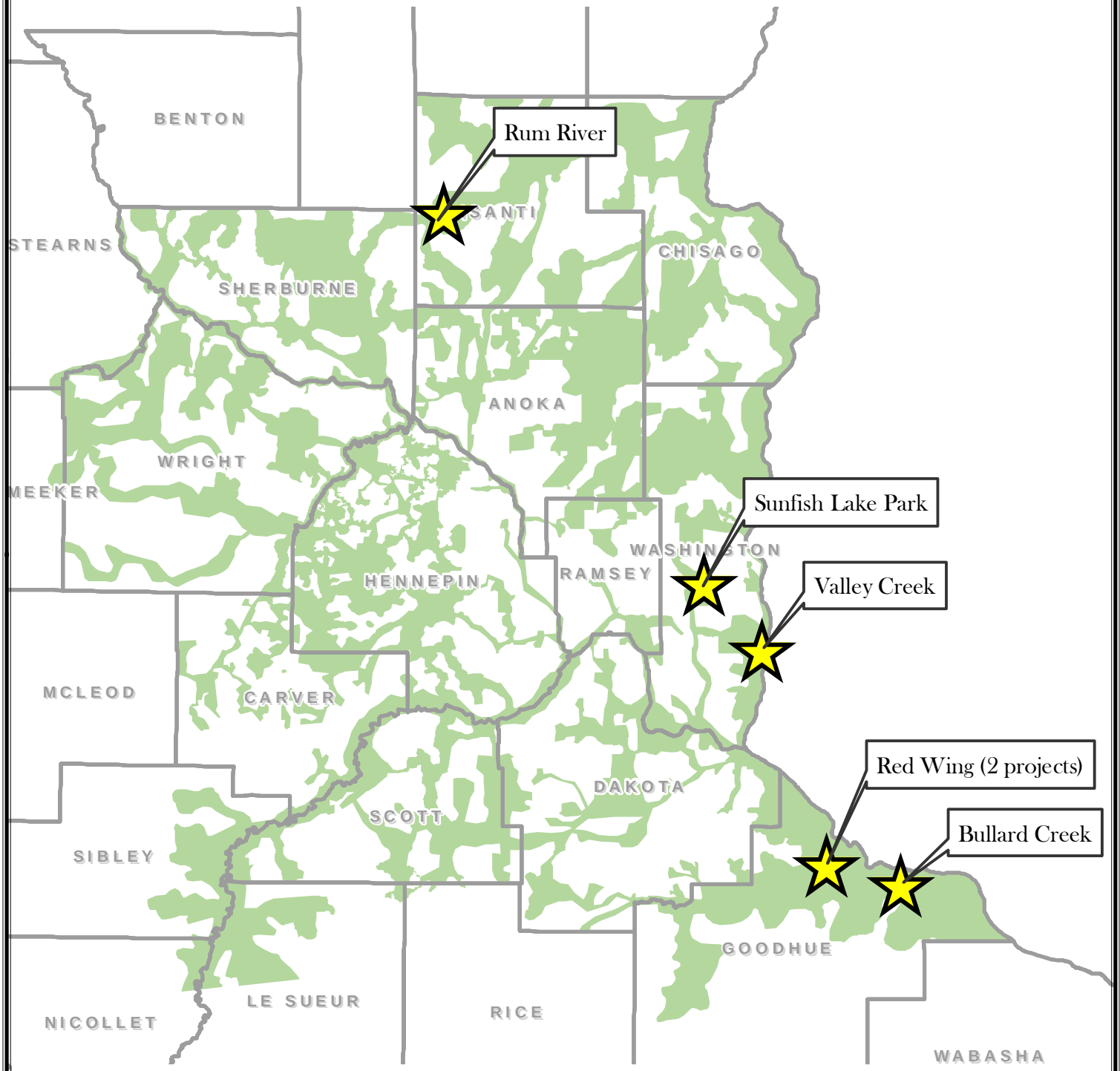
Minnesota Land Trust: Metro Conservation Corridors – 2008 (Phase 4)
Summary of Purchased Easements

Project	**Acres**	**Funding Type**	**Funds Use**	**Funding Amount**
Bullard Creek Goodhue County	140	ENTF – 2008 Land Trust allocation	Purchase price of conservation easement	$100,000
		Doris Duke Foundation	Purchase price of conservation easement	$150,000
		Minnesota Land Trust acquisition fund	Purchase price of conservation easement	$75,000
		Landowner donation	Donated value of conservation easement	$276,200
		ENTF – 2008 Land Trust allocation	Stewardship	$15,000
Valley Creek Washington County	13	ENTF – 2007 Metro Greenways Allocation	Purchase price of conservation easement	$75,000
		The Conservation Fund/Doris Duke Foundation	Purchase price of conservation easement	$75,000
		Landowner donation	Donated value of conservation easement	$30,000
		ENTF-2008 Land Trust allocation	Stewardship	$15,000

In addition to the expenses listed above, staff time and professional services expenses covering closing costs, title review, etc. were incurred and covered by the Land Trust's 2008 Metro Conservation Corridors allocation. The Land Trust does not allocate staff time or professional services expenses to specific conservation projects.

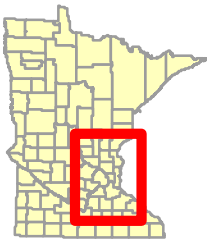
Minnesota Land Trust Completed Projects

METRO CONSERVATION CORRIDORS PARTNERSHIP
2008 - PHASE IV



MINNESOTA LAND TRUST

Metro Conservation Corridors
Completed Projects
Counties



Minnesota Land Trust Completed Projects
LCCMR Metro Corridors 2008 - Phase IV

Rum River: This 56-acre property in Isanti County is situated along the Rum River and features approximately 1,777 feet of river shoreline. The property contains relatively natural fish and wildlife habitat provided by the Rum River and its associated floodplain forest, along with rolling grasslands, wetlands and agricultural fields. The floodplain forest of the property has been mapped and identified as a high quality native community by the Minnesota County Biological Survey. This parcel is the sixth property that the Land Trust has protected along the Rum River.

Sunfish Lake Park: This 256-acre property in Washington County is a public city park within the City of Lake Elmo. The park is used primarily for low-impact recreation, and there is a trail system for walking, hiking, and horseback riding. The property consists mainly of forested rolling hills with cherry, oak, maple, birch, and bittersweet trees. The property also contains a portion of Sunfish Lake, thereby providing an important public access to the lake. This parcel also lies adjacent to several other properties previously protected by the Land Trust.

Valley Creek: This 13-acre property in Washington County is varied in topography and predominately oak woodland. Valley Creek, a designated trout stream, flows through this corner of the property. *Besseya bullii*, a perennial kitten-tail that has been state-listed as "threatened," has been found and documented on the property. The property is bordered to the north and west by Belwin Conservancy property that is protected with a conservation easement held by the Minnesota Land Trust.

Bullard Creek: This project in Goodhue protects 193 acres near the City of Red Wing and is the second easement project completed by the same family. The protected property contains relatively undisturbed natural areas with high quality examples of terrestrial communities including hardwood forest and dry bluff prairie. The property also includes 2,957 feet of shoreline along an intermittent stream that flows directly into Bullard Creek, a MN DNR-designated trout stream.

Red Wing: This 414-acre property in Goodhue County features approximately 5,275 linear feet of shoreline on Spring Creek, a designated trout stream, which meanders through the central portion of the property. The property also contains small openings of dry prairie bedrock bluff, as well as hillsides covered in hardwood forest. The Protected Property contains several sites identified and listed as significant archeological sites for pre-settlement Native Americans, as identified by the Minnesota Institute of Archaeology.

Red Wing: This 28-acre property in Goodhue County is located in the City of Red Wing. It is close to the Cannon River and is situated between two noncontiguous parcels of the Cannon River Turtle Preserve Scientific and Natural Area. The entire property consists of Silver Maple-Green Ash-Cottonwood Terrace floodplain forest. This forest type is considered rare or uncommon in Minnesota and provides habitat for a variety of species in greatest conservation need.

2008 Project Abstract
For the Period Ending June 30, 2010

TITLE: Metro Conservation Corridors Phase IV (3.3) – Fee Acquisition for Minnesota Valley National Wildlife Refuge
PROJECT MANAGER: Deborah Loon
ORGANIZATION: Minnesota Valley National Wildlife Refuge Trust, Inc.
ADDRESS: 2312 Seabury Avenue, Minneapolis, MN 55406
WEB SITE ADDRESS: www.mnvalleytrust.org
FUND: Environment and Natural Resources Trust Fund
LEGAL CITATION: ML 2008, Ch. 367, Sec. 2, Subd. 3(a) -- 3.3

APPROPRIATION AMOUNT: $225,000

Overall Project Outcome and Results

With funding support from the Environment and Natural Resources Trust Fund, as recommended by the LCCMR, the Minnesota Valley Trust acquired fee title to the following parcels containing significant floodplain forest and prairie habitat along the Minnesota River:

- 67.32 acres in Sibley County on July 24, 2008 to expand the Jessenland Unit of the Minnesota Valley National Wildlife Refuge.

- 21.5 acres in Carver County on December 31, 2009 to expand the Rapids Lake Unit of the Minnesota Valley National Wildlife Refuge.

Of the 88.82 acres acquired, the Environment and Natural Resources Trust Fund paid for 47.34 acres and the Minnesota Valley Trust paid for 41.48 acres with nonprofit and other non-state funds.

Both of these acquisitions expand upon prior acquisitions funded in part by the Environment and Natural Resources Trust Fund, as recommended by the LCCMR. The parcels acquired are adjacent to lands already protected by the Minnesota Valley Trust for the Minnesota Valley National Wildlife Refuge.

The Jessenland and Rapids Lake Units of the Refuge were identified through a public planning process by the US Fish and Wildlife Service as priority expansion units of the Minnesota Valley National Wildlife Refuge.

After restoration, the lands will be donated to the US Fish and Wildlife Service for perpetual management as part of the Minnesota Valley National Wildlife Refuge. They will be managed for wildlife and wildlife-dependent recreation, including hunting, fishing, wildlife observation, photography, wildlife interpretation and environmental education.

Project Results Use and Dissemination

The Minnesota Valley Trust will publicize the completion of this acquisition and plans for the lands through its website and news releases to the local media. After restoration is completed, the land will be donated to the Minnesota Valley National Wildlife Refuge and Wetland Management District. All funding partners will be acknowledged on Refuge kiosks, including the Environment and Natural Resources Trust Fund, as recommended by the Legislative Commission on Minnesota Resources.

Trust Fund 2008 Work Program – Final Report

Date of Report: February 1, 2010 (revised March 10, 2010)
Date of Next Status Report: NA
Date of Work program Approval:
Project Completion Date: June 30, 2010

I. PROJECT TITLE: Metro Conservation Corridors – Phase IV – Minnesota Valley Trust – 3.3

Project Manager: Deborah Loon
Affiliation: Minnesota Valley National Wildlife Refuge Trust, Inc.
Mailing Address: 2312 Seabury Avenue
City / State / Zip: Minneapolis, MN 55406
Telephone Number: 612-801-1935
E-mail Address: DebLoon@comcast.net
FAX Number: 612-728-0700
Web Page address: NA

Location: Metro Conservation Corridors Project Area 10, Minnesota River Valley

Total Trust Fund Project Budget:	**Trust Fund Appropriation:**	**$ 225,000**
	Minus Amount Spent:	**$ 225,000**
	Equal Balance:	**$ 0**

Legal Citation: ML 2008, Chap. 367, Sec. 2, Subd. 3(a)

Appropriation Language: $3,150,000 is from the trust fund to the commissioner of natural resources for the fourth appropriation for acceleration of agency programs and cooperative agreements. Of this appropriation, $1,915,000 is for Department of Natural Resources agency programs and $1,235,000 is for agreements as follows: $475,000 with the Trust for Public Land; $92,000 with Friends of the Mississippi River; $111,000 with Great River Greening; $225,000 with Minnesota Land Trust; $225,000 with Minnesota Valley National Wildlife Refuge Trust, Inc.; and $107,000 with Friends of the Minnesota Valley for the purposes of planning, restoring, and protecting important natural areas in the metropolitan area, as defined under Minnesota Statutes, section 473.121, subdivision 2, and portions of the surrounding counties, through grants, contracted services, conservation easements, and fee title acquisition. Land acquired with this appropriation must be sufficiently improved to meet at least minimum management standards as determined by the commissioner of natural resources. Expenditures are limited to the identified project corridor areas as defined in the work program. This appropriation may not be used for the purchase of residential structures, unless expressly approved in the work program. All conservation easements must be perpetual and have a natural resource management plan. Any land acquired in fee title by the commissioner of natural

resources with money from this appropriation must be designated as an outdoor recreation unit under Minnesota Statutes, section 86A.07. The commissioner may similarly designate any lands acquired in less than fee title. A list of proposed restorations and fee title and easement acquisitions must be provided as part of the required work program. All funding for conservation easements must include a long-term stewardship plan and funding for monitoring and enforcing the agreement.

II. PROJECT SUMMARY AND RESULTS: Fee title acquisition of 45 acres of significant habitat in the Minnesota River Valley within Carver, LeSueur, Scott and/or Sibley Counties. After restoration, lands will be donated to the US Fish and Wildlife Service for management as part of the Minnesota Valley National Wildlife Refuge.

III. PROGRESS SUMMARY AS OF February 5, 2009: The Minnesota Valley Trust acquired fee title to 67.32 acres of significant habitat along the Minnesota River in Sibley County on July 24, 2008. We have not filed our final report and initial land acquisition report yet, as we are negotiating on additional land to complete the leverage pledged for this grant. The wetlands and prairie will be restored on these lands in 2009. After restoration, the land will be donated to the USFWS to be managed as part of the Jessenland Unit of the Minnesota Valley National Wildlife Refuge.

PROGRESS SUMMARY AS OF August 1, 2009: No change in status. See February 5, 2009 progress summary.

PROGRESS SUMMARY AS OF FEBRUARY 1, 2010: The Minnesota Valley Trust acquired fee title to the following parcels containing significant habitat along the Minnesota River for expansion of the Minnesota Valley National Wildlife Refuge:

1) 67.32 acres in Sibley County on July 24, 2008 for the Jessenland Unit of the Refuge
2) 21.5 acres in Carver County on December 31, 2009 for the Rapids Lake Unit of the Refuge.

Of the 88.82 acres acquired, the Environment and Natural Resources Trust Fund paid for 47.34 acres and the Minnesota Valley Trust paid for 41.48 acres with nonprofit and other non-state funds.

Both of these acquisitions expand upon prior acquisitions funded in part by the Environment and Natural Resources Trust Fund, as recommended by the LCCMR. The parcels acquired are adjacent to lands already protected by the Minnesota Valley Trust for the Minnesota Valley National Wildlife Refuge.

The Jessenland and Rapids Lake Units of the Refuge were identified through a public planning process by the US Fish and Wildlife Service as priority expansion units of the Minnesota Valley National Wildlife Refuge. The parcels acquired are within the expansion boundaries of those Refuge units.

After restoration, the lands will be donated to the US Fish and Wildlife Service for perpetual management as part of the Minnesota Valley National Wildlife Refuge. They will be managed for wildlife and wildlife-dependent recreation, including hunting, fishing, wildlife observation, photography, wildlife interpretation and environmental education.

Appraised value was paid on both parcels:
1) $332,405 on the 67.32 acres in Sibley County for Jessenland Unit
2) $86,000 on the 21.5 acres in Carver County for Rapids Lake Unit.

Transaction costs for the acquisitions were as follows:
1) $2,544.40 on the 67.32 acres in Sibley County for Jessenland Unit -- $399 legal, $800 appraisal, $1,345.50 closing, title insurance, recording fees
2) $2,035.80 on the 21.5 acres in Carver County for Rapids Lake Unit -- $682 legal, $900 appraisal, $453.80 closing, title insurance, recording fees

Total cost of the two acquisitions -- $422,985.20. Funds for the acquisitions came from several sources:
1) Environment and Natural Resources Trust Fund -- $225,000
2) North American Wetland Conservation Act grant funds -- $75,000
3) MN Valley Trust funds -- $122,985.20

IV. OUTLINE OF PROJECT RESULTS*:*

Result 1:

Description: Fee title acquisition of 45 acres of significant habitat in the Minnesota River Valley within Carver, Scott and/or Sibley Counties. The Minnesota Valley Trust will leverage these grant funds and acquire an additional 45 acres or more with other funds.

The Trust is working with multiple landowners within the following expansion units of the Minnesota Valley National Wildlife Refuge, as delineated by the US Fish and Wildlife Service. We anticipate completing at least one acquisition with the Trust Funds in the following target areas, expanding the Refuge:
- Rapids Lake Unit – San Francisco Township, Carver County
- San Francisco Unit - San Francisco Township, Carver County
- Jessenland Unit - Faxon and Jessenland Townships, Sibley County
- Ahlswede Unit - Scott County and
- St. Lawrence Unit - St. Lawrence Township, Scott County.

The lands to be acquired have been identified by the US Fish and Wildlife Service as offering significant habitat for wildlife and opportunities for wildlife-dependent recreation. The lands generally run along the Minnesota River and include floodplain, cropland and bluffs. Some of the targetted lands are adjacent to lands already in public ownership (FWS, DNR). These acquisitions will connect floodplain

forest and prairie habitat in the Minnesota River bottoms, benefiting many species of wildlife including wood ducks, mallards, bald eagles, grassland nesting birds as well as numerous resident game species such as turkeys and deer.

After acquisition and restoration of the habitat by the Minnesota Valley Trust and other partners, the lands will be donated and conveyed to the US Fish and Wildlife Service for management as part of the Minnesota Valley National Wildlife Refuge.

This project will benefit wildlife and improve water quality by retiring cropland in the Minnesota River Valley and restoring lands to the natural habitats of floodplain forest, wetlands and prairie. When donated to the USFWS, the public will be given access to the lands for wildlife-dependent recreational activities, such as birding, photography, hiking, hunting and fishing.

Summary Budget Information for Result 1:	**Trust Fund Budget:**	**$ 225,000**
	Amount Spent:	**$ 0**
	Balance:	**$ 225,000**

Deliverable	**Completion Date**	**Budget**	**Status**
1. Acquire 45 acres	**June 30, 2010**	**$225,000**	**Complete**

Completion Date: June 30, 2010

Result Status as of February 1, 2009: The Minnesota Valley Trust acquired fee title to 67.32 acres of significant habitat along the Minnesota River in Sibley County on July 24, 2008. We have not filed our final report and initial land acquisition report yet, as we are negotiating on additional land to complete the leverage pledged for this grant. The wetlands and prairie will be restored on these lands in 2009. After restoration, the land will be donated to the USFWS to be managed as part of the Jessenland Unit of the Minnesota Valley National Wildlife Refuge.

Result Status as of August 1, 2009: No change in status. See status as of February 1, 2009.

Result Status as of February 1, 2010: See final report summary.

Final Report Summary: The Minnesota Valley Trust acquired fee title to the following parcels containing significant habitat along the Minnesota River for expansion of the Minnesota Valley National Wildlife Refuge:

1) 67.32 acres in Sibley County on July 24, 2008 for the Jessenland Unit of the Refuge

2) 21.5 acres in Carver County on December 31, 2009 for the Rapids Lake Unit of the Refuge.

Both of these acquisitions expand upon prior acquisitions funded in part by the Environment and Natural Resources Trust Fund, as recommended by the LCCMR. The parcels acquired are adjacent to lands already protected by the Minnesota Valley Trust for the Minnesota Valley National Wildlife Refuge.

The Jessenland and Rapids Lake Units of the Refuge were identified through a public planning process by the US Fish and Wildlife Service as priority expansion units of the Minnesota Valley National Wildlife Refuge. The parcels acquired are within the expansion boundaries of those Refuge units.

After restoration, the lands will be donated to the US Fish and Wildlife Service for perpetual management as part of the Minnesota Valley National Wildlife Refuge. They will be managed for wildlife and wildlife-dependent recreation, including hunting, fishing, wildlife observation, photography, wildlife interpretation and environmental education.

V. TOTAL TRUST FUND PROJECT BUDGET:

Staff or Contract Services: $0
Equipment: $0
Development: $ 0
Restoration: $ 0
Acquisition, including easements: $ 225,000 for fee title acquisition of at least 45 acres. After Trust acquisition and restoration, the land will be donated to the USFWS for perpetual management as part of the Minnesota Valley National Wildlife Refuge.
Other: $0

TOTAL TRUST FUND PROJECT BUDGET: $ 225,000

Explanation of Capital Expenditures Greater Than $3,500:

VI. OTHER FUNDS & PARTNERS:

A. Project Partners: US Fish & Wildlife Service, Friends of the Minnesota Valley, local units of government and other partners

B. Other Funds Proposed to be Spent during the Project Period: $225,000

C. Past Spending: 2001: $ 0; 2003: $ 98,300 (HCP) and $290,000 (MeCC); 2005: $ 50,400 (HCP) and $230,000 (MeCC); 2007: $100,000 (HCP) and $210,000 (MeCC)

D. Time: 2 years: July 1, 2008 – June 30, 2010

VII. DISSEMINATION: As projects are completed, the Minnesota Valley Trust will announce the accomplishments through press releases and the Trust's website.

VIII. REPORTING REQUIREMENTS:

Periodic work program progress reports will be submitted not later than February 1 and August 1 of each year. A final work program report and associated products will be submitted between June 30 and August 1, 2009 or 2010 as requested by the LCCMR.

IX. RESEARCH PROJECTS: NA

Attachment A: Budget Detail for 2008 Projects

Project Title: Metro Conservation Corridors Phase lV - Minnesota Valley National Wildlife Refuge Trust - 3.3

Project Manager Name: Deborah Loon, Minnesota Valley National Wildlife Refuge Trust.

Trust Fund Appropriation: $ 225,000

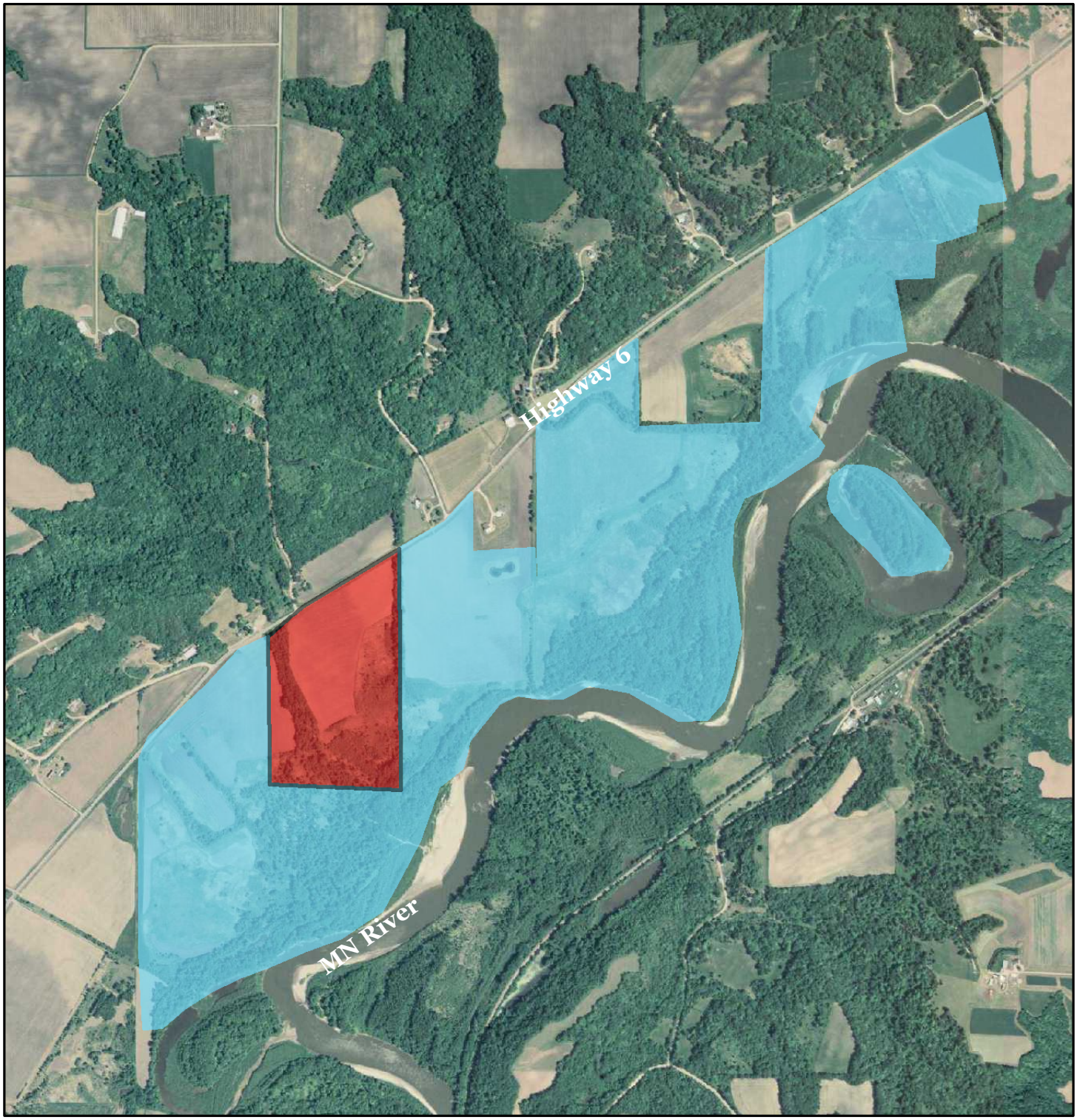
1) See list of non-eligible expenses, do not include any of these items in your budget sheet

2) Remove any budget item lines not applicable

2008 Trust Fund Budget	**Result 1 Budget:**	**Amount Spent 2.1.10**	**Balance 2.1.10**	**TOTAL BUDGET**	**TOTAL BALANCE**
	Acquire 45 acres of significant habitat in project area 10 of Metro Conservation Corridors.				
BUDGET ITEM			0	0	0
Land acquisition	225,000	225,000	0	225,000	0
COLUMN TOTAL	**$225,000**	**$225,000**	**$0**	**$225,000**	**$0**

Jessenland Unit Addition

MN Valley National Wildlife Refuge - Sibley County, MN
T113N, R26W, S13



0 0.5 1 Miles

Jessenland Unit Addition

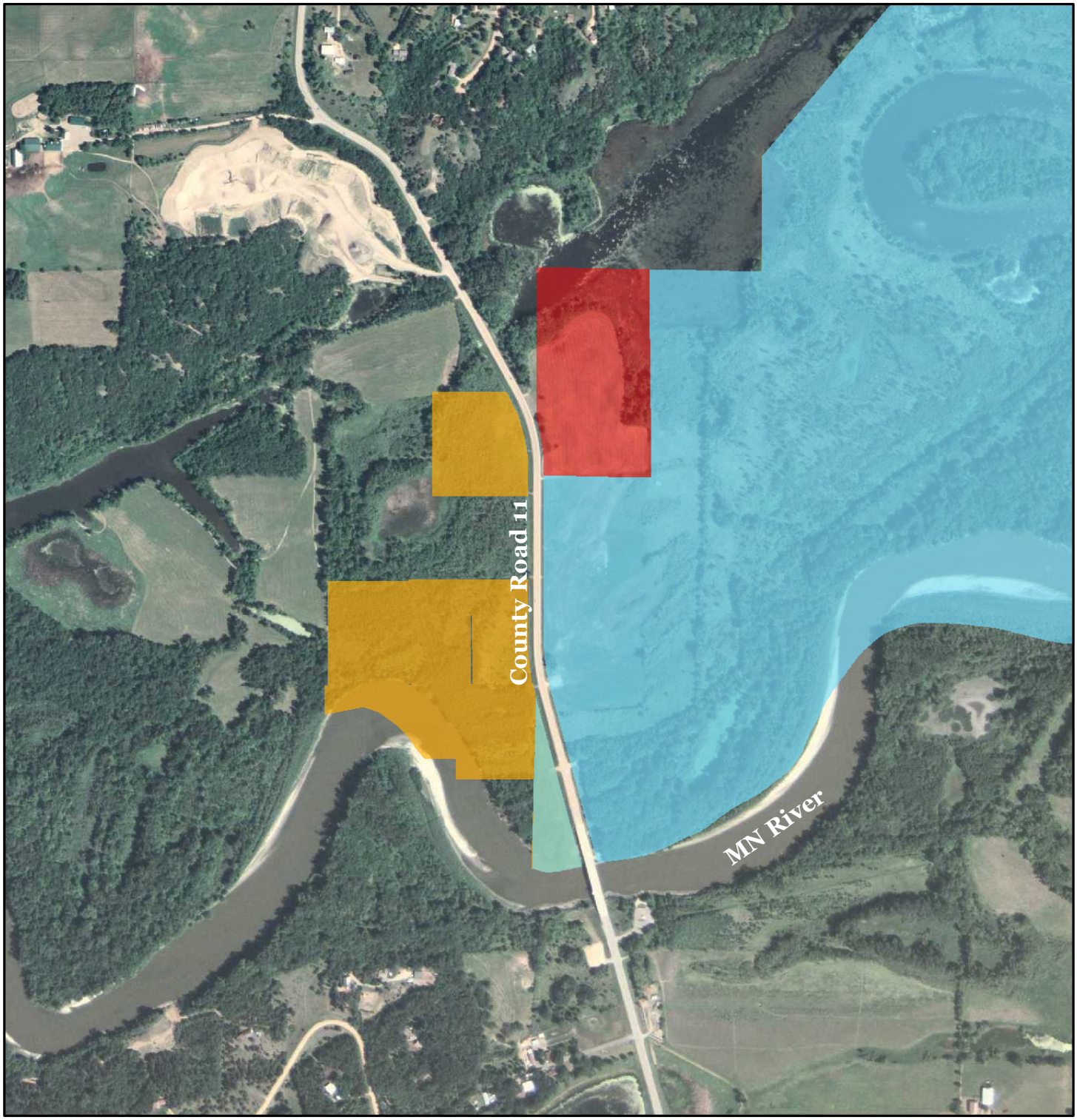
Jessenland Unit - MN Valley NWR

MINNESOTA VALLEY TRUST
Minnesota Valley National Wildlife Refuge Trust, Inc.

Rapids Lake Unit Addition

MN Valley National Wildlife Refuge - Carver County, MN

T114N, R23W, S7



0 0.3 0.6 Miles

Rapids Lake Unit Addition - 21.5 Acres

Rapids Lake Unit - MN Valley NWR

San Francisco Unit - MN Valley NWR

MINNESOTA VALLEY TRUST
Minnesota Valley National Wildlife Refuge Trust, Inc.

2008 Project Abstract
For the Period Ending June 30, 2010

PROJECT TITLE: 3.5: Fish and Wildlife Acquisition
Metro Conservation Corridors
PROJECT MANAGER: Mike Halverson
AFFILIATION: MN DNR – Division of Fish & Wildlife
MAILING ADDRESS: 500 Lafayette Rd.
CITY/STATE/ZIP: St. Paul, MN 55155
PHONE: (651) 259- 5209
FAX: (651) 297-4916
E-MAIL: mike.halverson@state.mn.us
WEBSITE: [

FUNDING SOURCE: Environment and Natural Resources Trust Fund
LEGAL CITATION: ML 2008, CH 367, Sec. 2. Sub 3(a)

APPROPRIATION AMOUNT: $557,000

Overall Project Outcome and Results

This project resulted in the completion of three fee title acquisition parcels on the Vermillion River in Dakota County. Totals for the 3 acquisitions equaled 323.3 acres, including 2.75 total miles of shoreline. One of the parcels on the Vermillion River was also paid for with 2009 Environment and Natural Resources Trust Fund (ENRTF) acquisition dollars, resulting in both acres and miles being divided proportionately between the two phases. As part of this project, ENRTF dollars ($556,388) directly acquired approximately 87.1 acres of the total, including 0.61 miles of stream. Other state dollars ($774,000) acquired approximately 132.3 acres, including 1.1 miles of stream. Donation of value ($568,205) accounted for 103.9 acres, including 1.0 miles of stream.

Project goals were to secure fee title or easements on approximately 50 acres, and leverage about 25 acres of acquisition through partner funds.

2008 Environment and Natural Resources Trust Fund (ENRTF)
Final Work Program Report

Date of Report: July 14, 2010
Date of Next Status Report: NA
Date or Work Program Approval: July 1, 2008
Project Completion Date: June 30, 2010

I. Project Title*:* Metro Conservation Corridors - Fish and Wildlife Acquisition (3.5)

Name:	Mike Halverson
Sponsoring Organization:	DNR Section of Fish & Wildlife
Address:	500 Lafayette Rd, Box 20**,** St Paul, 55155-4020
Telephone Number:	651-259-5209
E-mail:	Mike.Halverson@dnr.state.mn.us
Fax :	651-297-4916
Web Address:	www.dnr.state.mn.us

Location: Greater Metro Region (targeted portions of 15 counties)

Total ENRTF Project Budget:

	ENRTF
Appropriation:	$ 557,000
Minus Amount Spent:	$ 556,388
Equal Balance:	$ 612

Legal Citation: ML 2008, Chap.367, Sec.2, Subd.3(a).

Appropriation Language: $3,150,000 is from the trust fund to the commissioner of natural resources for the fourth appropriation for acceleration of agency programs and cooperative agreements. Of this appropriation, $1,915,000 is for Department of Natural Resources agency programs and $1,235,000 is for agreements as follows: $475,000 with the Trust for Public Land; $92,000 with Friends of the Mississippi River; $111,000 with Great River Greening; $225,000 with Minnesota Land Trust; $225,000 with Minnesota Valley National Wildlife Refuge Trust, Inc.; and $107,000 with Friends of the Minnesota Valley for the purposes of planning, restoring, and protecting important natural areas in the metropolitan area, as defined under Minnesota Statutes, section 473.121, subdivision 2, and portions of the surrounding counties, through grants, contracted services, conservation easements, and fee title acquisition. Land acquired with this appropriation must be sufficiently improved to meet at least minimum management standards as determined by the commissioner of natural resources. Expenditures are limited to the identified project corridor areas as defined in the work program. This appropriation may not be used for the purchase of residential structures, unless expressly approved in the work program. All conservation easements must be perpetual and have a natural resource management plan. Any land acquired in fee title by the commissioner of natural resources with money from this appropriation must be designated as an outdoor recreation unit under Minnesota Statutes, section 86A.07. The commissioner may similarly designate any lands acquired in less than fee title. A list of proposed restorations and fee title and easement acquisitions must be provided as part of the required work program. All funding for conservation easements must include a long-term stewardship plan and funding for monitoring and enforcing the agreement.

II. & III. FINAL PROJECT SUMMARY:

This project resulted in the completion of three fee title acquisition parcels on the Vermillion River in Dakota County. Totals for the three acquisitions equal 323.3 acres, including 2.75 total miles of shoreline. One of the parcels on the Vermillion River was also paid for with 09 ETF acquisition dollars, resulting in both acres and miles being divided proportionately between the two phases. As part of this project, Environmental and Natural Resources Trust dollars ($556,388) directly acquired approximately 87.1 acres of the total, including 0.61 miles of stream. Other state dollars ($774,000) acquired approximately 132.3 acres, including 1.1 miles of stream. Donation of value ($568,205) accounted for 103.9 acres, including 1.0 miles of stream.

Professional Services costs for 08 ETF acquisitions totaled $31,888

IV. OUTLINE OF PROJECT RESULTS*:*

Acquisition will focus on linkages that provide both fish and wildlife habitat values. The acquired lands will be designated and managed as Wildlife Management Area (WMA) or Aquatic Management Area (AMA) or a combination of both. Any shoreline easements acquired will provide environmental protection of the shoreline and riparian zone as well as public angler access. A monitoring program will be implemented for all easements, and stewardship requirements will be funded with Fisheries project dollars.

Result 1: Fish and Wildlife Land Acquisition
Allocation $556,388 Balance $612 (back to ETF)

Program Area/Result	Trust Dollars Spent	Trust Accomplishments
	$ 556,388	323.3 acres with 2.75 miles of shoreline

Professional services in the amount of $31,888 related to land acquisition is included

Completion Date: June 30, 2010

Description: This project will secure fee title or easements on approximately 50 acres, and leverage about 25 acres of acquisition through partner funds. Priority will be given to acquiring regionally significant fish and wildlife habitat that will both build on the existing shoreline habitat and provide angler access. Project money is expected to generate additional non-state funded acres and shoreline miles, for a grand total of 75 acres and 1.6 miles of critical shoreline habitat. Collaborative partnerships will be promoted in order to acquire key lands. Projects may occur anywhere within the Southern and Eastern Focus areas including, but not limited to, Dakota County, Scott County, and Washington County depending on priorities, risk of development, and potential partners. Specifically, acquisition under this grant will be of high priority property at one or more of the following sites.

- Vermillion River (Dakota County),
- Brown's Creek Washington County), and/or
- Eagle Creek (Scott County)

Gores AMA, Parcel 1, Dakota County

Trust Acres	Trust Miles	Trust $	Other St. $	Other $	Other St. Acres	Other St. Miles	Other Acres	Other Miles	Total Acres	Total Miles
18.3	0.19	$100,000	$344,000	$568,205	62.8	0.65	103.8	1.06	185	1.90

Vermillion River, Parcel 7, Dakota County

Trust Acres	Trust Miles	Trust $	Other St. $	Other $	Other St. Acres	Other St. Miles	Other Acres	Other Miles	Total Acres	Total Miles
37.2	0.27	$204,500	$200,000	$0	36.4	0.26	0	0	73.55	0.53

Vermillion River, Parcel 5, Dakota County

Trust Acres	Trust Miles	Trust $	Other St. $	Other $	Other St. Acres	Other St. Miles	Other Acres	Other Miles	Total Acres	Total Miles
31.6	0.16	$220,000	$230,000	$0	33.1	0.16	0	0	64.7	0.32

Total

87.1	0.61	$524,500	$774,000	$568,205	132.3	1.1	103.8	1.1	323.3	2.75

Professional Services Total: **Grand Total (Trust only):** **$ 31,888**

Summary Budget Information for Result 1: Trust Fund Budget: **$557,000**
Balance: **$ 612**

V. OTHER FUNDS & PARTNERS:

A. Project Partners: Metro Conservation Corridor partners (see Table A) and private landowners, local governments, regional, state and federal agencies, nonprofit organizations and citizen groups.

B. Other Funds Being spent during the Project Period:

Year	Funding Source	Fisheries	Wildlife
2008	Bonding	$1,000,000	$5,000,000
Total		$1,000,000	$5,000,000

C. Past Spending

Year	Funding Source	Fisheries	Wildlife
1997	ETF	$ 567,000	$ 500,000
2001	ETF – Outstate	$2,000,000	
2003	ETF – Metro	$ 384,000	$ 240,000
2003	ETF – Outstate	$ 600,000	$
2005	ETF – Metro	$ 290,000	$
2005	ETF – Outstate	$ 280,000	$ 27,350
2005	ETF - Bonding	$1,050,000	$10,000,000
2006	ETF - Bonding	$2,000,000	$14,000,000

Total	$7,471,000	$24,767,350

D. Time: Fisheries plans to expend these funds within 12-15 months of their availability. July 1, 2008 – June 30, 2010 (if needed).

VII. DISSEMINATION: Fisheries in cooperation with its partners will issue a press release and/or publicize a dedication event for each acquisition completed through this project. Other dissemination of information will be through Metro Corridors partnership, Embrace Open Space, and on the Metro Corridors website.

VIII. REPORTING REQUIREMENTS:
Periodic work program progress reports will be submitted not later than February 1st and August 1st of each year. A final work program report and associated products will be submitted between June 30 and August 1, 2009 or 2010 as requested by the LCCMR

IX. RESEARCH PROJECTS: NA

Attachment A: Budget Detail for 2008 Projects - Final

Project Title: Metro Conservation Corridors (MeCC) Phase IV: DNR Fish and Wildlife (3.5)

Project Manager Name: Mike Halverson

Trust Fund Appropriation: $ 557,000

2008 Trust Fund Budget	**Result 1 Budget:**	**Amount Spent** *(June 30, 2010)*	**Balance** *(June 30,2010)*	**TOTAL BUDGET**	**BALANCE**
BUDGET ITEM	Acquisition				
PERSONNEL: wages and benefits			$ -		
Land acquisition	$ 522,000	$ 524,500	$ (2,500)	$ 522,000	$ (2,500)
Professional Services for Acq.	$ 35,000	$ 31,888	$ 3,112	$ 35,000	$ 3,112
Improvement of Acquired Lands			$ -		
COLUMN TOTAL	**$ 557,000**	**$ 556,388**	**$ 612**	**$ 557,000**	**$ 612**

2008 Project Abstract
For the Period Ending June 30, 2010

PROJECT TITLE: Habitat Conservation Partnership – Phase V
PROJECT MANAGER: Joe Pavelko
AFFILIATION: Pheasants Forever, Inc.
MAILING ADDRESS: 7975 Acorn Circle
CITY/STATE/ZIP: Victoria, MN 55386
PHONE: 612-532-3800
E-MAIL: jpavelko@pheasantsforever.org
WEBSITE: www.mnhabitatcorridors.org
FUNDING SOURCE: Environment and Natural Resources Trust Fund
LEGAL CITATION: ML 2008 First Special Section, Ch.367, Sec. 2 Subd. 3(c).

APPROPRIATION AMOUNT: $3,150,000

Overall Project Outcome and Results
During the period between July 1st, 2008 and June 30th, 2010, Minnesota's Habitat Conservation Partnership (HCP) collectively expended $3,100,005 of Environment and Natural Resources Trust Fund (ENRTF) dollars to restore, enhance, or protect 8,143 acres of habitat and 199,832 feet of shoreline and riparian areas. Additionally, HCP used these funds to leverage an additional $6,607,398 of other non-state funds to restore, enhance, or protect 8,423 acres of habitat and 23,585 feet of shoreline and riparian areas. In total, HCP expended $11,877,328 to restore, enhance or protect a total of 17,397 acres of habitat and 152,780 feet of shoreline and riparian areas within the defined HCP project areas.

Partners expended a total of $1,926,055 ($1,140,480 ENRTF; $785,575 other non-state funds) to restore/enhance a total of 9,081 acres (7,244 acres ENRTF; 1,837 other non-state funds). Work included 5,230 acres of grassland restoration/enhancement, 3,054 acres of wetland restoration/enhancement, 185 acres of woodland restoration, 27,380 feet of shoreline restoration, & 200 acres of wild rice restoration. Other accomplishments included shallow lake surveys, dam modifications, and site access/development.

Partners expended a total of $7,484,898 ($877,500 ENRTF; $6,607,398 other non-state funds) to acquire 6,951 acres (616 acres ENRTF; 6,335 acres other non-state funds) of perpetual conservation easements. Grassland/wetlands continued to be a priority for HCP partners working on easements, with 6,152 acres protected. Shoreline/riparian areas were also a priority with almost 32,000 feet protected. In addition, 504 acres of woodland was also permanently protected.

Partners expended a total of $1,868,112 ($994,985 ENRTF; $873,127 other funds) to permanently protect 560 acres (309 acres ENRTF; 251 acres other non-state funds) in fee-title acquisition. HCP achieved 290 acres of new WMAs, 66 acres of AMAs, 124 acres of SNAs, and 80 acres of WPAs. Additionally, almost 10,000 feet of shoreline/riparian areas were protected.

For complete information, go to http://www.mnhabitatcorridors.org.

HCP Partners include: Ducks Unlimited, Fond du Lac Reservation, Friends of the Detroit Lakes Wetland Management District, Leech Lake Band of Ojibwe, MN Board of Water and Soil Resources, MN Deer Hunters Association, MN Department of Natural Resources, MN Land Trust, MN Valley National Wildlife Refuge Trust, Inc, National Wild Turkey Federation, Pheasants Forever, The Nature Conservancy, Trust for Public Land, U.S. Fish and Wildlife Service, U.S. Natural Resources Conservation Service

Project Results Use and Dissemination
The partnership acknowledges funding from the Minnesota Environment and Natural Resources Trust Fund. Accomplishment report information, mapping products, and project information can be found at

www.mnhabitatcorridors.org. Other forms of information can be obtained by contacting Joe Pavelko, the HCP Coordinator, at (612) 532-3800.

Minnesota's Habitat Conservation Partnership

2008 – Phase V Habitat Conservation Partnership Final Report – August 30, 2010
M.L. 2008, Chapter 367, Section 2, Subd. 3(c)

The mission of the Minnesota Habitat Corridors Partnership is to restore, enhance and conserve habitat corridors for the purpose of sustaining fish, wildlife and native plant communities for all generations.

This unique Partnership is funded in part by the Minnesota Legislature, as recommended by the Legislative Commission on Minnesota Resources. Funding is provided by the Environment & Natural Resources Trust Fund and the participating partners. The Partnership provides for statewide coordination of existing federal, state, and private land and water conservation programs and focuses resources on identified habitat corridors.

Partner Organizations

Ducks Unlimited ☼ Fond du Lac Reservation ☼ Leech Lake Band of Ojibwe ☼ Minnesota Board of Water and Soil Resources ☼ Minnesota Deer Hunters Association
Minnesota Department of Natural Resources ☼ Minnesota Land Trust ☼ Minnesota Valley National Wildlife Refuge Trust, Inc. ☼ National Wild Turkey Federation
Pheasants Forever ☼ Friends of the Detroit Lakes Wetland Management District☼ The Nature Conservancy ☼ Trust for Public Land ☼ U.S. Fish and Wildlife Service
U.S. Natural Resources Conservation Service

Table of Contents

HCP History	3
Overall Work Program Summary	4
Table 2 - Accomplishments by Work Program	7
Table 3 - Accomplishments by Project Area	9
Table 4 - Accomplishments by Results	15
Restoration Accomplishments Breakdown	20
Easement Accomplishments Breakdown	26
Acquisition Accomplishments Breakdown	28
Phase V Map	30
All Phases Map	31

Restoring Minnesota's Fish and Wildlife Habitat Corridors

A Brief History

The general concept of focusing conservation efforts in geographic areas with the greatest need and opportunity is intuitively attractive. Applying this approach to the problem of habitat fragmentation makes sense to most conservationists. It was this approach that formed the basis for the project proposal Restoring Minnesota's Fish and Wildlife Habitat Corridors submitted to LCMR in 2000. It was heralded as a fresh approach to bringing together conservation partners, differing restoration and protection strategies, and consolidated funding to a new level of coordination. Even before the project was officially approved, members of LCMR wanted to know more about where the corridors would be and what kinds of activities would be funded.

In response, a group of partners led by the Minnesota Waterfowl Association and in consult with the Citizens Advisory Committee to the LCMR was convened to identify target areas, or "corridors", to form the backbone of the proposal. The complexity of the issue became immediately apparent. The state of Minnesota is highly variable in terms of natural resources, threats to these resources, loss of the resources, potential for protection and restoration, and the agencies and nongovernmental organizations committed to sound resource management.
The first step was to apply a geographic information system to map important aspects of the existing resource base. The basic elements were forests, grasslands, water, and land use. Data layers included mapped information from state and federal agencies. Examples included: Wildlife Management Areas, RIM easements, the Minnesota Natural Heritage Database, rivers, and shallow lakes.

More information about important resources areas was gathered through regional meetings with Department of Natural Resources and U. S. Fish and Wildlife Service field staff throughout the state. The information was further refined through meetings with individual partners. The meetings with partners also served to identify information related to partner specific priorities and restrictions.

The three basic geographic concepts created through these meetings were: Spatial Corridors, Linear Corridors and Project Areas.

Project Areas: These areas were the actual areas identified for focusing projects within the LCMR proposal and work plans. Project areas included spatial and linear corridors but were modified by political, cultural, and practical considerations. While the two types of corridors were driven primarily by natural resource considerations, the project areas were driven by organization resource considerations. There were spirited discussions concerning the appropriate size and configuration of the project areas as they were identified on maps. Some partners wanted to limit the size of the areas in order to concentrate project dollars in specific areas of high priority to their organization. Others favored larger areas toallow flexibility in identification of projects for funding and completion. Meetings were held with the 14 Restoring Minnesota's Fish and Wildlife Corridors Project Partners to determine which spatial or linear corridors in the State projects will be performed for the LCMR grant. Each Project Partner selected a combination of 3 linear and/or 3 spatial corridors throughout the State where they will perform restoration & management programs, conservation easement programs, or habitat acquisition programs for the grant. Those corridors that were selected became the boundaries for the Corridor Project Areas theme. Community GIS Services then on-screen digitized the polygons.

In the end, eleven project areas were identified that sought to balance opportunities for all the partners while focusing the habitat protection and restoration efforts on key areas of Minnesota. Phase I of the Minnesota Habitat Corridors Partnership completed work within the eleven identified project areas. In Phase II & III, only minor changes were made to the some project areas. Future Phases may change the project area boundaries when justified, but it has been agreed that the total project area acreage would not increase.

Spatial corridors: Spatial corridors are broad areas that include resources of interest to the partners. An example is the headwaters of the Minnesota River valley. This area includes a relative abundance of wetlands and native prairie as well as major state and federal management areas. Meetings were held at Community GIS Services offices with resource managers from MN DNR wildlife and the Minnesota Waterfowl Association Staff. At these meetings, corridor delineations were on-screen digitized based upon the spatial corridor criteria including: 1) Clusters of shallow lakes that provide important production and migration benefits to waterfowl, 2) Concentrations of 500 acre of larger shallow lakes that provide greater security and resources , areas of historical significance to waterfowl, other migratory birds, and wetland wildlife, 3) Relationships to high density waterfowl production areas 4) Recommendations of resource managers and project partners. The associated data and spatial corridors were printed on large format paper and brought to project partner meetings and resource manager meetings with USFWS and MN DNR wildlife staff where corrections and additions were made. The spatial corridors were then clipped to project areas.

Linear Corridors: Linear corridors are relatively narrow bands of resources that generally follow distinct geologic features or river corridors and often occurred within one or more spatial corridors. An example is the riparian area along the Cannon River in southeastern Minnesota. Meetings were held at each MN DNR Regional Office throughout the state where approximately 35-40 maps with mylar overlays containing the information listed below was presented to resource managers from MN DNR wildlife, forestry and fisheries staff. At these meetings corridor delineations were made on mylar overlays that contained important habitat and protected land linkages by the resource managers. The maps and mylar overlays were brought back to the Community GIS Services offices. There, with the oversight of Corridors Partners, linear corridors were delineated either based upon ArcView Shapefile buffers of rivers/streams or by selecting groups of sections from the MN DNR Section Level Public Land Survey and creating ArcView Shapefiles. These ArcView Shapefiles of linear corridors ere merged in ArcView and clipped to the 11 project area polygons.

LCCMR FINAL REPORT
Restoring Minnesota's Fish and Wildlife Habitat Corridors - Phase 5
Habitat Conservation Partnership

Project Manager: Joe Pavelko

Affiliation: Pheasants Forever

Address: 7975 Acorn Circle
Victoria, MN 55386

Phone: 612-532-3800

Email: jpavelko@pheasantsforever.org

Website: www.mnhabitatcorridors.org

Fund: Environment and Natural Resources Trust Fund

Legal Citation: ML 2008 First Special Section, Ch.367, Sec. 2 Subd. 3(c).

Appropriation Language: Minnesota Habitat Corridors Partnership - Phase 5

$3,150,000 is from the trust fund for the fifth appropriation for acceleration of agency programs and cooperative agreements. Of this appropriation, $250,000 is to the Board of Water and Soil Resources; $733,500 is to the commissioner of natural resources for agency programs; and $2,166,500 is for agreements as follows: $420,000 with Pheasants Forever; $30,000 with Minnesota Deer Hunters Association; $597,500 with Ducks Unlimited, Inc.; $85,000 with National Wild Turkey Federation; $317,000 with the Nature Conservancy; $210,000 with Minnesota Land Trust; $350,000 with the Trust for Public Land; $50,000 with Minnesota Valley National Wildlife Refuge Trust, Inc.; $30,000 with U. S. Fish and Wildlife Service; $30,000 with the Leech Lake Band of Chippewa; $27,000 with the Fond du Lac Band of Chippewa; and $20,000 with Friends of Detroit Lakes Watershed Management District to plan, restore, and acquire fragmented landscape corridors that connect areas of quality habitat to sustain fish, wildlife, and plants. The USDA-Natural Resources Conservation Service is a cooperating partner in the appropriation. Expenditures are limited to the project corridor areas as defined in the work program. Land acquired with this appropriation must be sufficiently improved to meet at least minimum habitat and facility management standards as determined by the commissioner of natural resources. This appropriation may not be used for the purchase of residential structures, unless expressly approved in the work program. All conservation easements must be perpetual and have a natural resource management plan. Any land acquired in fee title by the commissioner of natural resources with
money from this appropriation must be designated as an outdoor recreation unit under Minnesota Statutes, section 86A.07. The commissioner may similarly designate any lands acquired in less than fee title. A list of proposed restorations and fee title and easement acquisitions must be provided as part of the required work program. All funding for conservation easements must include a long-term stewardship plan and funding for monitoring and enforcing the agreement.

Total Project Budget

Result	Environmental Trust Allocation	Environmental Trust Funds Spent	Environmental Trust Balance	Other Funds Spent
Coordination/Mapping	$70,000	$52,041	$17,959	-
Restoration	$1,172,500	$1,140,480	$32,020	-
Easement	$877,500	$877,500	$0	-
Acquisition	$1,030,000	$1,029,985	$15	-
Total	$3,150,000	$3,100,006	$49,994	-

*The above table reflects Habitat Corridors Partnership expenditures by result. Please note that the expenditures for restoration, easement acquisition and fee-title acquisition reflected here will not exactly match the subtotals for those categories reflected in Table 2. Also note that the total expenditures are identical. The reason for this is that some work programs expend dollars on both acquisition and restoration. Also, some partners expend funds on both easement and fee title acquisition, depending on the wishes of the landoowner they are working with. For example, a partner working under the 4a work program to acquire a state wildlife management area (acquisition) is also responsible to ensure that the initial habitat is developed (restoration) on that acquired

Overall Work Program Summary

During the period between July 1st, 2008 and June 30th, 2010, Minnesota's Habitat Conservation Partnership (HCP) collectively expended $11,877,328 of funds to restore, enhance or protect a total of 17,423 acres of habitat and 52,779 feet of shoreline and riparian areas within the defined HCP project areas. More specifically, 8,199 acres of habitat and 120,383 feet of shoreline and riparian areas were restored, enhanced or protected with $3,150,000 of Environment and Natural Resources Trust Funds (ENTF) that leveraged an additional $6,607,398 of other non-state funds to restore, enhance, or protect 8,423 acres of habitat and 23,585 feet of shoreline and riparian areas.

Partners expended $1,926,055 ($1,140,480 ENTF) to restore/enhance a total of 9,081 acres (7,244 acres ENTF). Work included 5,230 acres of grassland restoration/enhancement, 3,054 acres of wetland restoration/enhancement, 185 acres of woodland restoration, 27,380 feet of shoreline restoration, & 200 acres of wild rice restoration. Other accomplishments included shallow lake surveys, dam modifications, and site access/development.

Partners acquired a total of 6,951 acres (616 acres ENTF) of perpetual conservation easements. Grassland/wetlands continued to be a priority for HCP partners working on easements, with 6,152 acres protected. Shoreline/riparian areas were also a priority with almost 32,000 feet protected. In addition, 504 acres of woodland was also permanently protected.

Partners permanently protected 590 acres in fee-title acquisition with $1,094,985 ENTF and $870,127 of other non-state funds. HCP achieved 290 acres of new WMAs, 66 acres of AMAs, 154 acres of SNAs, and 80 acres of WPAs.

For complete information, go to http://www.mnhabitatcorridors.org.

HCP Partners include: Ducks Unlimited, Fond du Lac Reservation, Friends of the Detroit Lakes Wetland Management District, Leech Lake Band of Ojibwe, MN Board of Water and Soil Resources, MN Deer Hunters Association, MN Department of Natural Resources, MN Land Trust, MN Valley National Wildlife Refuge Trust, Inc, National Wild Turkey Federation, Pheasants Forever, The Nature Conservancy, Trust for Public Land, U.S. Fish and Wildlife Service, U.S. Natural Resources Conservation Service

Project Results Use and Dissemination

The partnership acknowledges funding from the Minnesota Environment and Natural Resources Trust Fund. Accomplishment report information, mapping products, and project information can be found at www.mnhabitatcorridors.org <http://www.mnhabitatcorridors.org>. Other forms of information can be obtained by contacting Joe Pavelko, the HCP Coordinator, at (612) 532-3800.

Table 2 - Accomplishments by Work Program - Phase 5 **Minnesota Habitat Conservation Partnership**

	ENVIRONMENTAL AND NATURAL RESOURCES TRUST FUNDS					OTHER FUNDS			STATE FUNDS			PARTNERS STATE LEVERGED FUNDS			OTHER		
Activity(Results)	ENTF Allocation	ENTF Expenditure	Balance	Acres	Shoreline /Riparian (feet)	Expenditure	Acres	Shoreline /Riparian (feet)	Expenditure	Acres	Shoreline /Riparian (feet)	Expenditure	Acres	Shoreline /Riparian (feet)	Expenditure	Acres	Shoreline /Riparian (feet)
1. Project Coordination and Mapping																	
1A - Project Coordination and Mapping - Pheasants Forever	$70,000	$52,041	$17,959	0	0	$0	0	0	$0	0	0	$0	0	0	$0	0	0
SubTotal:	$70,000	$52,041	$17,959	0	0	$0	0	0	$0	0	0	$0	0	0	$0	0	0
2. Restoration & Management																	
2A - Hides for Habitat - MDHA	$30,000	$29,928	$72	15	0	$15,000	0	0	$0	0	0	$9,890	0	0	$7,467	0	0
2B - Partners for Wildlife - U.S. Fish & Wildlife Service	$30,000	$30,000	$0	139	0	$78,855	150	0	$0	0	0	$0	0	0	$9,525	21	0
2C - Living Lakes Enhancement - Ducks Unlimited	$180,000	$180,000	$0	590	0	$296,231	427	0	$0	0	0	$0	0	0	$0	0	0
2D - Shallow Lakes Management - MN DNR - Division of Wildlife	$73,500	$73,308	$192	0	0	$0	0	0	$0	0	0	$0	0	0	$0	0	0
2E - Wild Rice Habitat Restoration - Fond du Lac Band of Chippewa Indians	$27,000	$0	$27,000	0	0	$0	0	0	$0	0	0	$0	0	0	$0	0	0
2F - Shallow Lake & Impoundment Managment - Leech Lake Band of Ojibwe	$30,000	$30,000	$0	2,071	27,107	$10,602	36	4,181	$0	0	0	$0	0	0	$0	0	0
2G - Wildlife Areas Management - DNR-Division of Fish & Wildlife	$30,000	$29,102	$898	41	0	$0	0	0	$0	0	0	$0	0	0	$0	0	0
2H - Fisheries Habitat Restoration - MN DNR - Division of Fisheries	$200,000	$198,760	$1,240	2	73,013	$38,825	0	457	$37,084	0	102	$0	0	0	$21,500	0	192
2I - Set Out Seedlings - National Wild Turkey Federation	$15,000	$12,833	$2,167	23	0	$0	0	0	$0	0	0	$0	0	0	$0	0	0
2J - Lakescaping - MN DNR - Division of Ecological Services	$75,000	$75,000	$0	6	661	$6,000	0	44	$0	0	0	$0	0	0	$0	0	0
2K - Prairie Management - MN DNR - Scientific and Natural Areas Program	$75,000	$74,700	$300	1,017	0	$0	0	0	$0	0	0	$0	0	0	$0	0	0
2N - Campaign for Conservation - The Nature Conservancy	$317,000	$317,000	$0	3,255	0	$340,062	1,224	0	$0	0	0	$0	0	0	$0	0	0
2O - Working Lands Partnership - Friends of the Detroit Lakes Wetland Managment Dis	$20,000	$19,849	$151	16	0	$0	0	0	$0	0	0	$0	0	0	$0	0	0
2P - Bluffland Restoration - National Wild Turkey Federation	$70,000	$70,000	$0	44	0	$0	0	0	$0	0	0	$0	0	0	$0	0	0
SubTotal:	$1,172,500	$1,140,480	$32,020	7,218	100,781	$785,575	1,837	4,682	$37,084	0	102	$9,890	0	0	$38,492	21	96

Table 2 - Accomplishments by Work Program - Phase 5 **Minnesota Habitat Conservation Partnership**

	ENVIRONMENTAL AND NATURAL RESOURCES TRUST FUNDS					OTHER FUNDS			STATE FUNDS			PARTNERS STATE LEVERGED FUNDS			OTHER		
Activity(Results)	ENTF Allocation	ENTF Expenditure	Balance	Acres	Shoreline /Riparian (feet)	Expenditure	Acres	Shoreline /Riparian (feet)	Expenditure	Acres	Shoreline /Riparian (feet)	Expenditure	Acres	Shoreline /Riparian (feet)	Expenditure	Acres	Shoreline /Riparian (feet)
3. Conservation Easement Programs																	
3A - Shorelands Protection Program - Minnesota Land Trust	$210,000	$210,000	$0	240	12,685	$414,000	593	10,147	$0	0	0	$0	0	0	$0	0	15,682
3C - Living Lakes Easements - Ducks Unlimited	$150,000	$150,000	$0	87	2,028	$519,886	305	6,775	$0	0	0	$0	0	0	$0	0	0
3D - Wetlands Reserve Program - DU and NRCS	$267,500	$267,500	$0	0	0	$4,014,810	5,437	0	$0	0	0	$0	0	0	$0	0	0
3E - RIM Reserve - Minnesota Board of Water & Soil Resources	$250,000	$250,000	$0	289	330	$0	0	0	$84,908	122	0	$125,723	258	0	$0	0	275
SubTotal:	$877,500	$877,500	$0	616	15,044	$4,948,697	6,335	16,922	$84,908	122	0	$125,723	258	0	$0	0	0
4. Habitat Acquisition Programs																	
4A - Critical Lands Conservation Initiative - Pheasants Forever	$350,000	$349,985	$15	130	0	$428,446	159	0	$0	0	0	$0	0	0	$0	0	0
4B - Fisheries Land Acquisition - MN DNR - Division of Fisheries	$250,000	$250,000	$0	42	2,076	$299,000	24	1,650	$180,000	36	522	$0	0	0	$653,828	79	2,905
4C - Critical Lands Protection Program - The Trust for Public Land	$350,000	$350,000	$0	106	1,931	$60,000	18	331	$1,040,000	316	5,738	$0	0	0	$0	0	0
4H - Habitat Acquisition for Minnesota Valley Wetland Managment District of UWFWS - MN Valley Trust	$50,000	$50,000	$0	30	0	$85,681	50	0	$0	0	0	$0	0	0	$0	0	0
4I - Professional Services - MN DNR - Division of Fish & Wildlife	$30,000	$30,000	$0	0	0	$0	0	0	$0	0	0	$0	0	0	$0	0	0
SubTotal:	$1,030,000	$1,029,985	$15	309	4,007	$873,127	251	1,981	$1,220,000	351	6,260	$0	0	0	$653,828	79	2,905
Grand Total:	$3,150,000	$3,100,005	$49,995	8,143	119,832	$6,607,398	8,423	8,423	$1,341,992	473	473	$135,613	100	258	$692,320	100	258

Funding Type Definitions

ENTF:	Grant dollars provided through the Minnesota Environment and Natural Resources Trust Fund
Other Funds:	Non-state, non-state leveraged dollars (if partner funds are leveraging State Funds (e.g. RIM) they are not eligible to be considered Other Funds)
State Funds:	State Funds expended on HCP projects (not eligible for use as Other Funds commitment)
Partner's State Leveraged Funds:	Non State Funds that have leveraged State Funds as part of an HCP project (not eligible for use as Other Funds commitment)
Other:	Any other expenditures (e.g. grant income funds)

Table 3 - Accomplishments by Project Area - Phase 5 | **Minnesota Habitat Conservation Partnership** |

	ENVIRONMENTAL AND NATURAL RESOURCES TRUST FUNDS					OTHER FUNDS					STATE FUNDS					PARTNERS STATE LEVERGED FUNDS					OTHER				
Activity(Results)	Expenditure	Acquisition Acres	Easement Acres	Restoration Acres	Shoreline/ Riparian	Expenditure	Acquisition Acres	Easement Acres	Restoration Acres	Shoreline/ Riparian	Expenditure	Acquisition Acres	Easement Acres	Restoration Acres	Shoreline/ Riparian	Expenditure	Acquisition Acres	Easement Acres	Restoration Acres	Shoreline/ Riparian	Expenditure	Acquisition Acres	Easement Acres	Restoration Acres	Shoreline/ Riparian
1 - Aspen Parklands																									
Restoration																									
2A -Hides for Habitat	$29,928	0	0	15	0	$15,000	0	0	0	0	$0	0	0	0	0	$9,890	0	0	0	0	$7,467	0	0	0	0
2B -Partners for Wildlife	$1,200	0	0	8	0	$975	0	0	7	0	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
2O -Working Lands Partnership	$19,849	0	0	16	0	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
Restoration Subtotal	$50,977	0	0	39	0	$975	0	0	7	0	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
Easement																									
3A -Shorelands Protection Program	$12,000	0	67	0	2,847	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
3D -Wetlands Reserve Program	$0	0	0	0	0	$3,073,753	0	4,876	0	0	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
Easement Subtotal	$12,000	0	67	0	2,847	$2,910,771	0	4,876	0	0	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
Acquisition																									
4C -Critical Lands Protection Program	$350,000	0	0	0	1,931	$60,000	18	0	0	331	$1,040,000	316	0	0	5,738	$0	0	0	0	0	$0	0	0	0	0
Acquisition Subtotal	$350,000	106	0	0	1,931	$60,000	18	0	0	331	$1,040,000	316	0	0	5,738	$0	0	0	0	0	$0	0	0	0	0
1 - Aspen Parklands Subtotal	$412,977	106	67	39	5,261	$2,971,746	18	4,876	7	414	$1,040,000	316	67	39	7,172	$0	316	0	0	0	$0	0	0	0	0
2 - Mississippi Headwaters																									
Restoration																									
2F -Shallow Lake & Impoundment Managment	$30,000	0	0	2,071	27,107	$10,602	0	0	36	4,181	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
2H -Fisheries Habitat Restoration	$9,546	0	0	0	25,864	$1,500	0	0	0	0	$1,000	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
2J -Lakescaping	$11,066	0	0	1	78	$1,000	0	0	0	7	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
Restoration Subtotal	$50,612	0	0	2,072	53,049	$13,102	0	0	36	4,188	$1,000	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
Easement																									
3A -Shorelands Protection Program	$15,000	0	23	0	1,508	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
Easement Subtotal	$15,000	0	23	0	1,508	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
Acquisition																									
4B -Fisheries Land Acquisition	$205,176	0	0	0	551	$0	0	0	0	0	$180,000	36	0	0	522	$0	0	0	0	0	$0	0	0	0	0
Acquisition Subtotal	$205,176	38	0	0	551	$0	0	0	0	0	$180,000	36	0	0	522	$0	0	0	0	0	$0	0	0	0	0
2 - Mississippi Headwaters Subtotal	$270,788	38	23	2,072	55,798	$13,102	0	0	36	4,188	$181,000	36	23	2,072	522	$0	36	0	0	0	$0	0	0	0	0

	ENVIRONMENTAL AND NATURAL RESOURCES TRUST FUNDS					OTHER FUNDS					STATE FUNDS					PARTNERS STATE LEVERGED FUNDS					OTHER				
Activity(Results)	Expenditure	Acquisition Acres	Easement Acres	Restoration Acres	Shoreline/ Riparian	Expenditure	Acquisition Acres	Easement Acres	Restoration Acres	Shoreline/ Riparian	Expenditure	Acquisition Acres	Easement Acres	Restoration Acres	Shoreline/ Riparian	Expenditure	Acquisition Acres	Easement Acres	Restoration Acres	Shoreline/ Riparian	Expenditure	Acquisition Acres	Easement Acres	Restoration Acres	Shoreline/ Riparian
3 - Border Prairie																									
Restoration																									
2B -Partners for Wildlife	$16,150	0	0	66	0	$51,753	0	0	74	0	$0	0	0	0	0	$0	0	0	0	0	$2,500	0	0	12	0
2H -Fisheries Habitat Restoration	$55,777	0	0	1	22,257	$12,000	0	0	0	249	$5,841	0	0	0	79	$0	0	0	0	0	$1,500	0	0	0	36
2K -Prairie Management	$30,225	0	0	512	0	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
2N -Campaign for Conservation	$80,149	0	0	48	0	$295,462	0	0	112	0	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
Restoration Subtotal	$182,301	0	0	627	22,257	$251,161	0	0	187	249	$5,841	0	0	0	79	$0	0	0	0	0	$4,000	0	0	12	36
Easement																									
3A -Shorelands Protection Program	$0	0	0	0	0	$158,000	0	149	0	1,297	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
Easement Subtotal	$0	0	0	0	0	$158,000	0	149	0	1,297	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
Acquisition																									
4A -Critical Lands Conservation Initiative	$21,408	0	0	0	0	$35,474	13	0	0	0	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
4B -Fisheries Land Acquisition	$38,897	0	0	0	1,525	$130,000	22	0	0	1,350	$0	0	0	0	0	$0	0	0	0	0	$3,828	0	0	0	90
Acquisition Subtotal	$60,305	12	0	0	1,525	$165,474	35	0	0	1,350	$0	0	0	0	0	$0	0	0	0	0	$3,828	0	0	0	90
3 - Border Prairie Subtotal	$242,606	12	0	627	24,747	$574,635	35	149	187	2,896	$5,841	0	0	627	79	$0	0	0	0	0	$7,828	0	0	12	126
4 - Central Lakes																									
Restoration																									
2B -Partners for Wildlife	$4,550	0	0	6	0	$7,183	0	0	10	0	$0	0	0	0	0	$0	0	0	0	0	$7,025	0	0	9	0
2H -Fisheries Habitat Restoration	$54,186	0	0	0	20,377	$23,250	0	0	0	170	$4,354	0	0	0	18	$0	0	0	0	0	$10,000	0	0	0	60
2J -Lakescaping	$15,386	0	0	1	169	$1,000	0	0	0	11	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
Restoration Subtotal	$74,122	0	0	7	20,546	$31,433	0	0	10	181	$4,354	0	0	0	18	$0	0	0	0	0	$17,025	0	0	9	60
Easement																									
3A -Shorelands Protection Program	$24,000	0	68	0	4,580	$251,000	0	52	0	2,677	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
Easement Subtotal	$24,000	0	68	0	4,580	$251,000	0	52	0	2,677	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
Acquisition																									
4B -Fisheries Land Acquisition	$3,966	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0	$650,000	78	0	0	2,815
Acquisition Subtotal	$3,966	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0	$0	78	0	0	0	$650,000	78	0	0	2,815
4 - Central Lakes Subtotal	$102,088	0	68	7	21,573	$282,433	0	52	10	1,892	$4,354	0	68	7	18	$0	0	0	0	0	$667,025	78	0	9	2,875

	ENVIRONMENTAL AND NATURAL RESOURCES TRUST FUNDS					OTHER FUNDS					STATE FUNDS					PARTNERS STATE LEVERGED FUNDS					OTHER				
Activity(Results)	Expenditure	Acquisition Acres	Easement Acres	Restoration Acres	Shoreline/ Riparian	Expenditure	Acquisition Acres	Easement Acres	Restoration Acres	Shoreline/ Riparian	Expenditure	Acquisition Acres	Easement Acres	Restoration Acres	Shoreline/ Riparian	Expenditure	Acquisition Acres	Easement Acres	Restoration Acres	Shoreline/ Riparian	Expenditure	Acquisition Acres	Easement Acres	Restoration Acres	Shoreline/ Riparian
5 - Lower St. Louis River																									
Restoration																									
2H -Fisheries Habitat Restoration	$5,962	0	0	0	0	$0	0	0	0	0	$5,000	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
2N -Campaign for Conservation	$22,598	0	0	162	0	$108,054	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
Restoration Subtotal	$28,560	0	0	162	0	$0	0	0	0	0	$5,000	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
Easement																									
3A -Shorelands Protection Program	$15,000	0	82	0	3,750	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
Easement Subtotal	$15,000	0	82	0	3,750	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
Acquisition																									
4B -Fisheries Land Acquisition	$1,042	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
Acquisition Subtotal	$1,042	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
5 - Lower St. Louis River Subtotal	$44,602	0	82	162	966	$0	0	0	0	0	$5,000	0	82	162	0	$0	0	0	0	0	$0	0	0	0	0
6 - Upper Minnesota River																									
Restoration																									
2B -Partners for Wildlife	$5,000	0	0	54	0	$4,000	0	0	44	0	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
2C -Living Lakes Enhancement	$32,920	0	0	0	0	$67,557	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
2H -Fisheries Habitat Restoration	$3,666	0	0	1	1	$0	0	0	0	0	$1,500	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
2K -Prairie Management	$4,700	0	0	108	0	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
2N -Campaign for Conservation	$20,000	0	0	523	0	$138,454	0	0	795	0	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
Restoration Subtotal	$66,286	0	0	686	1	$80,114	0	0	839	0	$1,500	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
Acquisition																									
4A -Critical Lands Conservation Initiative	$94,473	0	0	0	0	$136,263	69	0	0	0	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
4B -Fisheries Land Acquisition	$719	0	0	0	0	$169,000	3	0	0	300	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
Acquisition Subtotal	$95,192	48	0	0	0	$305,263	71	0	0	300	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
6 - Upper Minnesota River Subtotal	$161,477	48	0	686	967	$385,377	71	0	839	300	$1,500	0	0	686	0	$0	0	0	0	0	$0	0	0	0	0
7 - Alexandria Moraine																									
Restoration																									
2K -Prairie Management	$8,000	0	0	64	0	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
2N -Campaign for Conservation	$30,000	0	0	105	0	$117,954	0	0	35	0	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
Restoration Subtotal	$38,000	0	0	169	0	$9,900	0	0	35	0	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
Easement																									
3D -Wetlands Reserve Program	$0	0	0	0	0	$735,055	0	334	0	0	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
Easement Subtotal	$0	0	0	0	0	$572,072	0	334	0	0	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
7 - Alexandria Moraine Subtotal	$38,000	0	0	169	966	$581,972	0	334	35	0	$0	0	0	169	0	$0	0	0	0	0	$0	0	0	0	0

	ENVIRONMENTAL AND NATURAL RESOURCES TRUST FUNDS					OTHER FUNDS					STATE FUNDS					PARTNERS STATE LEVERGED FUNDS					OTHER				
Activity(Results)	Expenditure	Acquisition Acres	Easement Acres	Restoration Acres	Shoreline/ Riparian	Expenditure	Acquisition Acres	Easement Acres	Restoration Acres	Shoreline/ Riparian	Expenditure	Acquisition Acres	Easement Acres	Restoration Acres	Shoreline/ Riparian	Expenditure	Acquisition Acres	Easement Acres	Restoration Acres	Shoreline/ Riparian	Expenditure	Acquisition Acres	Easement Acres	Restoration Acres	Shoreline/ Riparian
9 - Des Moines River Valley																									
Restoration																									
2B -Partners for Wildlife	$3,100	0	0	3	0	$14,944	0	0	16	0	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
2C -Living Lakes Enhancement	$11,025	0	0	0	0	$32,330	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
2H -Fisheries Habitat Restoration	$5,770	0	0	0	8	$500	0	0	0	0	$4,150	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
2I -Set Out Seedlings	$10,833	0	0	23	0	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
2J -Lakescaping	$48,548	0	0	4	414	$4,000	0	0	0	26	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
2K -Prairie Management	$31,775	0	0	333	0	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
Restoration Subtotal	$111,051	0	0	363	422	$29,931	0	0	16	26	$4,150	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
Acquisition																									
4A -Critical Lands Conservation Initiative	$34,279	0	0	0	0	$54,500	24	0	0	0	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
Acquisition Subtotal	$34,279	15	0	0	0	$54,500	24	0	0	0	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
9 - Des Moines River Valley Subtotal	$145,330	15	0	363	1,388	$84,431	24	0	16	26	$4,150	0	0	363	0	$0	0	0	0	0	$0	0	0	0	0
10 - Southern Lakes																									
Restoration																									
2C -Living Lakes Enhancement	$67,899	0	0	504	0	$177,831	0	0	391	0	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
2G -Wildlife Areas Management	$4,913	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
2H -Fisheries Habitat Restoration	$2,318	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
Restoration Subtotal	$75,130	0	0	504	0	$155,988	0	0	391	0	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
Easement																									
3A -Shorelands Protection Program	$7,757	0	0	0	0	$5,000	0	392	0	6,173	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
3D -Wetlands Reserve Program	$0	0	0	0	0	$328,298	0	77	0	0	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
Easement Subtotal	$7,757	0	0	0	0	$170,315	0	469	0	6,173	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
Acquisition																									
4A -Critical Lands Conservation Initiative	$194,648	0	0	0	0	$169,934	49	0	0	0	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
4H -Habitat Acquisition for Minnesota Valley Wetland Managment District of UWFWS	$50,000	0	0	0	0	$85,681	50	0	0	0	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
Acquisition Subtotal	$244,648	90	0	0	0	$255,615	98	0	0	0	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
10 - Southern Lakes Subtotal	$327,535	90	0	504	966	$581,918	98	469	391	0	$0	0	0	504	0	$0	0	0	0	0	$0	0	0	0	0

Table 3 - Accomplishments by Project Area - Phase 5 | **Minnesota Habitat Conservation Partnership** |

	ENVIRONMENTAL AND NATURAL RESOURCES TRUST FUNDS					OTHER FUNDS					STATE FUNDS					PARTNERS STATE LEVERGED FUNDS					OTHER				
Activity(Results)	Expenditure	Acquisition Acres	Easement Acres	Restoration Acres	Shoreline/ Riparian	Expenditure	Acquisition Acres	Easement Acres	Restoration Acres	Shoreline/ Riparian	Expenditure	Acquisition Acres	Easement Acres	Restoration Acres	Shoreline/ Riparian	Expenditure	Acquisition Acres	Easement Acres	Restoration Acres	Shoreline/ Riparian	Expenditure	Acquisition Acres	Easement Acres	Restoration Acres	Shoreline/ Riparian
11 - Mississippi Bluff Lands																									
Restoration																									
2H -Fisheries Habitat Restoration	$54,193	0	0	0	4,350	$0	0	0	0	0	$13,654	0	0	0	0	$0	0	0	0	0	$10,000	0	0	0	0
2P -Bluffland Restoration	$63,000	0	0	44	0	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
Restoration Subtotal	$117,193	0	0	44	4,350	$0	0	0	0	0	$13,654	0	0	0	0	$0	0	0	0	0	$10,000	0	0	0	0
Easement																									
3E -RIM Reserve	$25,227	0	11	0	275	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
Easement Subtotal	$25,227	0	11	0	275	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
Acquisition																									
4B -Fisheries Land Acquisition	$200	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
Acquisition Subtotal	$200	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
11 - Mississippi Bluff Lands Subtotal	$142,620	0	11	44	5,316	$0	0	0	0	0	$13,654	0	11	44	0	$0	0	0	0	0	$10,000	0	0	0	0
3-7-8 - Border Prairie Transition Zon																									
Restoration																									
2C -Living Lakes Enhancement	$60,000	0	0	86	0	$84,042	0	0	36	0	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
2G -Wildlife Areas Management	$24,189	0	0	41	0	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
2H -Fisheries Habitat Restoration	$7,343	0	0	0	156	$1,575	0	0	0	39	$1,585	0	0	0	5	$0	0	0	0	0	$0	0	0	0	0
2N -Campaign for Conservation	$36,859	0	0	2,417	0	$112,355	0	0	282	0	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
3E -RIM Reserve	$0	0	0	0	0	$0	0	0	0	0	$84,908	0	0	122	0	$125,723	0	0	258	0	$0	0	0	0	0
Restoration Subtotal	$128,390	0	0	2,544	156	$68,075	0	0	318	39	$86,493	0	0	122	5	$125,723	0	0	258	0	$0	0	0	0	0
Easement																									
3C -Living Lakes Easements	$140,380	0	87	0	2,028	$519,886	0	305	0	6,775	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
3D -Wetlands Reserve Program	$0	0	0	0	0	$366,653	0	150	0	0	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
3E -RIM Reserve	$224,773	0	279	0	56	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
Easement Subtotal	$365,153	0	366	0	2,084	$660,011	0	455	0	6,775	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
Acquisition																									
4A -Critical Lands Conservation Initiative	$177	0	0	0	0	$32,275	5	0	0	0	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
Acquisition Subtotal	$177	0	0	0	0	$32,275	5	0	0	0	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
3-7-8 - Border Prairie Transition Zone Subtotal	$493,721	0	366	2,544	3,205	$760,360	5	455	318	6,814	$86,493	0	366	2,544	5	$125,723	0	0	258	0	$0	0	0	0	0

Table 3 - Accomplishments by Project Area - Phase 5 | **Minnesota Habitat Conservation Partnership** |

	ENVIRONMENTAL AND NATURAL RESOURCES TRUST FUNDS					OTHER FUNDS					STATE FUNDS					PARTNERS STATE LEVERGED FUNDS					OTHER				
Activity(Results)	Expenditure	Acquisition Acres	Easement Acres	Restoration Acres	Shoreline/ Riparian	Expenditure	Acquisition Acres	Easement Acres	Restoration Acres	Shoreline/ Riparian	Expenditure	Acquisition Acres	Easement Acres	Restoration Acres	Shoreline/ Riparian	Expenditure	Acquisition Acres	Easement Acres	Restoration Acres	Shoreline/ Riparian	Expenditure	Acquisition Acres	Easement Acres	Restoration Acres	Shoreline/ Riparian
Expenditures not Attributable to Specific Projects	$718,261	-	-	-	-	$371,426	-	-	-	-	$0	-	-	-	-	$9,890	-	-	-	-	$7,467	-	-	-	-
Grand Total:	$3,100,005	309	616	7,218	119,832	$6,607,398	251	6,335	1,837	23,585	$1,341,992	351	0	122	6,362	$135,613	0	0	258	0	$692,320	79	0	21	3,001

Funding Type Definitions

ENTF:	Grant dollars provided through the Minnesota Environment and Natural Resources Trust Fund
Other Funds:	Non-state, non-state leveraged dollars (if partner funds are leveraging State Funds (e.g. RIM) they are not eligible to be considered Other Funds)
State Funds:	State Funds expended on HCP projects (not eligible for use as Other Funds commitment)
Partner's State Leveraged Funds:	Non State Funds that have leveraged State Funds as part of an HCP project (not eligible for use as Other Funds commitment)
Other:	Any other expenditures (e.g. grant income funds)

Table 4 - Accomplishments by Result - Phase 5 | **Minnesota Habitat Conservation Partnership** |

	ENVIRONMENTAL AND NATURAL RESOURCES TRUST FUNDS					OTHER FUNDS					STATE FUNDS					PARTNERS STATE LEVERGED FUNDS					OTHER				
Activity(Results)	Expenditure	Acquisition Acres	Easement Acres	Restoration Acres	Shoreline/ Riparian	Expenditure	Acquisition Acres	Ease ment Acres	Restoration Acres	Shoreline/ Riparian	Expenditure	Acquisition Acres	Easement Acres	Restoration Acres	Shoreline/ Riparian	Expenditure	Acq. Acres	Easement Acres	Rest. Acres	Shoreline/ Riparian	Expenditure	Acquisition Acres	Easement Acres	Restoration Acres	Shoreline/ Riparian
Project Coordination/Mapping																									
1A -Project Coordination and Mapping	$52,041	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
SubTotal:	$52,041	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
Restoration																									
2A -Hides for Habitat	$29,928	0	0	15	0	$15,000	0	0	0	0	$0	0	0	0	0	$9,890	0	0	0	0	$7,467	0	0	0	0
2B -Partners for Wildlife	$30,000	0	0	139	0	$78,855	0	0	150	0	$0	0	0	0	0	$0	0	0	0	0	$9,525	0	0	21	0
2C -Living Lakes Enhancement	$180,000	0	0	590	0	$296,231	0	0	427	0	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
2D -Shallow Lakes Management	$73,308	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
2E -Wild Rice Habitat Restoration	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
2F -Shallow Lake & Impoundment Managment	$30,000	0	0	2,071	27,107	$10,602	0	0	36	4,181	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
2G -Wildlife Areas Management	$29,102	0	0	41	0	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
2H -Fisheries Habitat Restoration	$198,760	0	0	2	73,013	$38,825	0	0	0	457	$37,084	0	0	0	102	$0	0	0	0	0	$21,500	0	0	0	96
2I -Set Out Seedlings	$12,833	0	0	23	0	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
2J -Lakescaping	$75,000	0	0	6	661	$6,000	0	0	0	44	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
2K -Prairie Management	$74,700	0	0	1,017	0	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
2N -Campaign for Conservation	$317,000	0	0	3,255	0	$340,062	0	0	1,224	0	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
2O -Working Lands Partnership	$19,849	0	0	16	0	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
2P -Bluffland Restoration	$70,000	0	0	44	0	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
3E -RIM Reserve	$0	0	0	0	0	$0	0	0	0	0	$84,908	0	0	122	0	$125,723	0	0	258	0	$0	0	0	0	0
SubTotal:	1,335,986	0	0	7,218	100,781	$867,206	0	0	1,837	4,682	$121,992	0	0	122	102	$125,723	0	0	258	0	$31,025	0	0	21	96
Easement																									
3A -Shorelands Protection Program	$210,000	0	240	0	12,685	$414,000	0	593	0	10,147	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
3C -Living Lakes Easements	$150,000	0	87	0	2,028	$519,886	0	305	0	6,775	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
3D -Wetlands Reserve Program	$267,500	0	0	0	0	$4,014,810	0	5,437	0	0	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
3E -RIM Reserve	$250,000	0	289	0	330	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
SubTotal:	$877,500	0	616	0	15,044	$4,948,697	0	6,335	0	16,922	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
Acquisition																									
4A -Critical Lands Conservation Initiative	$349,985	130	0	0	0	$428,446	159	0	0	0	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
4B -Fisheries Land Acquisition	$250,000	42	0	0	2,076	$299,000	24	0	0	1,650	$180,000	36	0	0	522	$0	0	0	0	0	$653,828	79	0	0	2,905
4C -Critical Lands Protection Program	$350,000	106	0	0	1,931	$60,000	18	0	0	331	$1,040,000	316	0	0	5,738	$0	0	0	0	0	$0	0	0	0	0
4H -Habitat Acquisition for Minnesota Valley Wetland Managment District of UWFWS	$50,000	30	0	0	0	$85,681	50	0	0	0	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
4I -Professional Services	$30,000	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0	$0	0	0	0	0
SubTotal:	1,029,985	309	0	0	4,007	$873,127	251	0	0	1,981	$1,220,000	351	0	0	6,260	$0	79	0	0	0	$653,828	79	0	0	2,905

	ENVIRONMENTAL AND NATURAL RESOURCES TRUST FUNDS					OTHER FUNDS					STATE FUNDS					PARTNERS STATE LEVERGED FUNDS					OTHER				
Activity(Results)	Expenditure	Acquisition Acres	Easement Acres	Restoration Acres	Shoreline/ Riparian	Expenditure	Acquisition Acres	Ease ment Acres	Restoration Acres	Shoreline/ Riparian	Expenditure	Acquisition Acres	Easement Acres	Restoration Acres	Shoreline/ Riparian	Expenditure	Acq. Acres	Easement Acres	Rest. Acres	Shoreline/ Riparian	Expenditure	Acquisition Acres	Easement Acres	Restoration Acres	Shoreline/ Riparian
Grand Total:	3,100,005	309	616	7,2181	19,832	$6,607,398	251	6,335	1,837	23,585	$1,341,992	351	0	122	6,362	$135,613	0	0	258	0	$692,320	79	0	21	3,001

*Table 4 reflects Habitat Conservation Partnership expenditures by result. Please note that the expenditures for restoration, easement acquisition and fee-title acquisition reflected here will not exactly match the subtotals for those categories reflected in Table 2. Also note that the total expenditures are identical. The reason for this is that some work programs expend dollars on both acquisition and restoration. For example, a partner working under the 4a work program to acquire a state wildlife management area (acquisition) is also responsible to ensure that the initial habitat is developed (restoration) on that acquired parcel.

Funding Type Definitions

ENTF:	Grant dollars provided through the Minnesota Environment and Natural Resources Trust Fund
Other Funds:	Non-state, non-state leveraged dollars (if partner funds are leveraging State Funds (e.g. RIM) they are not eligible to be considered Other Funds)
State Funds:	State Funds expended on HCP projects (not eligible for use as Other Funds commitment)
Partner's State Leveraged Funds:	Non State Funds that have leveraged State Funds as part of an HCP project (not eligible for use as Other Funds commitment)
Other:	Any other expenditures (e.g. grant income funds)

	ENTF			Other		
	FundingAmoun	ProRatedAcres	ProRatedShorel	FundingAmoun	ProRatedAcres	ProRatedShorel
2A	**$29,928.06**	**14.69**	**0.00**	**$0.00**	**0.00**	**0.00**
2B	**$30,000.00**	**138.50**	**0.00**	**$9,525.00**	**21.21**	**0.00**
2C	**$171,844.00**	**590.13**	**0.00**	**$0.00**	**0.00**	**0.00**
2F	**$30,000.08**	**2,071.41**	**27,106.37**	**$0.00**	**0.00**	**0.00**
2G	**$29,101.98**	**40.80**	**0.00**	**$0.00**	**0.00**	**0.00**
2H	**$198,760.47**	**2.32**	**73,012.82**	**$21,500.00**	**0.06**	**95.80**
2I	**$10,833.03**	**23.00**	**0.00**	**$0.00**	**0.00**	**0.00**
2J	**$75,000.00**	**5.63**	**661.18**	**$0.00**	**0.00**	**0.00**
2K	**$74,700.00**	**1,017.00**	**0.00**	**$0.00**	**0.00**	**0.00**
2N	**$189,606.10**	**3,255.11**	**0.00**	**$0.00**	**0.00**	**0.00**
2O	**$19,849.14**	**16.00**	**0.00**	**$0.00**	**0.00**	**0.00**
2P	**$63,000.00**	**43.50**	**0.00**	**$0.00**	**0.00**	**0.00**
3E	**$0.00**	**0.00**	**0.00**	**$0.00**	**0.00**	**0.00**
Total	**$922,622.86**	**7,218.09**	**100,780.36**	**$31,025.00**	**21.26**	**95.80**

Other Funds			Partners State Leveraged Funds		
FundingAmoun	ProRatedAcres	ProRatedShorel	FundingAmoun	ProRatedAcres	ProRatedShorel
$0.00	**0.00**	**0.00**	**$0.00**	**0.00**	**0.00**
$78,855.00	**150.45**	**0.00**	**$0.00**	**0.00**	**0.00**
$274,388.41	**426.77**	**0.00**	**$0.00**	**0.00**	**0.00**
$10,601.50	**35.55**	**4,180.77**	**$0.00**	**0.00**	**0.00**
$0.00	**0.00**	**0.00**	**$0.00**	**0.00**	**0.00**
$38,825.00	**0.28**	**457.25**	**$0.00**	**0.00**	**0.00**
$0.00	**0.00**	**0.00**	**$0.00**	**0.00**	**0.00**
$6,000.00	**0.37**	**43.76**	**$0.00**	**0.00**	**0.00**
$0.00	**0.00**	**0.00**	**$0.00**	**0.00**	**0.00**
$232,007.42	**1,223.46**	**0.00**	**$0.00**	**0.00**	**0.00**
$0.00	**0.00**	**0.00**	**$0.00**	**0.00**	**0.00**
$0.00	**0.00**	**0.00**	**$0.00**	**0.00**	**0.00**
$0.00	**0.00**	**0.00**	**$125,723.00**	**257.81**	**0.00**
$640,677.33	**1,836.88**	**4,681.79**	**$125,723.00**	**257.81**	**0.00**

State Funds			Total		
FundingAmoun	ProRatedAcres	ProRatedShorel	FundingAmoun	ProRatedAcres	ProRatedShorel
$0.00	**0.00**	**0.00**	**$29,928.06**	**14.69**	**0.00**
$0.00	**0.00**	**0.00**	**$118,380.00**	**310.17**	**0.00**
$0.00	**0.00**	**0.00**	**$446,232.41**	**1,016.90**	**0.00**
$0.00	**0.00**	**0.00**	**$40,601.58**	**2,106.96**	**31,287.14**
$0.00	**0.00**	**0.00**	**$29,101.98**	**40.80**	**0.00**
$37,084.00	**0.16**	**101.70**	**$296,169.47**	**2.81**	**73,667.57**
$0.00	**0.00**	**0.00**	**$10,833.03**	**23.00**	**0.00**
$0.00	**0.00**	**0.00**	**$81,000.00**	**6.00**	**704.94**
$0.00	**0.00**	**0.00**	**$74,700.00**	**1,017.00**	**0.00**
$0.00	**0.00**	**0.00**	**$421,613.52**	**4,478.57**	**0.00**
$0.00	**0.00**	**0.00**	**$19,849.14**	**16.00**	**0.00**
$0.00	**0.00**	**0.00**	**$63,000.00**	**43.50**	**0.00**
$84,908.00	**121.78**	**0.00**	**$210,631.00**	**379.59**	**0.00**
$121,992.00	**121.93**	**101.70**	**$1,842,040.19**	**9,455.97**	**105,659.64**

Restoration Expenditures and Accomplishments by Funding Type, Activity, Land Type, and Owner

Minnesota's Habitat Conservation Partnership - Phase 5

The table below reflects expenditures attributable to specific restoration projects. Please note that the expenditures here will not match the subtotals for those categories reflected in Table 2 and Table 4. Also note that the total accomplishments(acres and shoreline) are identical. The reason for this is that some work programs expend dollars not attributable to a specific projects. For example Ducks Unlimited expends funds on technical assistance by DU biologists to DNR, US Fish & Wildlife Service, local units of goverment, and private landowners regarding shallow lake assesment, improvment, and managment. These personal expenditures are not reflected in the table below.

Funding Type Definitions

ENTF:	Grant dollars provided through the Minnesota Environment and Natural Resources Trust Fund
Other Funds:	Non-state, non-state leveraged dollars (If partner funds are leveraging state funds (e.g. RIM) they are not eligible to be considered Other Funds)
State Funds:	State Funds expended on HCP projects (not eligible for use as other funds commitment)
Partners State Levereged Funds:	Non state funds that have leveraged state funds as part of an HCP project (not eligible for use as other funds commitment)
Other:	Any other expenditures (e.g. grant income funds)

			ENTF			Other Funds			Partners State Leveraged Funds			State Funds			Other			Total		
			Expenditures	Acres	Shoreline	Expenditures	Acres	Shoreline	Expenditures	Acres	Shoreline	Expenditures	Acres	Shoreline	Expenditures	Acres	Shoreline	Expenditures	Acres	Shoreline
Dam Modification	Public	AMA	$5,444	0	8	$0	0	0	$0	0	0	$1,000	0	0	$0	0	0	$6,444	0	8
		Lake	$2,318	0	0	$0	0	0	$0	0	0	$0	0	0	$0	0	0	$2,318	0	0
		River	$6,709	0	46,984	$0	0	0	$0	0	0	$2,500	0	0	$0	0	0	$9,209	0	46,984
		Total	**$14,471**	**0**	**46,992**	**$0**	**0**	**0**	**$0**	**0**	**0**	**$3,500**	**0**	**0**	**$0**	**0**	**0**	**$17,971**	**0**	**46,992**
	Total		**$14,471**	**0**	**46,992**	**$0**	**0**	**0**	**$0**	**0**	**0**	**$3,500**	**0**	**0**	**$0**	**0**	**0**	**$17,971**	**0**	**46,992**
Grassland Enhancement	Private	Lake	$5,950	74	0	$0	0	0	$0	0	0	$0	0	0	$0	0	0	$5,950	74	0
		Land	$102,430	552	0	$35,325	66	0	$0	0	0	$0	0	0	$1,500	11	0	$139,255	629	0
		Total	**$108,380**	**626**	**0**	**$35,325**	**66**	**0**	**$0**	**0**	**0**	**$0**	**0**	**0**	**$1,500**	**11**	**0**	**$145,205**	**703**	**0**
	Public	SNA	$22,640	314	0	$0	0	0	$0	0	0	$0	0	0	$0	0	0	$22,640	314	0
		WMA	$29,928	15	0	$0	0	0	$0	0	0	$0	0	0	$0	0	0	$29,928	15	0
		Total	**$52,568**	**329**	**0**	**$0**	**0**	**0**	**$0**	**0**	**0**	**$0**	**0**	**0**	**$0**	**0**	**0**	**$52,568**	**329**	**0**

Restoration Expenditures and Accomplishments by Funding Type, Activity, Land Type, and Owner

Minnesota's Habitat Conservation Partnership - Phase 5

The table below reflects expenditures attributable to specific restoration projects. Please note that the expenditures here will not match the subtotals for those categories reflected in Table 2 and Table 4. Also note that the total accomplishments(acres and shoreline) are identical. The reason for this is that some work programs expend dollars not attributable to a specific projects. For example Ducks Unlimited expends funds on technical assistance by DU biologists to DNR, US Fish & Wildlife Service, local units of goverment, and private landowners regarding shallow lake assesment, improvment, and managment. These personal expenditures are not reflected in the table below.

Funding Type Definitions

ENTF:	Grant dollars provided through the Minnesota Environment and Natural Resources Trust Fund
Other Funds:	Non-state, non-state leveraged dollars (If partner funds are leveraging state funds (e.g. RIM) they are not eligible to be considered Other Funds)
State Funds:	State Funds expended on HCP projects (not eligible for use as other funds commitment)
Partners State Levereged Funds:	Non state funds that have leveraged state funds as part of an HCP project (not eligible for use as other funds commitment)
Other:	Any other expenditures (e.g. grant income funds)

			ENTF			Other Funds			Partners State Leveraged Funds			State Funds			Other			Total		
			Expenditures	Acres	Shoreline	Expenditures	Acres	Shoreline	Expenditures	Acres	Shoreline	Expenditures	Acres	Shoreline	Expenditures	Acres	Shoreline	Expenditures	Acres	Shoreline
Grassland	**Total**		**$160,948**	**955**	**0**	**$35,325**	**66**	**0**	**$0**	**0**	**0**	**$0**	**0**	**0**	**$1,500**	**11**	**0**	**$197,773**	**1,032**	**0**
Grassland Restoration	Private	Land	$182,738	3,284	0	$245,507	1,251	0	$61,223	204	0	$20,408	68	0	$1,000	1	0	$510,876	4,808	0
		Total	**$182,738**	**3,284**	**0**	**$245,507**	**1,251**	**0**	**$61,223**	**204**	**0**	**$20,408**	**68**	**0**	**$1,000**	**1**	**0**	**$510,876**	**4,808**	**0**
	Public	Lake	$4,808	12	0	$3,000	8	0	$0	0	0	$0	0	0	$0	0	0	$7,808	20	0
		SNA	$5,800	48	0	$0	0	0	$0	0	0	$0	0	0	$0	0	0	$5,800	48	0
		Total	**$10,608**	**60**	**0**	**$3,000**	**8**	**0**	**$0**	**0**	**0**	**$0**	**0**	**0**	**$0**	**0**	**0**	**$13,608**	**68**	**0**
	Total		**$193,346**	**3,345**	**0**	**$248,507**	**1,259**	**0**	**$61,223**	**204**	**0**	**$20,408**	**68**	**0**	**$1,000**	**1**	**0**	**$524,484**	**4,876**	**0**
Nestbox Installed	Public	Lake	$167	0	0	$0	0	0	$0	0	0	$0	0	0	$0	0	0	$167	0	0
		Total	**$167**	**0**	**0**	**$0**	**0**	**0**	**$0**	**0**	**0**	**$0**	**0**	**0**	**$0**	**0**	**0**	**$167**	**0**	**0**
	Tribal	Lake	$3,833	0	0	$382	0	0	$0	0	0	$0	0	0	$0	0	0	$4,215	0	0
		Total	**$3,833**	**0**	**0**	**$382**	**0**	**0**	**$0**	**0**	**0**	**$0**	**0**	**0**	**$0**	**0**	**0**	**$4,215**	**0**	**0**

Restoration Expenditures and Accomplishments by Funding Type, Activity, Land Type, and Owner

Minnesota's Habitat Conservation Partnership - Phase 5

The table below reflects expenditures attributable to specific restoration projects. Please note that the expenditures here will not match the subtotals for those categories reflected in Table 2 and Table 4. Also note that the total accomplishments(acres and shoreline) are identical. The reason for this is that some work programs expend dollars not attributable to a specific projects. For example Ducks Unlimited expends funds on technical assistance by DU biologists to DNR, US Fish & Wildlife Service, local units of goverment, and private landowners regarding shallow lake assesment, improvment, and managment. These personal expenditures are not reflected in the table below.

Funding Type Definitions

ENTF:	Grant dollars provided through the Minnesota Environment and Natural Resources Trust Fund
Other Funds:	Non-state, non-state leveraged dollars (If partner funds are leveraging state funds (e.g. RIM) they are not eligible to be considered Other Funds)
State Funds:	State Funds expended on HCP projects (not eligible for use as other funds commitment)
Partners State Levereged Funds:	Non state funds that have leveraged state funds as part of an HCP project (not eligible for use as other funds commitment)
Other:	Any other expenditures (e.g. grant income funds)

			ENTF			Other Funds			Partners State Leveraged Funds			State Funds			Other			Total		
			Expenditures	Acres	Shoreline	Expenditures	Acres	Shoreline	Expenditures	Acres	Shoreline	Expenditures	Acres	Shoreline	Expenditures	Acres	Shoreline	Expenditures	Acres	Shoreline
Nestbox	**Total**		**$4,000**	**0**	**0**	**$382**	**0**	**0**	**$0**	**0**	**0**	**$0**	**0**	**0**	**$0**	**0**	**0**	**$4,382**	**0**	**0**
Shallow Lake Survey / Design /	Public	Lake	$15,704	0	0	$28,916	0	0	$0	0	0	$0	0	0	$0	0	0	$44,620	0	0
		WPA	$32,920	0	0	$45,714	0	0	$0	0	0	$0	0	0	$0	0	0	$78,634	0	0
		Total	**$48,624**	**0**	**0**	**$74,631**	**0**	**0**	**$0**	**0**	**0**	**$0**	**0**	**0**	**$0**	**0**	**0**	**$123,254**	**0**	**0**
	Total		**$48,624**	**0**	**0**	**$74,631**	**0**	**0**	**$0**	**0**	**0**	**$0**	**0**	**0**	**$0**	**0**	**0**	**$123,254**	**0**	**0**
Shoreline Habitat Restoratio n /	Private	Lake	$82,313	6	894	$7,825	0	102	$0	0	0	$302	0	9	$0	0	0	$90,440	6	1,005
		Total	**$82,313**	**6**	**894**	**$7,825**	**0**	**102**	**$0**	**0**	**0**	**$302**	**0**	**9**	**$0**	**0**	**0**	**$90,440**	**6**	**1,005**
	Public	Lake	$104,686	1	1,437	$37,000	0	399	$0	0	0	$14,028	0	93	$11,500	0	96	$167,214	1	2,025
		River	$68,625	0	24,350	$0	0	0	$0	0	0	$17,754	0	0	$10,000	0	0	$96,379	0	24,350
		Total	**$173,311**	**1**	**25,787**	**$37,000**	**0**	**399**	**$0**	**0**	**0**	**$31,782**	**0**	**93**	**$21,500**	**0**	**96**	**$263,593**	**1**	**26,375**
	Total		**$255,624**	**7**	**26,681**	**$44,825**	**1**	**501**	**$0**	**0**	**0**	**$32,084**	**0**	**102**	**$21,500**	**0**	**96**	**$354,033**	**8**	**27,380**
Site /	Public	WMA	$29,102	41	0	$0	0	0	$0	0	0	$0	0	0	$0	0	0	$29,102	41	0

Restoration Expenditures and Accomplishments by Funding Type, Activity, Land Type, and Owner

Minnesota's Habitat Conservation Partnership - Phase 5

The table below reflects expenditures attributable to specific restoration projects. Please note that the expenditures here will not match the subtotals for those categories reflected in Table 2 and Table 4. Also note that the total accomplishments(acres and shoreline) are identical. The reason for this is that some work programs expend dollars not attributable to a specific projects. For example Ducks Unlimited expends funds on technical assistance by DU biologists to DNR, US Fish & Wildlife Service, local units of goverment, and private landowners regarding shallow lake assesment, improvment, and managment. These personal expenditures are not reflected in the table below.

Funding Type Definitions

ENTF:	Grant dollars provided through the Minnesota Environment and Natural Resources Trust Fund
Other Funds:	Non-state, non-state leveraged dollars (If partner funds are leveraging state funds (e.g. RIM) they are not eligible to be considered Other Funds)
State Funds:	State Funds expended on HCP projects (not eligible for use as other funds commitment)
Partners State Levereged Funds:	Non state funds that have leveraged state funds as part of an HCP project (not eligible for use as other funds commitment)
Other:	Any other expenditures (e.g. grant income funds)

			ENTF			Other Funds			Partners State Leveraged Funds			State Funds			Other			Total		
			Expenditures	Acres	Shoreline	Expenditures	Acres	Shoreline	Expenditures	Acres	Shoreline	Expenditures	Acres	Shoreline	Expenditures	Acres	Shoreline	Expenditures	Acres	Shoreline
Site / Access Developme	Public	**Total**	**$29,102**	**41**	**0**	**$0**	**0**	**0**	**$0**	**0**	**0**	**$0**	**0**	**0**	**$0**	**0**	**0**	**$29,102**	**41**	**0**
	Total		**$29,102**	**41**	**0**	**$0**	**0**	**0**	**$0**	**0**	**0**	**$0**	**0**	**0**	**$0**	**0**	**0**	**$29,102**	**41**	**0**
Wetland Enhancem ent	Public	Lake	$52,195	504	0	$127,072	391	0	$0	0	0	$0	0	0	$0	0	0	$179,267	895	0
		NWR	$11,025	0	0	$10,487	0	0	$0	0	0	$0	0	0	$0	0	0	$21,512	0	0
		WPA	$60,000	86	0	$62,199	36	0	$0	0	0	$0	0	0	$0	0	0	$122,199	122	0
		Total	**$123,220**	**590**	**0**	**$199,758**	**427**	**0**	**$0**	**0**	**0**	**$0**	**0**	**0**	**$0**	**0**	**0**	**$322,978**	**1,017**	**0**
	Tribal	Lake	$1,784	88	0	$99	5	0	$0	0	0	$0	0	0	$0	0	0	$1,883	93	0
		Land	$1,000	70	0	$0	0	0	$0	0	0	$0	0	0	$0	0	0	$1,000	70	0
		Total	**$2,784**	**158**	**0**	**$99**	**5**	**0**	**$0**	**0**	**0**	**$0**	**0**	**0**	**$0**	**0**	**0**	**$2,883**	**163**	**0**
	Total		**$126,004**	**748**	**0**	**$199,856**	**432**	**0**	**$0**	**0**	**0**	**$0**	**0**	**0**	**$0**	**0**	**0**	**$325,861**	**1,180**	**0**
Wetland	Private	Land	$15,150	20	0	$30,030	57	0	$64,500	54	0	$64,500	54	0	$7,025	9	0	$181,205	193	0

Restoration Expenditures and Accomplishments by Funding Type, Activity, Land Type, and Owner

Minnesota's Habitat Conservation Partnership - Phase 5

The table below reflects expenditures attributable to specific restoration projects. Please note that the expenditures here will not match the subtotals for those categories reflected in Table 2 and Table 4. Also note that the total accomplishments(acres and shoreline) are identical. The reason for this is that some work programs expend dollars not attributable to a specific projects. For example Ducks Unlimited expends funds on technical assistance by DU biologists to DNR, US Fish & Wildlife Service, local units of goverment, and private landowners regarding shallow lake assesment, improvment, and managment. These personal expenditures are not reflected in the table below.

Funding Type Definitions

ENTF:	Grant dollars provided through the Minnesota Environment and Natural Resources Trust Fund
Other Funds:	Non-state, non-state leveraged dollars (If partner funds are leveraging state funds (e.g. RIM) they are not eligible to be considered Other Funds)
State Funds:	State Funds expended on HCP projects (not eligible for use as other funds commitment)
Partners State Levereged Funds:	Non state funds that have leveraged state funds as part of an HCP project (not eligible for use as other funds commitment)
Other:	Any other expenditures (e.g. grant income funds)

			ENTF			Other Funds			Partners State Leveraged Funds			State Funds			Other			Total		
			Expenditures	Acres	Shoreline	Expenditures	Acres	Shoreline	Expenditures	Acres	Shoreline	Expenditures	Acres	Shoreline	Expenditures	Acres	Shoreline	Expenditures	Acres	Shoreline
Wetland Restoration	Private	**Total**	**$15,150**	**20**	**0**	**$30,030**	**57**	**0**	**$64,500**	**54**	**0**	**$64,500**	**54**	**0**	**$7,025**	**9**	**0**	**$181,205**	**193**	**0**
	Public	Lake	$3,666	1	1	$0	0	0	$0	0	0	$1,500	0	0	$0	0	0	$5,166	1	1
		WPA	$19,849	16	0	$0	0	0	$0	0	0	$0	0	0	$0	0	0	$19,849	16	0
		Total	**$23,515**	**17**	**1**	**$0**	**0**	**0**	**$0**	**0**	**0**	**$1,500**	**0**	**0**	**$0**	**0**	**0**	**$25,015**	**17**	**1**
	Tribal	Lake	$2,259	70	5,486	$0	0	0	$0	0	0	$0	0	0	$0	0	0	$2,259	70	5,486
		Land	$12,649	1,594	21,620	$6,731	0	4,181	$0	0	0	$0	0	0	$0	0	0	$19,380	1,594	25,801
		Total	**$14,908**	**1,664**	**27,106**	**$6,731**	**0**	**4,181**	**$0**	**0**	**0**	**$0**	**0**	**0**	**$0**	**0**	**0**	**$21,639**	**1,664**	**31,287**
	Total		**$53,573**	**1,701**	**27,107**	**$36,761**	**57**	**4,181**	**$64,500**	**54**	**0**	**$66,000**	**54**	**0**	**$7,025**	**9**	**0**	**$227,859**	**1,874**	**31,288**
Wild Rice Restoration	Public	Lake	$500	60	0	$0	0	0	$0	0	0	$0	0	0	$0	0	0	$500	60	0
		Total	**$500**	**60**	**0**	**$0**	**0**	**0**	**$0**	**0**	**0**	**$0**	**0**	**0**	**$0**	**0**	**0**	**$500**	**60**	**0**
	Tribal	Lake	$3,000	177	0	$390	23	0	$0	0	0	$0	0	0	$0	0	0	$3,390	200	0

Restoration Expenditures and Accomplishments by Funding Type, Activity, Land Type, and Owner

Minnesota's Habitat Conservation Partnership - Phase 5

The table below reflects expenditures attributable to specific restoration projects. Please note that the expenditures here will not match the subtotals for those categories reflected in Table 2 and Table 4. Also note that the total accomplishments(acres and shoreline) are identical. The reason for this is that some work programs expend dollars not attributable to a specific projects. For example Ducks Unlimited expends funds on technical assistance by DU biologists to DNR, US Fish & Wildlife Service, local units of goverment, and private landowners regarding shallow lake assesment, improvment, and managment. These personal expenditures are not reflected in the table below.

Funding Type Definitions

ENTF:	Grant dollars provided through the Minnesota Environment and Natural Resources Trust Fund
Other Funds:	Non-state, non-state leveraged dollars (If partner funds are leveraging state funds (e.g. RIM) they are not eligible to be considered Other Funds)
State Funds:	State Funds expended on HCP projects (not eligible for use as other funds commitment)
Partners State Levereged Funds:	Non state funds that have leveraged state funds as part of an HCP project (not eligible for use as other funds commitment)
Other:	Any other expenditures (e.g. grant income funds)

			ENTF			Other Funds			Partners State Leveraged Funds			State Funds			Other			Total		
			Expenditures	Acres	Shoreline	Expenditures	Acres	Shoreline	Expenditures	Acres	Shoreline	Expenditures	Acres	Shoreline	Expenditures	Acres	Shoreline	Expenditures	Acres	Shoreline
Wild Rice Restoration	Tribal	**Total**	**$3,000**	**177**	**0**	**$390**	**23**	**0**	**$0**	**0**	**0**	**$0**	**0**	**0**	**$0**	**0**	**0**	**$3,390**	**200**	**0**
	Total		**$3,500**	**237**	**0**	**$390**	**23**	**0**	**$0**	**0**	**0**	**$0**	**0**	**0**	**$0**	**0**	**0**	**$3,890**	**260**	**0**
Woodland Restoration	Public	State	$22,598	162	0	$0	0	0	$0	0	0	$0	0	0	$0	0	0	$22,598	162	0
		WMA	$10,833	23	0	$0	0	0	$0	0	0	$0	0	0	$0	0	0	$10,833	23	0
		Total	**$33,431**	**185**	**0**	**$0**	**0**	**0**	**$0**	**0**	**0**	**$0**	**0**	**0**	**$0**	**0**	**0**	**$33,431**	**185**	**0**
	Total		**$33,431**	**185**	**0**	**$0**	**0**	**0**	**$0**	**0**	**0**	**$0**	**0**	**0**	**$0**	**0**	**0**	**$33,431**	**185**	**0**
Total			**$922,623**	**7,218**	**100,780**	**$640,677**	**1,837**	**4,682**	**$125,723**	**258**	**0**	**$121,992**	**122**	**102**	**$31,025**	**21**	**96**	**$1,842,040**	**9,456**	**105,660**

Easement Expenditures and Accomplishments by Funding Type and Easement Holder

Minnesota's Habitat Conservation Partnership - Phase 5

The table below reflects expenditures attributable to specific easement projects. Please note that the expenditures here may not match the subtotals for those categories reflected in Table 2 and Table 4. Also note that the total accomplishments(acres and shoreline) are identical. The reason for this is that some work programs expend dollars not attributable to a specific project or a project that was not completed. For example Pheasants Forever expended funds on a appraisal fee for the desired acquisition of Hands Marsh WMA in which the offer was made and rejected by the potential seller. Therefore, this expenditure is not reflected in the table below.

Funding Type Definitions

ENTF:	Grant dollars provided through the Minnesota Environment and Natural Resources Trust Fund
Other Funds:	Non-state, non-state leveraged dollars (If partner funds are leveraging state funds (e.g. RIM) they are not eligible to be considered Other Funds)
State Funds:	State Funds expended on HCP projects (not eligible for use as other funds commitment)
Partners State Levereged Funds:	Non state funds that have leveraged state funds as part of an HCP project (not eligible for use as other funds commitment)
Other:	Any other expenditures (e.g. grant income funds)

		ENTF	Other Funds	Total
Board of Water and Soil Resources	Expenditures	$250,000	$0	$250,000
	Shoreline	56.0	0.0	56.0
	Riparian	275.0	0.0	274.5
	Grassland Acres	153.8	0.0	153.8
	Woodland Acres	4.5	0.0	4.5
	Wetland Acres	107.5	0.0	107.5
	Acres	289.4	0.0	289.4
Ducks Unlimited	Expenditures	$140,380	$456,341	$596,721
	Shoreline	2,027.0	6,774.0	8,802.0
	Riparian	0.0	0.0	0.0
	Grassland Acres	52.5	168.5	221.0
	Woodland Acres	10.7	45.3	56.0
	Wetland Acres	12.9	71.1	84.0
	Acres	87.2	304.7	391.9
Minnesota Land Trust	Expenditures	$73,757	$414,000	$487,757
	Shoreline	4,141.0	3,008.0	7,150.0
	Riparian	8,544.0	7,138.0	15,681.9
	Grassland Acres	9.0	47.0	56.0
	Woodland Acres	152.7	291.2	443.9
	Wetland Acres	77.0	16.0	93.0
	Acres	239.7	593.1	832.8

Easement Expenditures and Accomplishments by Funding Type and Easement Holder

Minnesota's Habitat Conservation Partnership - Phase 5

The table below reflects expenditures attributable to specific easement projects. Please note that the expenditures here may not match the subtotals for those categories reflected in Table 2 and Table 4. Also note that the total accomplishments(acres and shoreline) are identical. The reason for this is that some work programs expend dollars not attributable to a specific project or a project that was not completed. For example Pheasants Forever expended funds on a appraisal fee for the desired acquisition of Hands Marsh WMA in which the offer was made and rejected by the potential seller. Therefore, this expenditure is not reflected in the table below.

Funding Type Definitions

ENTF:	Grant dollars provided through the Minnesota Environment and Natural Resources Trust Fund
Other Funds:	Non-state, non-state leveraged dollars (If partner funds are leveraging state funds (e.g. RIM) they are not eligible to be considered Other Funds)
State Funds:	State Funds expended on HCP projects (not eligible for use as other funds commitment)
Partners State Levereged Funds:	Non state funds that have leveraged state funds as part of an HCP project (not eligible for use as other funds commitment)
Other:	Any other expenditures (e.g. grant income funds)

		ENTF	Other Funds	Total
USDA - Natural Resource Conservation Service	Expenditures	$0	$3,851,828	$3,851,828
	Shoreline	0.0	0.0	0.0
	Riparian	0.0	0.0	0.0
	Grassland Acres	0.0	3,039.2	3,039.2
	Woodland Acres	0.0	0.0	0.0
	Wetland Acres	0.0	2,398.0	2,398.0
	Acres	0.0	5,437.2	5,437.2
Total	Expenditures	$464,137	$4,722,168	$5,186,305
	Shoreline	6,224.2	9,782.6	16,006.8
	Riparian	8,818.1	7,138.3	15,956.4
	Grassland Acres	215.3	3,254.7	3,470.0
	Woodland Acres	167.9	336.5	504.4
	Wetland Acres	197.4	2,485.0	2,682.5
	Acres	616.3	6,335.0	6,951.3

Acquisition Expenditures and Accomplishments by Funding Type and Acquisition Holder

Minnesota's Habitat Conservation Partnership - Phase 5

The table below reflects expenditures attributable to acquisition projects. Please note that the expenditures here will not match the subtotals for those categories reflected in Table 2 and Table 4. Also note that the total accomplishments(acres and shoreline) are identical. The reason for this is that some work programs expend dollars not attributable to a specific project. For example the Minnesota Land Trust works on a large number of potential conservation projects and because many projects initiated or worked on under the grant are not actually completed in this phase of the project, the Land Trust does not allocate salaries to specific conservation easement projects. Therefore, salaries and benefits for staff working on contacing lanowners, negotiating conservation easements and completing all aspects of easement projects are not

Funding Type Definitions

ENTF:	Grant dollars provided through the Minnesota Environment and Natural Resources Trust Fund
Other Funds:	Non-state, non-state leveraged dollars (If partner funds are leveraging state funds (e.g. RIM) they are not eligible to be considered Other Funds)
State Funds:	State Funds expended on HCP projects (not eligible for use as other funds commitment)
Partners State Levereged Funds:	Non state funds that have leveraged state funds as part of an HCP project (not eligible for use as other funds commitment)
Other:	Any other expenditures (e.g. grant income funds)

		ENTF	Other	Other Funds	State Funds	Total
DNR-AMA	Expenditures	$250,000	$653,828	$299,000	$180,000	$1,382,828
	Shoreline	2,075.9	2,905.0	1,650.0	522.0	7,152.9
	Riparian	0.0	0.0	0.0	0.0	0.0
	Grassland Acres	2.0	0.0	0.0	0.0	2.0
	Woodland Acres	19.0	38.0	7.0	17.0	81.8
	Wetland Acres	20.8	40.1	17.3	18.5	96.6
	Acres	41.8	78.6	24.3	35.7	180.4
DNR-SNA	Expenditures	$350,000	$0	$60,000	$1,040,000	$1,450,000
	Shoreline	1,447.8	0.0	247.8	4,303.2	5,998.8
	Riparian	483.0	0.0	83.0	1,434.0	1,999.6
	Grassland Acres	0.0	0.0	0.0	0.0	0.0
	Woodland Acres	58.0	0.0	10.0	172.0	240.0
	Wetland Acres	48.3	0.0	8.3	143.4	200.0
	Acres	106.2	0.0	18.2	315.6	439.9
DNR-WMA	Expenditures	$344,985	$0	$428,446	$0	$773,431
	Shoreline	0.0	0.0	0.0	0.0	0.0
	Riparian	0.0	0.0	0.0	0.0	0.0
	Grassland Acres	81.0	0.0	110.0	0.0	190.5
	Woodland Acres	29.0	0.0	21.0	0.0	50.0
	Wetland Acres	20.1	0.0	28.5	0.0	48.6
	Acres	130.1	0.0	159.1	0.0	289.2

Acquisition Expenditures and Accomplishments by Funding Type and Acquisition Holder

Minnesota's Habitat Conservation Partnership - Phase 5

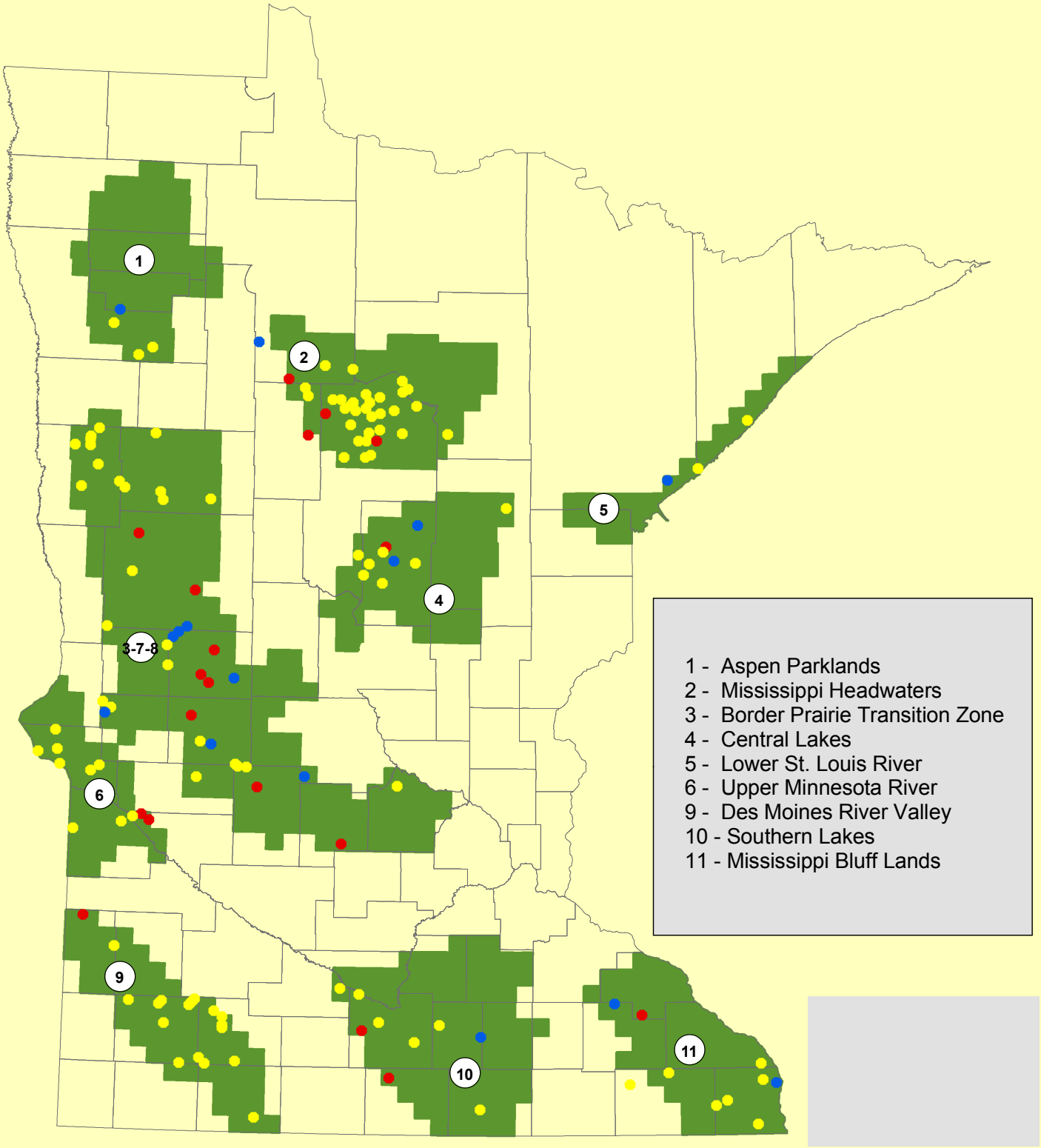
The table below reflects expenditures attributable to acquisition projects. Please note that the expenditures here will not match the subtotals for those categories reflected in Table 2 and Table 4. Also note that the total accomplishments(acres and shoreline) are identical. The reason for this is that some work programs expend dollars not attributable to a specific project. For example the Minnesota Land Trust works on a large number of potential conservation projects and because many projects initiated or worked on under the grant are not actually completed in this phase of the project, the Land Trust does not allocate salaries to specific conservation easement projects. Therefore, salaries and benefits for staff working on contacing lanowners, negotiating conservation easements and completing all aspects of easement projects are not

Funding Type Definitions

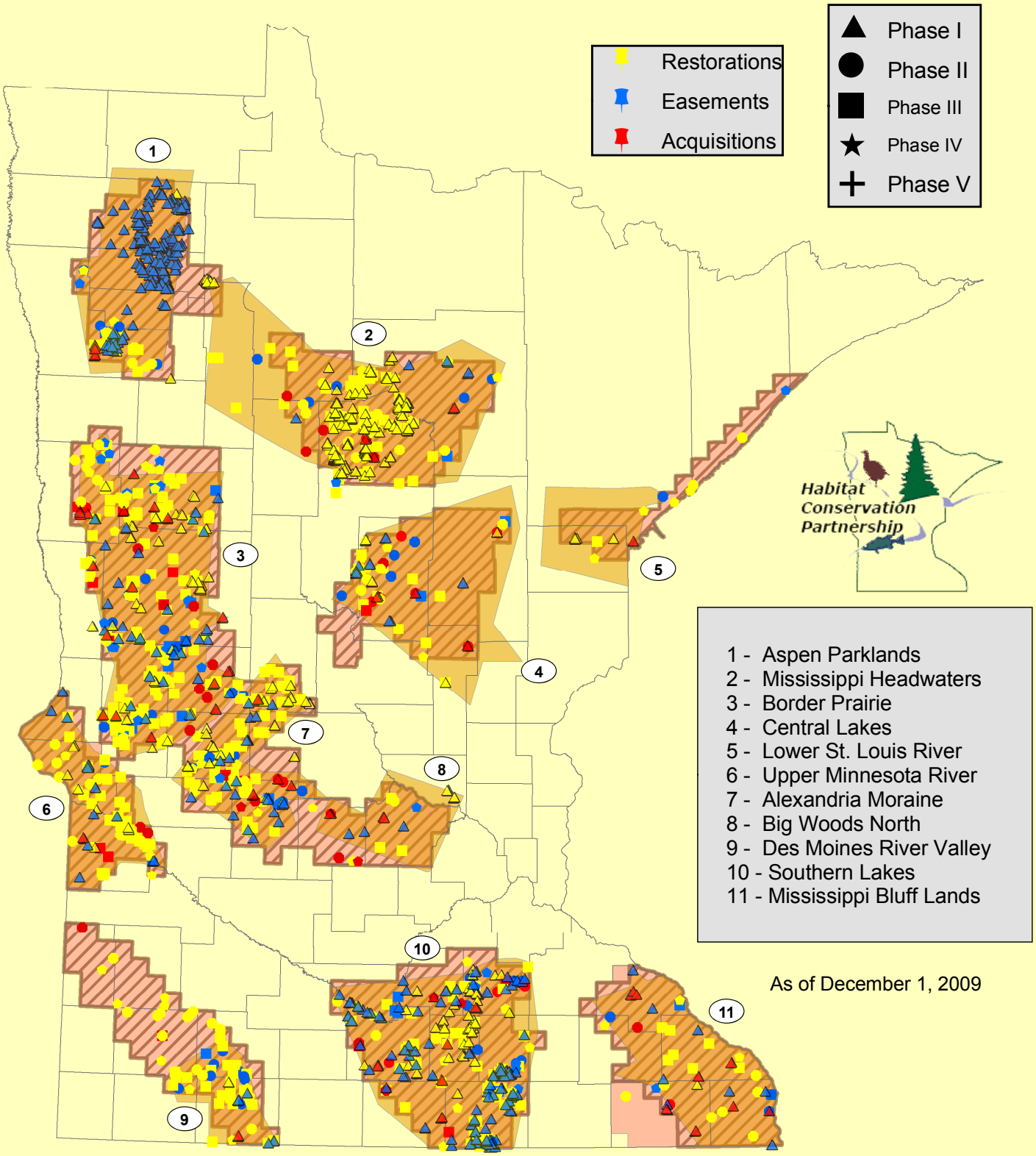
ENTF:	Grant dollars provided through the Minnesota Environment and Natural Resources Trust Fund
Other Funds:	Non-state, non-state leveraged dollars (If partner funds are leveraging state funds (e.g. RIM) they are not eligible to be considered Other Funds)
State Funds:	State Funds expended on HCP projects (not eligible for use as other funds commitment)
Partners State Levereged Funds:	Non state funds that have leveraged state funds as part of an HCP project (not eligible for use as other funds commitment)
Other:	Any other expenditures (e.g. grant income funds)

		ENTF	Other	Other Funds	State Funds	Total
USFWS-WPA	Expenditures	$50,000	$0	$85,681	$0	$135,681
	Shoreline	0.0	0.0	0.0	0.0	0.0
	Riparian	0.0	0.0	0.0	0.0	0.0
	Grassland Acres	23.0	0.0	37.0	0.0	60.0
	Woodland Acres	0.0	0.0	0.0	0.0	0.0
	Wetland Acres	7.6	0.0	12.4	0.0	20.0
	Acres	30.5	0.0	49.5	0.0	80.0
Total	Expenditures	$994,985	$653,828	$873,127	$1,220,000	$3,741,939
	Shoreline	3,523.7	2,905.0	1,897.8	4,825.2	13,151.7
	Riparian	482.6	0.0	82.6	1,434.4	1,999.6
	Grassland Acres	105.6	0.2	146.7	0.0	252.5
	Woodland Acres	106.1	38.3	37.9	189.4	371.7
	Wetland Acres	96.8	40.1	66.4	161.9	365.2
	Acres	308.6	78.6	251.0	351.3	989.5

Habitat Conservation Partnership
Phase V Accomplishments
Restoring Minnesota' Fish and Wildlife Habitat Corridors



Habitat Conservation Partnership
Accomplishments
Restoring Minnesota' Fish and Wildlife Habitat Corridors



Phase I - III Project Areas | Phase IV and V Project Areas | Phase VI+ Project Areas

Attachment A: Budget Detail for 2008 Projects - Summary and a Budget page for each partner

Project Title: Minnesota's Habitat Conservation Partnership - HCP V - 2008

Project Manager Name: Joe Pavelko, HCP Project Coordinator, Pheasants Forever

Trust Fund Appropriation: $ **$3,150,000**

2008 Trust Fund Budget	**Result 1 Budget:**	**Amount Spent** *(date)*	**Balance** *6/30/10*	**Result 2 Budget:**	**Amount Spent** *(date)*	**Balance** *6/30/10*	**Result 3 Budget:**	**Amount Spent** *(date)*	**Balance** *6/30/10*	**Result 4 Budget:**	**Amount Spent** *(date)*	**Balance** *6/30/10*	**TOTAL BUDGET**	**TOTAL BALANCE**
	Project Coordination and Mapping			*Restoration and Management*			*Conservation Easement Programs*			*Habitat Acquisition Programs*				
OVERALL HCP BUDGET	70,000	52,041	17,959	1,172,500	1,140,480	32,020	877,500	877,500	0	1,030,000	1,029,985	15	3,150,000	49,994
														0
COLUMN TOTAL	**$70,000**	**$52,041**	**$17,959**	**$1,172,500**	**$1,140,480**	**$32,020**	**$877,500**	**$877,500**	**$0**	**$1,030,000**	**$1,029,985**	**$15**	**$3,150,000**	**$49,994**

2008 Project Abstract
For the Period Ending June 30, 2010

PROJECT TITLE: Project Coordination and Mapping - 1a - Habitat Conservation Partnership
PROJECT MANAGER: Joe Pavelko
AFFILIATION: Pheasants Forever, Inc.
MAILING ADDRESS: 7975 Acorn Circle
CITY/STATE/ZIP: Victoria, MN 55386
PHONE: 612-532-3800
E-MAIL: jpavelko@pheasantsforever.org
WEBSITE: www.pheasantsforever.org www.minnesotapf.org
FUNDING SOURCE: Environment and Natural Resources Trust Fund
LEGAL CITATION: ML 2008 First Special Section, Ch.367, Sec. 2 Subd. 3(c).

APPROPRIATION AMOUNT: $70,000

Overall Project Outcome and Results

Duties assigned to the project coordinator under this work program and as outlined and approved by the Habitat Conservation Partnership were to:

1. Coordinate partners, projects and cultivate partnerships.
2. Manage project data and contract/coordinate mapping services
3. Solicit & compile partner information & provide reports to LCCMR and partners.
4. Schedule, coordinate, and chair meetings & provide meeting minutes.
5. Coordinate public relations outreach to media.
6. Serve as primary contact for LCCMR.
7. Facilitate executive & full committee meetings & coordinate subcommittee meetings.
8. Manage contract for administration and mapping components of the Partnership.

Pheasants Forever, Inc. completed the above tasks; expending a total of $52,040.68 of ENTF funds. ENTF expenditures for personnel (Project Coordinator and accounting staff) and project coordinator travel, and printing costs totaled $16,046.93. A total of $15,965 within the personnel budget item was not needed to achieve our results and remains unspent. In addition, $35,993.75 of ENTF funds were expended to manage data, operate the online reporting system from which all partner reports are generated, and map all partner projects. Pheasants Forever, Inc. contracted the mapping and data management services for the Phase V Habitat Conservation Partnership with Community GIS Services of Duluth, Minnesota.

The HCP website has been improved to increase reporting efficiency and usability after input from LCCMR staff, partners, and Community GIS services. All partnership data can be easily queried, evaluated, and mapped. All HCP project accomplishments and expenditures are accounted for and fully described within the online reporting system and report generation. Anyone can access the Phase V data electronically from the HCP website.

Project Results Use and Dissemination

The partnership acknowledges funding from the Minnesota Environment and Natural Resources Trust Fund. Accomplishment report information, mapping products, and project information can be found at www.mnhabitatcorridors.org. Other forms of information can be obtained by contacting Joe Pavelko, the HCP Coordinator, at (612) 532-3800.

LCCMR Work Program Final Report

Restoring Minnesota's Fish and Wildlife Habitat Corridors Phase 5
Habitat Conservation Partnership

1A: Project Coordination and Mapping - Pheasants Forever

Project Manager: Joe Pavelko

Affiliation: Pheasants Forever

Address: 7975 Acorn Circle
Victoria, MN 55,386

Phone: 612-532-3800

Fax:

E-mail: jpavelko@pheasantsforever.org

Fund: Environment and Natural Resources Trust Fund

Legal Citation: ML 2008 First Special Section, Ch. 367, Sec. 2 Subd. 3(c).

Total Work Program Budget

Result	ENTF Allocation	ENTF Funds Spent	ENTF Balance	Other Funds Proposed	Other Funds Spent
Project Coord./ Mapping	$70,000	$ 52,041	$17,959	$0	$0
Total	$70,000	$ 52,041	$17,959	$0	$0

Work Program Summary

Overall Project Outcome and Results

Duties assigned to the project coordinator under this work program and as outlined and approved by the Habitat Conservation Partnership were to:

1. Coordinate partners, projects and cultivate partnerships.
2. Manage project data and contract/coordinate mapping services
3. Solicit & compile partner information & provide reports to LCCMR and partners.
4. Schedule, coordinate, and chair meetings & provide meeting minutes.
5. Coordinate public relations outreach to media.
6. Serve as primary contact for LCCMR.
7. Facilitate executive & full committee meetings & coordinate subcommittee meetings.
8. Manage contract for administration and mapping components of the Partnership.

Pheasants Forever, Inc. completed the above tasks; expending a total of $52,040.68 of ENTF funds. ENTF expenditures for personnel (Project Coordinator and accounting staff) and project coordinator travel, and printing costs totaled $16,046.93. A total of $15,965 within the personnel budget item was not needed to achieve our results and remains unspent. In addition, $35,993.75 of ENTF funds were expended to manage data, operate the online reporting system from which all partner reports are generated, and map all partner projects. Pheasants Forever, Inc. contracted the mapping and data management services for the Phase V Habitat Conservation Partnership with Community GIS Services of Duluth, Minnesota.

The HCP website has been improved to increase reporting efficiency and usability after input from LCCMR staff, partners, and Community GIS services. All partnership data can be easily queried, evaluated, and mapped. All HCP project accomplishments and expenditures are accounted for and fully described within the online reporting system and report generation. Anyone can access the Phase V data electronically from the HCP website.

Project Results Use and Dissemination

The partnership acknowledges funding from the Minnesota Environment and Natural Resources Trust Fund. Accomplishment report information, mapping products, and project information can be found at www.mnhabitatcorridors.org. Other forms of information can be obtained by contacting Joe Pavelko, the HCP Coordinator, at (612) 532-3800.

LCCMR Work Program Final Report

Restoring Minnesota's Fish and Wildlife Habitat Corridors Phase 5
Habitat Conservation Partnership

1A: Project Coordination and Mapping - Pheasants Forever

Work Program Expenditures

FundingType	*Funding Category*	*Amount*	*Description*
ENTF	Travel	$614.07	In-state travel expenses for meetings
ENTF	Personnel Expenditures	$15,314.19	Documented, direct to project personnel costs for project coordinator, and grant staff. Total hours billed was 389.25.
ENTF	Professional Services	$35,993.75	Mapping, reporting and data management costs direct to the partnership. PF subcontracts to Community GIS Services of Duluth, Minnesota for this work.
ENTF	Supplies and Misc	$118.67	Printing costs for overall update reports.
	Total:	**$52,040.68**	

Funding Type Definitions

ENTF:	Grant dollars provided through the Minnesota Environment and Natural Resources Trust Fund
Other Funds:	Non-state, non-state leveraged dollars (if partner funds are leveraging State Funds (e.g. RIM) they are not eligible to be considered Other Funds)
State Funds:	State Funds expended on HCP projects (not eligible for use as Other Funds commitment)
Partner's State Leveraged Funds:	Non State Funds that have leveraged State Funds as part of an HCP project (not eligible for use as Other Funds commitment)
Other:	Any other expenditures (e.g. grant income funds)

Attachment A: Budget Detail for 2008 Projects					
Project Title:	**Project Coordination & Mapping - 1a**				
	Minnesota's Habitat Conservation Partnership (V)				
Project Manager Name: Joe Pavelko					
Trust Fund Appropriation: $ 70,000					
2008 Trust Fund Budget	**Result 1 Budget:**	**Amount Spent** *(June 30, 2010)*	**Balance 6/30/10**	**TOTAL BUDGET**	**TOTAL BALANCE**
	Project Coordination and Mapping				
BUDGET ITEM					
PERSONNEL: wages and benefits and coordinator expenses	34,000	16,047	17,953	34,000	17,953
Contracts					
Professional/technical (Contract mapping and Data Management with Community GIS Services of Duluth, MN)	36,000	35,994	6	36,000	6
COLUMN TOTAL	**$70,000**	**$52,041**	**$17,959**	**$70,000**	**$17,959**

2008 Project Abstract
For the Period Ending June 30, 2010

PROJECT TITLE: 2A:Hides for Habitat – MDHA – Restoration
PROJECT MANAGER: Kim Hanson
AFFILIATION: Minnesota Deer Hunters Association
MAILING ADDRESS: 460 Peterson Road
CITY/STATE/ZIP: Grand Rapids, MN 55744
PHONE: 218-327-1103 Ext. 16
FAX: 218-327-1349
E-MAIL: kimhanson@mndeerhunters.com
WEBSITE: www.mndeerhunters.com
FUNDING SOURCE: Environment and Natural Resources Trust Fund
LEGAL CITATION: ML 2008 First Special Section, Ch. 367, Sec. 2 Subd. 3(c).

APPROPRIATION AMOUNT: $ 30,000.00

Overall Project Outcome and Results
Environment and Natural Resources Trust Fund funds were used to restore a total of two oak savannahs (grassland enhancement) consisting of 14.69 acres on the Winger Waterfowl Production Area (WPA). Federal WPA's are managed for waterfowl production and are open to public hunting and other recreation consistent with the National Wildlife Refuge System. This restoration to the oak savannahs will create suitable habitat for deer, turkey, ruffed grouse, and other cavity nesting birds.

Specifically, on the Winger WPA (Polk County Winger Township 147, Range 42, Section 2) we restored two oak savannahs for 14.69 acres by shearing and piling undesirable trees such as boxelder, cottonwood, willow, and aspen which opened the landscape to promote savannah habitat. Large and small oak trees were not cut and the seedlings were flagged to prevent accidental damage.

All work was done in partnership with the U.S. Fish and Wildlife Service Detroit Lakes Wetland Management District and other funds were secured and provided by the Minnesota Deer Hunters Association Hides for Habitat funds.

Signs were purchased with a portion of the appropriation money and were placed on the Winger WPA in May of 2010. These signs state the nature of the oak savannah and the future management as well as the partners involved.

Project Results Use and Dissemination
MDHA has restored a total of 2 oak savannahs (14.69 acres total) on public land that is permanently protected and open to public hunting. These restored oak savannahs provide upland habitat for a variety of wildlife with a large scale benefit to hundreds of acres on the Winger WPA as well as the surrounding private land habitats. Future management of grasslands will be conducted by the USFWS Detroit Lakes Wetland Management District.

Since this initial project was submitted, MDHA changed project managers from Phase IV. In phase V our funds from matching came mostly from the Hides for Habitat funds through MDHA which is why there are less "other funds" contributed to this Phase V work plan. MDHA strives to identify projects that capitalize on our chapter system and will improve on this into the future.

LCCMR Work Program Final Report

Restoring Minnesota's Fish and Wildlife Habitat Corridors Phase 5
Habitat Conservation Partnership

2A:Hides for Habitat - MDHA

Project Manager: Kim Hanson

Affiliation: MDHA

Address: 460 Peterson Road
Grand Rapids, MN 55744

Phone: 218-327-1103 ext. 16

Fax: 218-327-1349

E-mail: kimhanson@mndeerhunters.com

Fund: Environment and Natural Resources Trust Fund

Legal Citation: ML 2008 First Special Section, Ch. 367, Sec. 2 Subd. 3(c).

Total Biennial Project Budget

Result	ENTF Allocation	ENTF Funds Spent	ENTF Balance	Other Funds * Proposed	Other Funds * Spent
Restoration	$30,000	$29,928	$72	$25,000	$15,000
Total	$30,000	$29,928	$72	$25,000	$15,000

*Other Funds are classified as non-state, non-state leveraged dollars (if partner funds are leveraging State Funds (e.g. RIM) they are not eligible to be considered Other Funds). Please note, however, that this work program has spent the following amounts not shown in the above table:

Partners State Levereged Funds: $9,889.71
Other: $7,467.00

See the tables and funding type definitions at the end of this report for further explanation.

Work Program Summary

Overall Project Outcome and Results

Environment and Natural Resources Trust Fund funds were used to restore a total of 2 oak savannahs (grassland enhancement) consisting of 14.69 acres on the Winger WPA. Federal WPA's are managed for waterfowl production and are open to public hunting and other recreation consistent with the National Wildlife Refuge System. This restoration to the oak savannahs will create suitable habitat for deer, turkey, ruffed grouse, and other cavity nesting birds.

Specifically, on the Winger WPA (Polk County Winger Township 147, Range 42, Section 2) we restored 2 oak savannahs for 14.69 acres by shearing and piling undesirable trees such as boxelder, cottonwood, willow, and aspen which opened the landscape to promote savannah habitat. Large and small oak trees were not cut and the seedlings were flagged to prevent accidental damage.

All work was done in partnership with the USFWS Detroit Lakes Wetland Management District and other funds were secured and provided by the Minnesota Deer Hunters Association Hides for Habitat funds.

Post mound podium signs were purchased with a portion of the appropriation money and were placed on the Winger WPA in May of 2010. These signs state the nature of the oak savannah and the future management as well as the partners involved.

Project Results Use and Dissemination

MDHA has restored a total of 2 oak savannahs (14.69 acres total) on public land that is permanently protected and open to public hunting. These restored oak savannahs provide upland habitat for a variety of wildlife with a large scale benefit to hundreds of acres on the Winger WPA as well as the surrounding private land habitats. Future management of grasslands will be conducted by the USFWS Detroit Lakes Wetland Management District.

Since this initial project was submitted, MDHA changed project managers from Phase IV. In phase V our funds from matching came mostly from the Hides for Habitat funds through MDHA which is why there are less "other funds" contributed to this Phase V work plan. MDHA strives to identify projects that capitalize on our chapter system and will improve on this into the future.

LCCMR Work Program Final Report

Restoring Minnesota's Fish and Wildlife Habitat Corridors Phase 5
Habitat Conservation Partnership

2A:Hides for Habitat - MDHA

Restoration Activities

Project Area - 1 - Aspen Parklands

Project Name: Winger WPA
Township: 147, Range: 42, Section: 2

Activity: Grassland Enhancement
Landtype: Public - WMA
Description: Tree Removal - Shear & Pile All boxelder, cottonwood, willow, aspen, etc to restore scattered oak savannas. All smaller oaks flagged to prevent accidental damage.

$50,620.76 in the phase IV (2007 Appropriation) project was spent on the restoration of these areas. Being that the phase V (2008 Appropriation) work plan was accepted, we continued into the phase V (2008) funds in fall of 2008.

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Restoration	$29,329.88	14.69	0.00
ENTF	Site Development	$598.18	0.00	0.00
Winger WPA Total		**$29,928.06**	**14.69**	**0.00**

Restoration Project Totals (By Funding Type)

Funding Type	Funding Amount	Acres	Shoreline Feet
ENTF:	$29,928.06	14.69	0.00
Total:	**$29,928.06**	**14.69**	**0.00**

LCCMR Work Program Final Report

Restoring Minnesota's Fish and Wildlife Habitat Corridors Phase 5
Habitat Conservation Partnership

2A:Hides for Habitat - MDHA

Work Program Expenditures - Not Attributable to Specific Projects

FundingType	*Category*	*Amount*	*Description*
Other	Personnel Expenditures	$5,000.00	USFWS Staff Hours for overseeing the project.
Other	Admin	$2,467.00	MDHA Project Management, fiscal responsibilities, and grants processing.
Other Funds	Equipment Costs	$5,000.00	2009 - Tree removal on Tessman WPA located in Becker county Detroit township.
Other Funds	Equipment Costs	$3,500.00	2009 - Tree removal on Tessman WPA located in Becker county Detroit township.
Other Funds	Equipment Costs	$6,500.00	2009 - Tree removal on Tessman WPA located in Becker county Detroit township.
Partners State Leveraged Funds	Equipment Costs	$9,889.71	2008 - Tree removal on Korell WPA and Mee WPA. Korell located in Clay county in Gooseberry township. Mee located in Polk county Sletten township.
Total:		**$32,356.71**	

Work Program Expenditures (Not Attributable to Specific Projects) By Funding Type

Funding Type	Amount
Other Funds	$15,000.00
State Funds	$9,889.71
Other	$7,467.00
Total	**$32,356.71**

Work Program Expenditures Breakdown

Funding Type:	Restoration Projects	Not Attributable to Specific Projects	Total
ENTF	$29,928.06	$0.00	$29,928.06
Other Funds	$0.00	$15,000.00	$15,000.00
Other	$0.00	$7,467.00	$0.00
Total	$29,928.06	$32,356.71	$62,284.77

LCCMR Work Program Final Report

Restoring Minnesota's Fish and Wildlife Habitat Corridors Phase 5
Habitat Conservation Partnership

2A:Hides for Habitat - MDHA

Funding Type Definitions

ENTF:	Grant dollars provided through the Minnesota Environment and Natural Resources Trust Fund
Other Funds:	Non-state, non-state leveraged dollars (if partner funds are leveraging State Funds (e.g. RIM) they are not eligible to be considered Other Funds)
State Funds:	State Funds expended on HCP projects (not eligible for use as Other Funds commitment)
Partner's State Leveraged Funds:	Non State Funds that have leveraged State Funds as part of an HCP project (not eligible for use as Other Funds commitment)
Other:	Any other expenditures (e.g. grant income funds)

Attachment A: Budget Detail for 2008 Projects - **Summary and a Budget page for each partner (if applicable)**

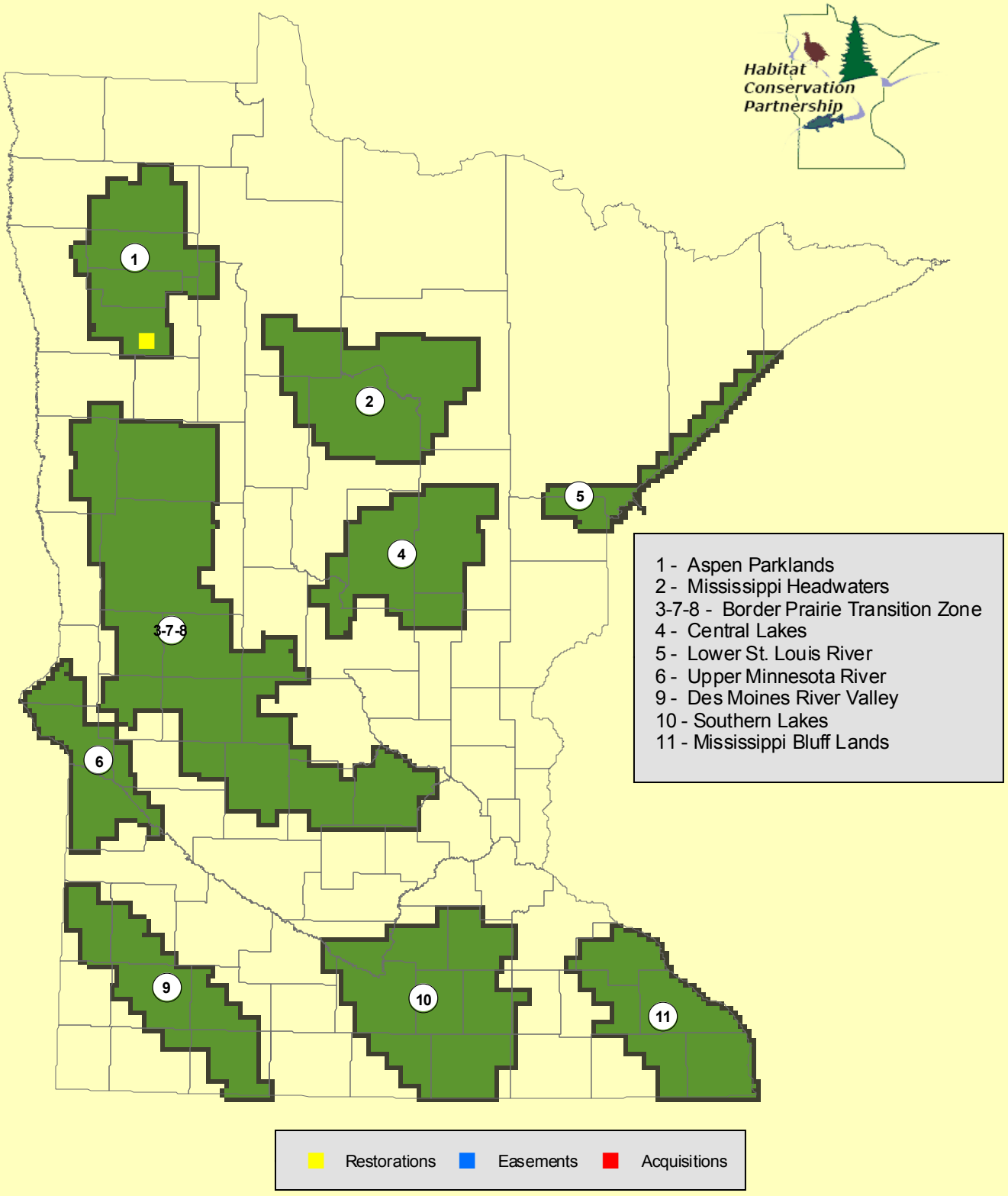
Project Title: *Winger WPA-Polk Cty - Savannas Rest*

Project Manager Name: *Kim Hanson*

Trust Fund Appropriation: $ *30,000*

2009 Trust Fund Budget	**Result 1 Budget:**	**Amount Spent** *(date)*	**Balance** *(date)*	**Result 2 Budget:**	**Amount Spent** *(date)*	**Balance** *(date)*	**Result 3 Budget:**	**Amount Spent** *(date)*	**Balance** *(date)*	**TOTAL BUDGET**	**TOTAL BALANCE**
	Winger WPA Restoration	*29329.88*	*$30,000.00*		*0*					**50,000**	
BUDGET ITEM	Sign purchased for site.	598									
PERSONNEL: wages and benefits											
Contracts	30,000	$29,329.88									
Professional/technical											
Other contracts - Strom Construction Inc.	TREE REMOVAL - SHEAR & PILE ALL BOXELDER, COTTONWOOD, WILLOW, ASPEN, ETC TO RESTORE SCATTERED OAK SAVANNAS. ALL SMALLER OAKS	Sign was created for placement at the WPA and knowledge of contributors and land									
COLUMN TOTAL	**$30,000**	**$29,928**	**$72**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**

Habitat Conservation Partnership
Hides for Habitat
2A



2008 Project Abstract – Final Report
For the Period Ending June 30, 2010

TITLE: Restoring Minnesota's Fish and Wildlife Habitat Corridors – Phase 5, Habitat Corridors Partnership - Partners for Fish and Wildlife Program (2b)

PROJECT MANAGER: Sheldon Myerchin
ORGANIZATION: U.S. Fish and Wildlife Service
ADDRESS (City, State, Zip): 434 Great Oak Drive, Waite Park, MN 56387
TELEPHONE: (320) 253-4682
FAX: (320)253-4682
E-MAIL: Sheldon_Myerchin@fws.gov
WEB SITE ADDRESS: http://midwest.fws.gov
FUND: Minnesota Environmental and Natural Resources Trust Fund
LEGAL CITATION: ML 2008 First Special Session, Chap. 367, Sec. 2, Subd. 3c.

APPROPRIATION AMOUNT: $30,000.00

Overall Project Outcome and Results
Since 1987, the USFWS' Partners for Fish and Wildlife (Partners) Program has restored more than 16,000 drained wetlands (73,000 acres) and more than 1,200 upland sites (52,000 acres) to native grasses and forbs, on private lands in Minnesota. Through its Partners Program, the USFWS works with other federal and state agencies, local units of government, tribal entities, conservation organizations, and individual landowners to restore or enhance fish and wildlife habitats on private land. This program emphasizes restoring habitats and native vegetation for fish and wildlife in concert with the goals of individual private landowners. These projects also benefit the general public by providing habitat for fish, wildlife, and plants; improving water quality and watershed health; reducing non-point source pollution; and creating opportunities for outdoor recreation and education.

The $30,000 of Minnesota Environment and Natural Resources Trust Fund (Trust Fund) funding accelerated the USFWS' existing Partners Program with an additional voluntary restoration or enhancement of 13 wetland basins covering 85.7 acres of wetland habitat and five grassland sites covering 197.5 acres of upland habitat. With this funding, a total of ten projects were completed on private land within HCP Project Areas 1, 3-7-8, 4, 6, and 10 These Trust Funds were expended from July 2008 through November 2009. One additional upland site covering 27 acres which had Trust Fund cost-shared wetland restorations was restored to native prairie vegetation utilizing Other Funds.

Under the Partners Program, wetlands are restored or enhanced by plugging or filling drainage ditches, removing excess sediment, breaking up sub-surface tile systems, embankment construction, and/or installing water control structures. Upland grassland areas are restored or enhanced by removing invasive woody vegetation and re-seeding former cropland to a native prairie seed mixture. All seeded areas complied with requirements to utilize local native ecotype seed as available.

Project selection for Trust Fund cost-share via the Partners Program is based on the project's contribution to building wetland and upland habitat complexes or corridors and/or restoring or enhancing native habitats in the focus project areas.

The USFWS committed $30,000 in matching funds to support this overall project, but a total of $78,855 was expended. These funds were used to provide cost-share on all projects funded with Trust Fund dollars and also to fund the one additional upland native prairie restoration project.

Project Results, Use, and Dissemination
These projects were completed within the nine HCP Project Areas across the state of Minnesota. Without the willingness of the landowners involved, and the variety of other partners, this important wetland, upland and river/riparian wildlife habitat would not be restored. Numerous presentations including the Trust Fund habitat restoration information have been made over the past nine years at various meetings including Minnesota State

Private Lands Meeting, the Wetland Summit, the Shallow Lakes Forum, MNDNR Roundtable, and at Kiwanis, Rotary, and Lion's Club presentations. One project completed with Trust Fund dollars was also featured on the Minnesota Bound television program hosted by Ron Schara.

LCCMR Work Program Final Report

Restoring Minnesota's Fish and Wildlife Habitat Corridors Phase 5

Habitat Conservation Partnership

2B:Partners for Wildlife - U.S. Fish & Wildlife Service

Project Manager: Sheldon Myerchin

Affiliation: U.S. Fish & Wildlife Service

Address: 434 Great Oak Drive

Waite Park, MN 56387

Phone: (320)253-4682

Fax: (320) 253-0710

E-mail: sheldon_myerchin@fws.gov

Fund: Environment and Natural Resources Trust Fund

Legal Citation: ML 2008 First Special Section, Ch. 367, Sec. 2 Subd. 3(c).

Total Biennial Project Budget

Result	ENTF Allocation	ENTF Funds Spent	ENTF Balance	Other Funds * Proposed	Other Funds * Spent
Restoration	$30,000	$30,000	$0	$30,000	$78,855
Total	$30,000	$30,000	$0	$30,000	$78,855

*Other Funds are classified as non-state, non-state leveraged dollars (if partner funds are leveraging State Funds (e.g. RIM) they are not eligible to be considered Other Funds). Please note, however, that this work program has spent the following amounts not shown in the above table:

Other: $9,525.00

See the tables and funding type definitions at the end of this report for further explanation.

Work Program Summary

Overall Project Outcome and Results

Since 1987, the USFWS' Partners for Fish and Wildlife (Partners) Program has restored more than 16,000 drained wetlands (73,000 acres) and more than 1,200 upland sites (52,000 acres) to native grasses and forbs, on private lands in Minnesota. Through its Partners Program, the USFWS works with other federal and state agencies, local units of government, tribal entities, conservation organizations, and individual landowners to restore or enhance fish and wildlife habitats on private land. This program emphasizes restoring habitats and native vegetation for fish and wildlife in concert with the goals of individual private landowners. These projects also benefit the general public by providing habitat for fish, wildlife and plants, improving water quality and watershed health, reducing non-point source pollution, and creating opportunities for outdoor recreation and education.

The $30,000.00 of Minnesota Environment and Natural Resources Trust Fund (Trust Fund) funding obtained through this work program, accelerated the USFWS' existing Partners Program with an additional voluntary restoration or enhancement of 13 wetland basins covering 85.7 acres of wetland habitat and five grassland sites covering 197.5 acres of upland habitat. With this funding, a total of ten projects were completed on private land within HCP Project Areas 1, 3-7-8, 4, 6, and 10 These Trust Funds were expended from July 2008 through November, 2009. One additional upland site covering 27 acres which had Trust Fund cost-shared wetland restorations was restored to native prairie vegetation utilizing Other Funds.

Under the Partners Program, wetlands are restored or enhanced by; plugging or filling drainage ditches, removing excess sediment, breaking up sub-surface tile systems, embankment construction, and/or installing water control structures. Upland grassland areas are restored or enhanced by removing invasive woody vegetation and re-seeding former cropland to a native prairie seed mixture. All seeded areas complied with requirements to utilize local native ecotype seed as available.

Project selection for Trust Fund cost-share via the Partners Program is based on the project's contribution to building wetland and upland habitat complexes or corridors and/or restoring or enhancing native habitats in the focus project areas.

The USFWS committed $30,000.00 in matching funds to support this overall project, but a total of $78,855 was expended. These

2B:Partners for Wildlife - U.S. Fish & Wildlife Service

funds were used to provide cost-share on all projects funded with Trust Fund dollars and also to fund the one additional upland native prairie restoration project.

Project Results Use and Dissemination

These projects were completed within the nine HCP Project Areas across the state of Minnesota. Without the willingness of the landowners involved, and the variety of other partners, this important wetland, upland and river/riparian wildlife habitat would not be restored.

Numerous presentations including the Trust Fund habitat restoration information have been made over the past nine years at various meetings i.e. Minnesota State Private Lands Meeting, the Wetland Summit, the Shallow Lakes Forum, MNDNR Roundtable, and at Kiwanis, Rotary, and Lion's Club presentations. One project completed with Trust Fund dollars was also featured on the Minnesota Bound television program hosted by Ron Schara.

LCCMR Work Program Final Report

Restoring Minnesota's Fish and Wildlife Habitat Corridors Phase 5

Habitat Conservation Partnership

2B:Partners for Wildlife - U.S. Fish & Wildlife Service

Restoration Activities

Project Area - 1 - Aspen Parklands

Project Name: PLTNCGIR-Upland enhancement-Polk Co.
Township: 149, Range: 44, Section: 27

Activity: Grassland Enhancement
Landtype: Private - Land
Description: This project enhanced 15 acres of prairie grassland by brush mowing woody vegetation encroaching into the prairie. Removal of the woody vegetation will allow for a more efficient prescribed fire to continue management of the prairie. This tract is protected in perpetuity by the landowner. The landowner and FWS are responsible for future maintenance and management of the habitat.

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Restoration	$1,200.00	8.28	0.00
Other Funds	Restoration	$975.00	6.72	0.00
PLTNCGIR-Upland enhancement-Polk Co. Total		**$2,175.00**	**15.00**	**0.00**

LCCMR Work Program Final Report

Restoring Minnesota's Fish and Wildlife Habitat Corridors Phase 5

Habitat Conservation Partnership

2B:Partners for Wildlife - U.S. Fish & Wildlife Service

Project Area - 3 - Border Prairie

Project Name: PLWelJ-Upland enhancement-Pope Co.
Township: 123, Range: 36, Section: 31

Activity: Grassland Enhancement
Landtype: Private - Land
Description: This project enhanced 70 acres of native prairie on private land through the removal of invasive woody vegetation. All the red cedar, hawthorn, siberian elm and buckthorn were cut from the native prairie. This project is protected by a 10-year agreement. The landowner and FWS are responsible for future maintenance and management.

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Restoration	$7,500.00	55.26	0.00
Other	Restoration	$1,500.00	11.05	0.00
Other Funds	Restoration	$500.00	3.68	0.00
PLWelJ-Upland enhancement-Pope Co. Total		**$9,500.00**	**70.00**	**0.00**

Project Name: PLCoDL-Upland Restoration-Becker Co.
Township: 139, Range: 41, Section: 28

Activity: Grassland Restoration
Landtype: Private - Land
Description: This project restored 2 acres of prairie seeding with the City of Detroit Lakes. The project is protected by a 10-year agreement. The City of Detroit Lakes and the FWS are responsible for future maintenance and management. Seed for this project was harvested off of a native prairie remnant within 25 miles of the seeding site.

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Restoration	$1,000.00	0.80	0.00
Other	Restoration	$1,000.00	0.80	0.00
Other Funds	Restoration	$500.00	0.40	0.00
PLCoDL-Upland Restoration-Becker Co. Total		**$2,500.00**	**2.00**	**0.00**

Project Name: PLpfSpringCreek-Upland restoration-Becker Co.
Township: 142, Range: 41, Section: 7

Activity: Grassland Restoration
Landtype: Private - Land
Description: This project restored 27 acres of native prairie by reseeding into former cropland on property owned in fee title by Pheasants Forever, which will eventually be transferred over to the MNDNR to be protected in perpetuity. The PF and the FWS are responsible for future maintenance and management, until the land is transferred to the MNDNR.

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
Other Funds	Restoration	$13,000.00	27.00	0.00

LCCMR Work Program Final Report

Restoring Minnesota's Fish and Wildlife Habitat Corridors Phase 5

Habitat Conservation Partnership

2B:Partners for Wildlife - U.S. Fish & Wildlife Service

Project Name: PLFitE-Upland Restoration-Clay Co.
Township: 139, Range: 44, Section: 12

Activity: Grassland Enhancement
Landtype: Private - Land
Description: This project enhances 12.5 acres of native prairie on a FWS habitat easement that is protected in perpetuity. The site was burned and reseeded. Future maintenance and management on the property for the native prairie will be the responsibility of the FWS and the landowner. Seed for this project was hand harvested off of a native prairie remnant within 25 miles of the seeding site.

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Restoration	$150.00	0.06	0.00
Other Funds	Restoration	$29,850.00	12.44	0.00
PLFitE-Upland Restoration-Clay Co. Total		**$30,000.00**	**12.50**	**0.00**

Project Name: PLBroD-Wetland Restoration-Clay Co.
Township: 140, Range: 45, Section: 10

Activity: Wetland Restoration
Landtype: Private - Land
Description: Two wetlands were restored on private land by removing culverts in drainage ditches and replacing with texas type crossings to allow access to other areas of the tract. The texas crossings act as ditch plugs to limit flow out of the wetlands. This project is protected by a 10-year agreement with the landowner. The FWS and landowner are responsible for any future maintenance and management.

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Restoration	$1,500.00	7.14	0.00
Other Funds	Restoration	$6,359.00	30.26	0.00
PLBroD-Wetland Restoration-Clay Co. Total		**$7,859.00**	**37.40**	**0.00**

Project Name: PLChrJ-Wetland Restoration-Becker Co.
Township: 139, Range: 43, Section: 20

Activity: Wetland Restoration
Landtype: Private - Land
Description: This project restored one wetland basin for 2.1 acres by filling a drainage ditch and installing a rock rip-rap spillway to allow overflow during heavy run-off events. This project is protected by a perpetual easement held by FWS. The FWS and landowner are responsible for any future maintenance and management.

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Restoration	$3,234.00	1.42	0.00
Other Funds	Restoration	$1,544.00	0.68	0.00
PLChrJ-Wetland Restoration-Becker Co. Total		**$4,778.00**	**2.10**	**0.00**

Project Name: PLpfSpringCreek-Wetland restoration-Becker Co.
Township: 142, Range: 41, Section: 7

Activity: Wetland Restoration
Landtype: Private - Land
Description: Five wetlands were restored on this project covering 1.7 acres by scraping excess sediment from the wetland basins and filling the drainage ditches to near historical conditions. This tract is protected in perpetuity by Pheasants Forever and will eventually be transferred to the MN DNR to establish a WMA. Future maintenance and management will be the responsibility of Pheasants Forever and FWS until the property is transferred to MNDNR.

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Restoration	$2,766.00	1.70	0.00

LCCMR Work Program Final Report

Restoring Minnesota's Fish and Wildlife Habitat Corridors Phase 5

Habitat Conservation Partnership

2B:Partners for Wildlife - U.S. Fish & Wildlife Service

Project Area - 4 - Central Lakes

Project Name: PLThoR-Wetland restoration-Aitkin Co.
Township: 50, Range: 23, Section: 34

Activity: Wetland Restoration
Landtype: Private - Land
Description: This project restored a 25 acre wetland on private land through the construction of an embankment and sheet-pile weir across a drainage way that connected to a road ditch. This site had historically held wild rice and was heavily used by migrating waterfowl until an old highway structure failed several years ago and the wetland drained through the road ditch. This project is protected by a 10-year PFW agreement and the landowner is interested in longer term protection. The USFWS and landowner are responsible for future maintenance and management.

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Restoration	$4,550.00	6.06	0.00
Other	Restoration	$7,025.00	9.36	0.00
Other Funds	Restoration	$7,183.00	9.57	0.00
PLThoR-Wetland restoration-Aitkin Co. Total		**$18,758.00**	**25.00**	**0.00**

Project Area - 6 - Upper Minnesota River

Project Name: PLSkjK-Upland enhancement-Lac Qui Parle Co.
Township: 119, Range: 43, Section: 20

Activity: Grassland Enhancement
Landtype: Private - Land
Description: This project enhanced 98 acres of grassland which a portion is native prairie by removing invasive woody vegetation. This project is project is protected by a 10-year agreement. The USFWS and landowner are responsible for follow-up treatment of prescribed fire and chemical treatment if necessary.

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Restoration	$5,000.00	54.44	0.00
Other Funds	Restoration	$4,000.00	43.56	0.00
PLSkjK-Upland enhancement-Lac Qui Parle Co. Tota		**$9,000.00**	**98.00**	**0.00**

Project Area - 9 - Des Moines River Valley

Project Name: PLHofC-Wetland Restoration-Cottonwood Co.
Township: 109, Range: 30, Section: 9

Activity: Wetland Restoration
Landtype: Private - Land
Description: This project restored three wetland basins and enhanced 1 wetland basin on private land totaling 19.5 acres. The wetlands were restored and enhanced by breaking an existing subsurface tile system and construction of an embankment across a drainage ditch. These restored/enhanced wetlands are surrounded by an additional 30 acres of grassland habitat. Project is protected by a 10-year agreement. The landowner and FWS are responsible for future maintenance and management.

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Restoration	$3,100.00	3.35	0.00
Other Funds	Restoration	$14,944.00	16.15	0.00
PLHofC-Wetland Restoration-Cottonwood Co. Total		**$18,044.00**	**19.50**	**0.00**

LCCMR Work Program Final Report

Restoring Minnesota's Fish and Wildlife Habitat Corridors Phase 5

Habitat Conservation Partnership

2B:Partners for Wildlife - U.S. Fish & Wildlife Service

Restoration Project Totals (By Funding Type)

Funding Type	Funding Amount	Acres	Shoreline Feet
ENTF:	$30,000.00	138.52	0.00
Other Funds:	$78,855.00	150.46	0.00
Other:	$9,525.00	21.22	0.00
Total:	**$118,380.00**	**310.20**	**0.00**

Funding Type Definitions

ENTF:	Grant dollars provided through the Minnesota Environment and Natural Resources Trust Fund
Other Funds:	Non-state, non-state leveraged dollars (if partner funds are leveraging State Funds (e.g. RIM) they are not eligible to be considered Other Funds)
State Funds:	State Funds expended on HCP projects (not eligible for use as Other Funds commitment)
Partner's State Leveraged Funds:	Non State Funds that have leveraged State Funds as part of an HCP project (not eligible for use as Other Funds commitment)
Other:	Any other expenditures (e.g. grant income funds)

Attachment A: Budget Detail for 2008 Projects - Summary and a Budget - Final

Project Title: *Minnesota's Habitat Conservation Partnership - Phase V, Partners for Fish and Wildlife (2b)*

Project Manager Name: *Sheldon Myerchin*

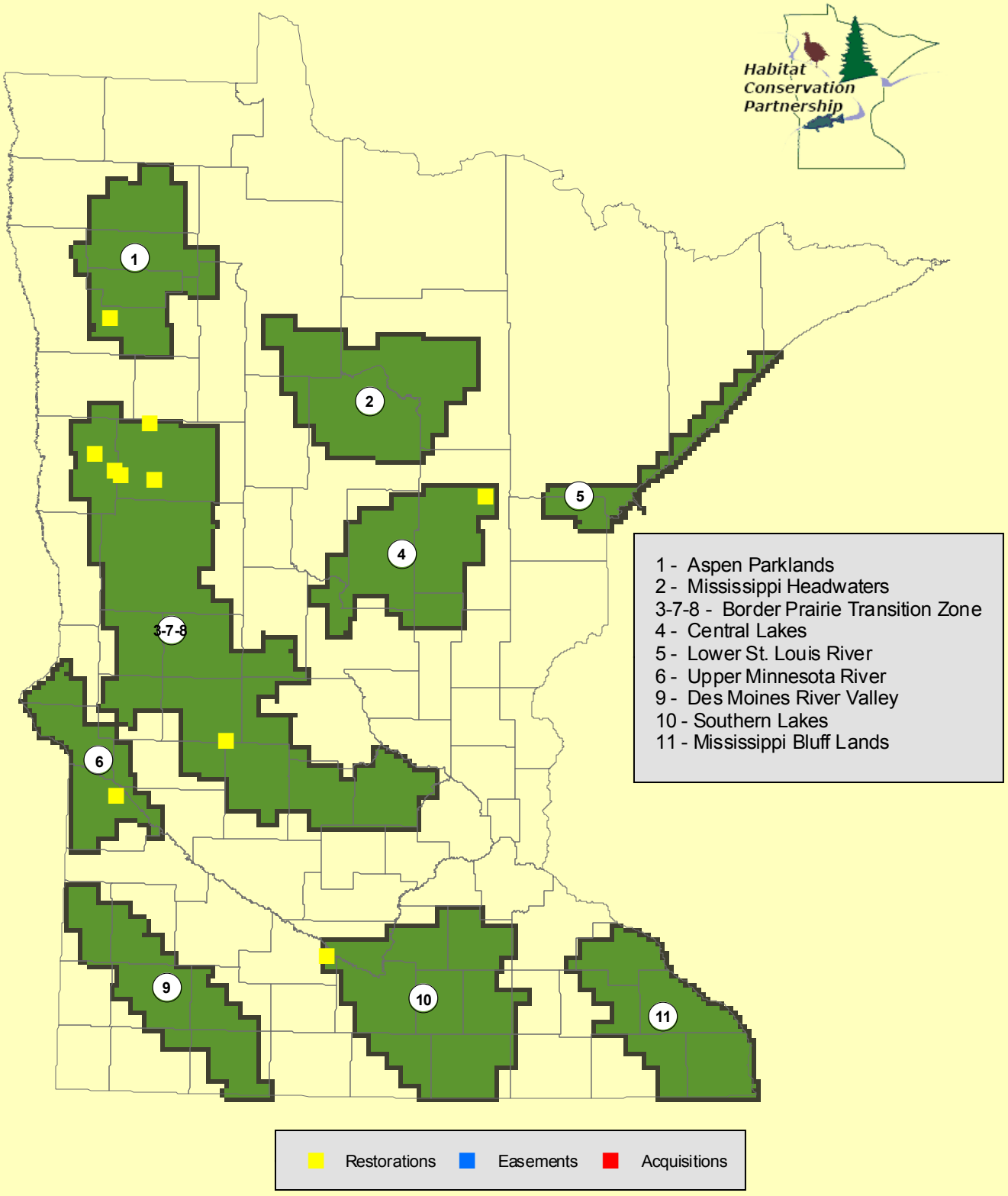
Trust Fund Appropriation: $30,000

1) See list of non-eligible expenses, do not include any of these items in your budget sheet

2) Remove any budget item lines not applicable

2008 Trust Fund Budget	Result 1 Budget:	Amount Spent *(date)*	Balance (11/01/09)	Result 2 Budget:	Amount Spent *(date)*	Balance *(date)*	Result 3 Budget:	Amount Spent *(date)*	Balance *(date)*	TOTAL BUDGET	TOTAL BALANCE
				Fill in your result title here.			*Fill in your result title here.*				
BUDGET ITEM - Restoration	30,000		30,000			0			0	30,000	30,000
See Restoration Activities Sheet for Project Expenditure Breakdown			0			0			0	0	0
Restoration			0			0			0	0	0
Project Area 1 Aspen Parklands		1,200	-1,200			0			0	0	-1,200
Project Area 2 Mississippi Headwaters			0			0			0	0	0
Project Area 3-7-8 Prairie Forest Transition Zone		16,150	-16,150			0			0	0	-16,150
Project Area 4 Central Lakes		4,550	-4,550			0			0	0	-4,550
Project Area 5 Lower St. Louis River			0			0			0	0	0
Project Area 6 Upper Minnesota River		5,000	-5,000			0			0	0	-5,000
Project Area 9 Des Moines River Valley			0			0			0	0	0
Project Area 10 Southern lakes		3,100	-3,100			0			0	0	-3,100
Project Area 11 Mississippi Bluff Lands			0			0			0	0	0
			0			0			0	0	0
COLUMN TOTAL	**$30,000**	**$30,000**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$30,000**	**$0**

Habitat Conservation Partnership
Partners for Wildlife
2B



2008 Project Abstract
For the Period Ending June 30, 2010

PROJECT TITLE: Living Lakes Enhancements & Easements
Minnesota's Habitat Conservation Partnership (Parts 2c&3c)
PROJECT MANAGER: Jon Schneider, Manager – Minn. Conservation Programs
AFFILIATION: Ducks Unlimited, Inc.
MAILING ADDRESS: 311 East Lake Geneva Road NE
CITY/STATE/ZIP: Alexandria, Minnesota 56308
PHONE: 320-762-9916
E-MAIL: jschneider@ducks.org
FAX: 320-759-1567
WEB SITE: www.ducks.org

FUNDING SOURCE: Environment and Natural Resources Trust Fund
LEGAL CITATION: **Minnesota Law 2008, Chapter 367, Section 2, Subd. 3(c)**

APPROPRIATION AMOUNT: **$ 330,000**

Overall Project Outcome and Results

The objective of this project was to accelerate Ducks Unlimited (DU) enhancement and protection of shallow lakes for waterfowl habitat through DU bio-engineering assistance and DU conservation easements as a part of the Habitat Conservation Partnership (HCP). In HCP part 2c, DU proposed to enhance at least one shallow lake totaling 100 acres by installing a new water control structure, engineering four new shallow lake structure projects, and providing technical assistance to the Minnesota DNR and U.S. Fish & Wildlife Service to assess and develop new shallow lake enhancement projects. In HCP part 3c, DU proposed to secure at least one permanent conservation easement protecting 100 acres or more along a shallow lake.

In HCP part 2c, DU constructed water control structures on the outlets of shallow lakes on the Bah Lake Waterfowl Production Area (WPA) in Grant County and on the outlet of Buffalo Lake in Waseca County, thereby enhancing 1,017 shallow lake acres. DU also surveyed and designed five new water control structures for Perch Lake in Blue Earth County, Gislason Lake in Lincoln County, and three shallow lakes on three federal WPAs in Big Stone County. DU also provided ongoing technical assistance to MNDNR and USFWS in HCP Project Areas to help assess and develop 41 new shallow lake projects for future implementation.

In HCP part 3c, DU secured four new permanent conservation easements protecting 392 acres on Lake Christina, including 8,803 feet of shallow lake shoreline. In addition, DU began negotiating a conservation easement with another landowner there, and provided technical assistance to 21 other landowners on other shallow lakes in HCP Project Areas.

Environment & Natural Resources Trust Fund (ENRTF) funds for annual easement monitoring and stewardship were calculated for each easement using the DU easement endowment worksheet table previously appended and approved for use by LCCMR staff in a 2005 appropriation to DU, which captures all anticipated expenditures for easement monitoring and stewardship. Estimated easement stewardship costs vary due to variation in size and location of easements, complexity in land configuration, condition, and habitat types, and the terms and conditions outlined in the easement. Stewardship funds are managed in a separate WAT easement stewardship account according to the DU Board's investment policy. Trust funds for easement monitoring and stewardship are received by DU National Headquarters in Memphis, Tennessee, and are immediately transferred to the WAT endowment account. Stewardship

funds are held in a restricted endowment to be used for stewardship on easements acquired with the Trust Fund money. DU staff costs to annually monitor easements and provide easement stewardship will be billed to specific easement project account codes on an annual basis, and funds to cover this expense will be made available from the WAT easement endowment to the DU regional office budget to cover these annual costs. Copies of the most recent WAT audited financial statements are available for LCCMR staff review at any time upon request. Annual reports on monitoring and management of easements acquired with ENRTF funding will be provided to LCCMR staff.

DU's total cost was $476,231 to enhance shallow lakes (part 2c) and $669,886 to secure conservation easements (part 3c), of which $180,000 for enhancements and $150,000 for easements was reimbursed to DU from this Environment & Natural Resources Trust Fund appropriation. A total of $816,117 in non-state Other Funds was contributed to these projects through donated private land value ($180,000), federal North American Wetlands Conservation Act (NAWCA) grants, and private funds from DU and the Bush Foundation.

Project Results Use and Dissemination

This grant helped accelerate DU Living Lakes assessment and enhancement of shallow lakes throughout southern, central, and western Minnesota. DU enhanced two shallow lakes and produced five detailed engineering design plans for state and federal agency use in future shallow lake enhancement projects, and helped inform the public of shallow lake functions and values through public meetings, news releases sent to the media, and in articles in DU publications. Shallow lake assessment data collected by DU biologists was provided to DNR's shallow lake program and area wildlife managers, and shared with MPCA to aid in their impaired waters assessment.

This grant also helped accelerate DU Living Lakes land protection and promotion of conservation easement concepts to many individual landowners on shallow lakes. Conservation easements with private landowners are sensitive land deals that don't lend themselves to widespread publicity; however, DU has recognized individual landowners and has publicized our work to protect Lake Christina shoreland locally through local conservation groups, including through the Christina-Ina-Anka Lake Association. DU also informed the foundations supporting our Living Lakes Initiative of our conservation accomplishments. The accomplishment of securing six new permanent conservation easements through this grant has helped encourage other private landowners around key shallow lakes (especially Christina) to consider working with DU to protect their shorelines, and news of our progress will be further disseminated through a DU news releases and articles DU publications in the future.

LCCMR Work Program Final Report

Restoring Minnesota's Fish and Wildlife Habitat Corridors Phase 5

Habitat Conservation Partnership

2C:Living Lakes Enhancement - Ducks Unlimited

Project Manager: Jon Schneider

Affiliation: Ducks Unlimited

Address: 311 East Lake Geneva Road

Alexandria, MN 56308

Phone: (320)762-9916

Fax: (320)759-1567

E-mail: jschneider@ducks.org

Fund: Environment and Natural Resources Trust Fund

Legal Citation: ML 2008 First Special Section, Ch. 367, Sec. 2 Subd. 3(c).

Total Biennial Project Budget

Result	ENTF Allocation	ENTF Funds Spent	ENTF Balance	Other Funds Proposed	Other Funds Spent
Restoration	$180,000	$180,000	$0	$90,000	$296,231
Total	$180,000	$180,000	$0	$90,000	$296,231

Work Program Summary

Overall Project Outcome and Results

The objective of this project was to accelerate Ducks Unlimited (DU) bio-engineering assistance to help agencies enhance shallow lakes for waterfowl through our Living Lakes Initiative. DU biologists and engineers provided technical assistance to Minnesota DNR, U.S. Fish & Wildlife Service, and private landowners around shallow lakes with a goal of enhancing at least one shallow lake totaling 100 wetland acres with a new water control structure and/or fish barrier, engineering at least four new shallow lake enhancement structure projects, and providing technical assistance to agency field staff on other shallow lake projects.

Through this grant project, DU biologists and engineers surveyed and designed 5 new water control structures and fish barriers for the Minnesota DNR and US Fish & Wildlife Service, including Perch Lake in Blue Earth County, Gislason Lake in Lincoln County, and Wiley, Kufrin, Barry WPAs in Big Stone County. These projects will be implemented in the future as permits and easements are secured. In addition, DU constructed previously designed water control structures on the outlets of the Bah WPA in Grant County and Buffalo Lake in Waseca County, thereby enhancing 1,017 shallow lake acres. Finally, DU shallow lakes field biologist provided ongoing technical assistance to MNDNR and USFWS on 41 shallow lake projects in HCP Project Areas to help assess and develop new projects for future implementation.

DU's total cost to provide these bio-engineering services to enhance shallow lakes was $476,231, and included reimbursement of $180,000 from the Environment & Natural Resources Trust Fund, and the expenditure of $296,231 in Other Funds (DU and federal funds) that far exceeds the Other Funds we proposed to spend.

Project Results Use and Dissemination

This grant helped DU, DNR, and the Service accelerate the assessment and enhancement of shallow lakes throughout southern, central and western Minnesota. DU provided 5 detailed engineering design plans to state and federal agency staff, and informed the public of shallow lake improvement projects through public meetings, news releases sent to the media, and in articles in DU publications. Shallow lake assessment data collected by DU biologists was provided to DNR's shallow lake program and area wildlife managers, and shared with MPCA to aid in their impaired waters assessment.

LCCMR Work Program Final Report

Restoring Minnesota's Fish and Wildlife Habitat Corridors Phase 5

Habitat Conservation Partnership

2C:Living Lakes Enhancement - Ducks Unlimited

Restoration Activities

Project Area - 6 - Upper Minnesota River

Project Name: Wiley WPA
Township: 122, Range: 45, Section: 12

Activity: Shallow Lake Survey / Design / Wetland Mapping
Landtype: Public - WPA
Description: DU engineered a water control structure for a shallow lake on the Wiley WPA in Big Stone County for the US Fish & Wildlife Service. The structure will be used to actively manage water levels and rejuvenate the aquatic ecology of the basin, once it is constructed. Funding for construction and related permits will be pursued in 2009.

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Personnel Expenditures	$12,919.84	0.00	0.00
Other Funds	Personnel Expenditures	$19,744.29	0.00	0.00
Wiley WPA Total		**$32,664.13**	**0.00**	**0.00**

Project Name: Kufrin WPA
Township: 122, Range: 45, Section: 21

Activity: Shallow Lake Survey / Design / Wetland Mapping
Landtype: Public - WPA
Description: DU engineered a water control structure for a shallow lake on the Kufrin WPA in Big Stone County for the US Fish & Wildlife Service. The structure will be used to actively manage water levels and rejuvenate the aquatic ecology of the basin. The USFWS provided $10,000 in federal funding through a Challenge Cost-Share grant to DU.

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Personnel Expenditures	$10,000.00	0.00	0.00
Other Funds	Personnel Expenditures	$13,448.64	0.00	0.00
Kufrin WPA Total		**$23,448.64**	**0.00**	**0.00**

Project Name: Barry WPA
Township: 124, Range: 47, Section: 8

Activity: Shallow Lake Survey / Design / Wetland Mapping
Landtype: Public - WPA
Description: DU is engineering a water control structure for a shallow lake on the Barry WPA in Big Stone County for the US Fish & Wildlife Service. The structure will be used to actively manage water levels and rejuvenate the aquatic ecology of the basin. Funding for project construction and permits will be pursued in 2009 and 2010.

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Personnel Expenditures	$10,000.00	0.00	0.00
Other Funds	Personnel Expenditures	$12,521.54	0.00	0.00
Barry WPA Total		**$22,521.54**	**0.00**	**0.00**

LCCMR Work Program Final Report

Restoring Minnesota's Fish and Wildlife Habitat Corridors Phase 5

Habitat Conservation Partnership

2C:Living Lakes Enhancement - Ducks Unlimited

Project Area - 9 - Des Moines River Valley

Project Name: Gislason Lake
Township: 111, Range: 44, Section: 1

Activity: Wetland Enhancement
Landtype: Public - NWR
Description: DU is engineering a water control structure for 120-acre Gislason Lake, a shallow lake on the Northern Tallgrass Prairie NWR in Lincoln County owned and managed by the US Fish & Wildlife Service. The structure will be constructed in 2009 or 2010 once new grant funds are secured from LCCMR or LSOHC, and it will be used to actively manage water levels and rejuvenate the aquatic ecology of the basin. The USFWS provided $15,000 in cost-share for the engineering of this project.

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Personnel Expenditures	$11,025.44	0.00	0.00
Other Funds	Personnel Expenditures	$10,486.69	0.00	0.00
Gislason Lake Total		**$21,512.13**	**0.00**	**0.00**

Project Area - 10 - Southern Lakes

Project Name: Buffalo Lake
Township: 107, Range: 24, Section: 16

Activity: Wetland Enhancement
Landtype: Public - Lake
Description: DU engineered a new outlet water control and fish barrier structure for Buffalo Lake in Waseca County under DU's 2006 LCCMR HCP Phase 3 grant, and purchased the Britton conservation easement on the outlet site to protect the lake and allow for construction, management, and maintenance of the structure under DU's 2007 LCCMR HCP Phase 4 grant. Then, under this 2008 LCCMR HCP Phase 5 grant, DU constructed the structure during fall 2008 and spring 2009 using a combination of Trust Funds, DU funds, and a $10,000 challenge cost share grant from the US Fish & Wildlife Service. DU awarded the construction contract in September 2008, and the project was completed in May 2009. The lake is now in a 2 year draw-down to rejuvenate its aquatic ecology.

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Personnel Expenditures	$2,479.17	0.00	0.00
ENTF	Restoration	$49,715.55	503.77	0.00
Other Funds	Personnel Expenditures	$88,462.17	0.00	0.00
Other Funds	Restoration	$38,609.80	391.23	0.00
Buffalo Lake Total		**$179,266.69**	**895.00**	**0.00**

Project Name: Perch Lake
Township: 106, Range: 26, Section: 13

Activity: Shallow Lake Survey / Design / Wetland Mapping
Landtype: Public - Lake
Description: DU engineered a new water control structure for the outlet of Perch Lake in Waseca County for the Minnesota DNR and Minnesota Valley Trust (owns the outlet, will transfer to USFWS). Perch Lake is one of DNR's 40 designated wildlife lake. The water control structure will be used by DNR to actively manage water levels in this shallow lake to rejuvenate its aquatic ecology. The structure will be constructed in 2009 using federal NAWCA grant funds and DU's 2009 LCCMR grant (HCP#6).

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Personnel Expenditures	$15,704.00	0.00	0.00
Other Funds	Personnel Expenditures	$28,916.04	0.00	0.00
Perch Lake Total		**$44,620.04**	**0.00**	**0.00**

LCCMR Work Program Final Report

Restoring Minnesota's Fish and Wildlife Habitat Corridors Phase 5

Habitat Conservation Partnership

2C:Living Lakes Enhancement - Ducks Unlimited

Project Area - 3-7-8 - Border Prairie Transition Zone

Project Name: Bah Lakes WPA
Township: 130, Range: 41, Section: 36

Activity: Wetland Enhancement
Landtype: Public - WPA
Description: DU engineered and installed a combination draw-down and fish barrier water control structure on the outlet of two small shallow lakes on Bah Lakes WPA in Grant County to allow the US Fish & Wildlife Service to improve water quality and aquatic ecology of these basins and prevent the re-infestation of the basins by fish. This project was started in fall 2008 and was completed in June 2009. The USFWS provided $25,000 in project funding through a Challenge Cost-Share grant.

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Restoration	$60,000.00	86.43	0.00
Other Funds	Personnel Expenditures	$37,506.21	0.00	0.00
Other Funds	Restoration	$24,693.03	35.57	0.00
Bah Lakes WPA Total		**$122,199.24**	**122.00**	**0.00**

Restoration Project Totals (By Funding Type)

Funding Type	Funding Amount	Acres	Shoreline Feet
ENTF:	$171,844.00	590.20	0.00
Other Funds:	$274,388.41	426.80	0.00
Total:	**$446,232.41**	**1,017.00**	**0.00**

LCCMR Work Program Final Report

Restoring Minnesota's Fish and Wildlife Habitat Corridors Phase 5

Habitat Conservation Partnership

2C:Living Lakes Enhancement - Ducks Unlimited

Work Program Expenditures - Not Attributable to Specific Projects

FundingType	*Category*	*Amount*	*Description*
ENTF	Personnel Expenditures	$464.00	DU shallow lakes biologist Josh Kavanagh provides technical assistance to DNR and USFWS in HCP Project Area 6 Upper Minnesota River to assess shallow lakes and develop shallow lake enhancement projects, including wildlife lake designation, water level management, invasive fish control projects, water quality sampling, and outreach to landowners and local stakeholders.
ENTF	Personnel Expenditures	$3,192.00	DU shallow lakes biologist Josh Kavanagh provides technical assistance to DNR and USFWS in HCP Project Area 12 Border Prairie Transition Zone to assess shallow lakes and develop shallow lake enhancement projects, including wildlife lake designation, water level management, invasive fish control projects, water quality sampling, and outreach to landowners and local stakeholders.
ENTF	Personnel Expenditures	$1,806.72	DU shallow lakes biologist Josh Kavanagh provides technical assistance to DNR and USFWS in HCP Project Area 10 Southern Lakes to assess shallow lakes and develop shallow lake enhancement projects, including wildlife lake designation, water level management, invasive fish control projects, water quality sampling, and outreach to landowners and local stakeholders.
ENTF	Personnel Expenditures	$1,693.28	DU shallow lakes biologist Josh Kavanagh provides technical assistance to DNR and USFWS in HCP Project Area 9 Prairie Coteau to assess shallow lakes and develop shallow lake enhancement projects, including wildlife lake designation, water level management, invasive fish control projects, water quality sampling, and outreach to landowners and local stakeholders.
ENTF	Personnel Expenditures	$1,000.00	DU grant administration and coordination of DU shallow lakes biologist and partnership work funded by this grant with Minnesota DNR and USFWS partners.
Other Funds	Personnel Expenditures	$479.89	DU shallow lakes biologist Josh Kavanagh provides technical assistance to DNR and USFWS in HCP Project Area 6 Upper Minnesota River to assess shallow lakes and develop shallow lake enhancement projects, including wildlife lake designation, water level management, invasive fish control projects, water quality sampling, and outreach to landowners and local stakeholders.
Other Funds	Personnel Expenditures	$9,721.96	DU shallow lakes biologist Josh Kavanagh provides technical assistance to DNR and USFWS in HCP Project Area 12 Border Prairie Transition Zone to assess shallow lakes and develop shallow lake enhancement projects, including wildlife lake designation, water level management, invasive fish control projects, water quality sampling, and outreach to landowners and local stakeholders.

2C:Living Lakes Enhancement - Ducks Unlimited

Other Funds	Personnel Expenditures	$1,986.84	DU shallow lakes biologist Josh Kavanagh provides technical assistance to DNR and USFWS in HCP Project Area 10 Southern Lakes to assess shallow lakes and develop shallow lake enhancement projects, including wildlife lake designation, water level management, invasive fish control projects, water quality sampling, and outreach to landowners and local stakeholders.
Other Funds	Personnel Expenditures	$5,756.59	DU shallow lakes biologist Josh Kavanagh provides technical assistance to DNR and USFWS in HCP Project Area 9 Prairie Coteau to assess shallow lakes and develop shallow lake enhancement projects, including wildlife lake designation, water level management, invasive fish control projects, water quality sampling, and outreach to landowners and local stakeholders.
Other Funds	Personnel Expenditures	$3,897.73	DU grant administration and coordination of DU shallow lakes biologist and partnership work funded by this grant with Minnesota DNR and USFWS partners.
	Total:	**$29,999.01**	

Work Program Expenditures (Not Attributable to Specific Projects) By Funding Type

Funding Type	Amount
ENTF	$8,156.00
Other Funds	$21,843.01
Total	**$29,999.01**

Work Program Expenditures Breakdown

Funding Type:	Restoration Projects	Not Attributable to Specific Projects	Total
ENTF	$171,844.00	$8,156.00	$180,000.00
Other Funds	$274,388.41	$21,843.01	$296,231.42
State Funds	$0.00	$0.00	$0.00
Total	$446,232.41	$29,999.01	$476,231.42

LCCMR Work Program Final Report

Restoring Minnesota's Fish and Wildlife Habitat Corridors Phase 5

Habitat Conservation Partnership

2C:Living Lakes Enhancement - Ducks Unlimited

Funding Type Definitions

ENTF:	Grant dollars provided through the Minnesota Environment and Natural Resources Trust Fund
Other Funds:	Non-state, non-state leveraged dollars (if partner funds are leveraging State Funds (e.g. RIM) they are not eligible to be considered Other Funds)
State Funds:	State Funds expended on HCP projects (not eligible for use as Other Funds commitment)
Partner's State Leveraged Funds:	Non State Funds that have leveraged State Funds as part of an HCP project (not eligible for use as Other Funds commitment)
Other:	Any other expenditures (e.g. grant income funds)

Attachment A: Budget Detail for 2008 Projects - Summary and a Budget page for each partner

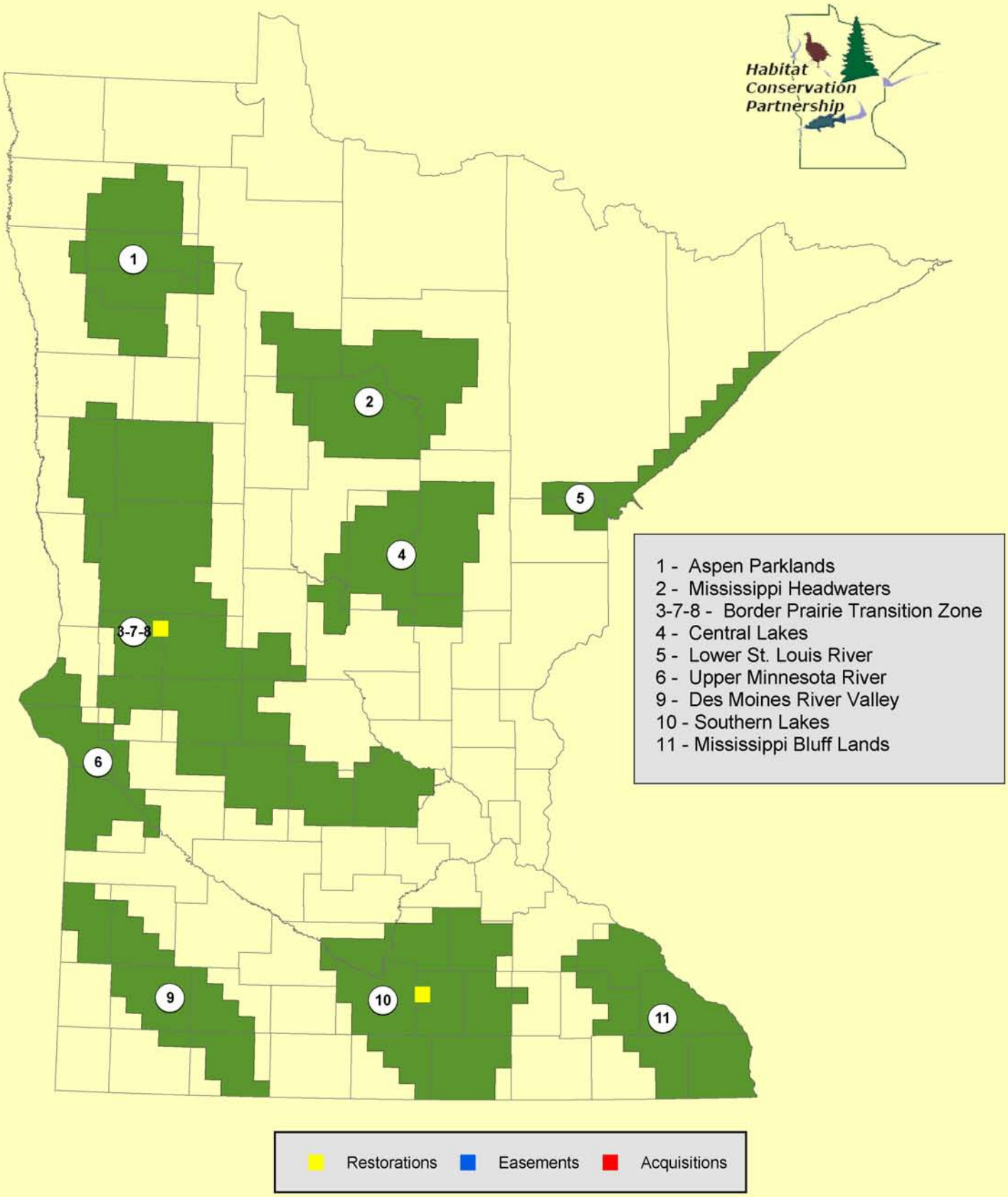
Project Title: Living Lakes Enhancements (2c) & Easements (3c)
Minnesota's Habitat Conservation Partnership (V)
Project Manager Name: Jon Schneider, DU

Trust Fund Appropriation: $ 330,000

DATE: FINAL REPORT JULY 2009

2008 Trust Fund Budget	**Result 1 Budget:**	**Amount Spent**	**Balance**	**Result 2 Budget:**	**Amount Spent**	**Balance**	**TOTAL BUDGET**	**TOTAL SPENT**	**TOTAL BALANCE**
	Living Lakes Enhancements			Living Lakes Easements					
BUDGET ITEM									
PERSONNEL: wages and benefits for DU biologist (1 FTE), engineers (1 FTE), and land protection (1 FTE) field staff	$70,284	$70,284	$0	$12,469	$12,469	$0	$82,753	$82,753	$0
CONTRACTS: construction of water structures, purchase of easements, contracted professional services such as soils investigation, title clearance, appraisal, legal work, and baseline documentation	$109,716		$0	$84,071		$0	$193,787	$0	$0
Professional/technical (consultant engineering and environmental services)		$0	$0		$3,083		$0	$3,083	
Land rights acquisition (easements)		$0	$0		$80,989		$0	$80,989	
Professional Services for Acquisition		$0	$0		$0	$0	$0	$0	$0
Construction (water control structures)		$109,716			$0	$0	$0	$109,716	
OTHER (easement monitoring stewardship)		$0	$0	$53,460	$53,460	$0	$53,460	$53,460	$0
COLUMN TOTAL	**$180,000**	**$180,000**	**$0**	**$150,000**	**$150,000**	**$0**	**$330,000**	**330,000**	**0**

Habitat Conservation Partnership
Phase 5 - Accomplishments
2C - Living Lakes Enhancement - Ducks Unlimited



2008 Project Abstract
For the Period Ending June 30, 2010

PROJECT TITLE: Restoring Minnesota's Fish and Wildlife Habitat Corridors Phase V – Shallow Lakes (2d) - Minnesota's Habitat Conservation Partnership
PROJECT MANAGER: Ray Norrgard
AFFILIATION: Minnesota Dept. of Natural Resources Division of Fish and Wildlife
MAILING ADDRESS: 500 Lafayette Rd
CITY/STATE/ZIP: St. Paul/MN/55155
PHONE: 651-259-5227
E-MAIL: ray.norrgard@state.mn.us
WEBSITE: www.mnhabitatcorridors.org
FUNDING SOURCE: Environment and Natural Resources Trust Fund
LEGAL CITATION: ML 2008 First Special Section, Ch.367, Sec. 2 Subd. 3(c).

APPROPRIATION AMOUNT: $73,500

Overall Project Outcome and Results
DNR spent $73,399 to continue on-site field investigations for an additional year (through September, 2009) to accelerate management of shallow lakes and adjacent wetland complexes and support the accomplishments of Ducks Unlimited through HCP 2c and 3c. Temporary field personnel (1 full time and 6 temporary) documented shallow lake habitat occurrence and quality. Habitat surveys were conducted on 94 lakes within six HCP project areas. The lakes surveyed totaled over 45,500 acres. The surveys were distributed more broadly than in the past with 8 surveys conducted within Area 1, 30 surveys conducted within Area 3, 14 surveys conducted within Area 4, 10 surveys conducted within Area 6, 22 surveys conducted within Area 9, and 10 surveys conducted within Area 10. Eight of the surveys were for evaluating and monitoring the effect of management actions. Data was entered into the DNR Shallow Lake Database, checked and verified.

Project Results Use and Dissemination
The habitat survey information was used to support DNR's shallow lake management efforts identified in the 2006 Duck Recovery Plan and Ducks Unlimited's efforts under Restoring Minnesota's Fish and Wildlife Habitat Corridors IV – Wildlife Shallow Lakes Enhancement 2(c). Dissemination of project accomplishments will be through the LCCMR reporting process and normal DNR budgeting and accomplishment reporting. Data collected on the habitat quality of shallow lakes will be available as part of the DNR shallow lakes database managed by Division of Fish and Wildlife staff in Brainerd.

Trust Fund 2008 Work Program Final Report

Date of Report: August 16, 2010
Final Report
Date of Work program Approval: 2008
Project Completion Date: June 30, 2010

I. PROJECT TITLE: **Restoring Minnesota's Fish and Wildlife Habitat Corridors Phase V – Shallow Lakes (2d) - Minnesota's Habitat Conservation Partnership**
Project Manager: Ray Norrgard
Affiliation: Minnesota Dept. of Natural Resources Division of Fish and Wildlife
Mailing Address: 500 Lafayette Rd
City / State / Zip : St. Paul/MN/55155
Telephone Number: 651-259-5227
E-mail Address: ray.norrgard@state.mn.us
FAX Number: 651 297-4961
Web Page address: www.mnhabitatcorridors.org

Location: All Habitat Conservation Partnership work will be completed within the nine Project Area boundaries identified in the attached map (please see the 1a Project Area Coordination and Mapping work plan).

Total Trust Fund Project Budget:	**Trust Fund Appropriation:**	**$**	**73,500**
	Minus Amount Spent:	**$**	**73,339**
	Equal Balance:	**$**	**161**

Legal Citation: ML 2008 First Special Section, Ch.367, Sec. 2 Subd. 3(c).

Appropriation Language: (c) Minnesota Habitat Conservation Partnership – Phase V. $3,150,000 is appropriated from the trust fund for the fifth appropriation for acceleration of agency programs and cooperative agreements.

II and III. FINAL PROJECT SUMMARY: DNR spent $73,399 to continue on-site field investigations for an additional year (through September, 2009) to accelerate management of shallow lakes and adjacent wetland complexes and support the accomplishments of Ducks Unlimited through HCP 2c and 3c. Temporary field personnel (1 full time and 6 temporary) documented shallow lake habitat occurrence and quality. Habitat surveys were conducted on 94 lakes within six HCP project areas. The lakes surveyed totaled over 45,500 acres. The surveys were distributed more broadly than in the past with 8 surveys conducted within Area 1, 30 surveys conducted within Area 3, 14 surveys conducted within Area 4, 10 surveys conducted within Area 6, 22 surveys conducted within Area 9, and 10 surveys conducted within Area 10. Eight of the surveys were for evaluating and monitoring the effect of management actions. Data was entered into the DNR Shallow Lake Database, checked and verified.

Retroactive Amendment Request: Approved December 27, 2010
I request to shift funds between categories within the overall budget for M. L. 2008 Chapter 367, Sec. 2, Subd. 3c-2d - Shallow Lakes. The request is needed to cover a shortfall in estimated vehicle rental costs. The needed funds will be shifted from the Travel, Equipment, and Personnel categories. The reason for the shortfall can be attributed to three factors:

1) I underestimated the number of surveys that could accomplished with the reduced budget. In Phase IV, crews completed 100 habitat surveys for a vehicle rental cost of $10,336. In Phase V (2008), crews completed 94 habitat surveys. If I had been on target with my estimate I would have budgeted at least $9,800 instead of $7,000;
2) The habitat surveys in Phase V were distributed more broadly than in the past with 8 surveys conducted within Area 1, 30 surveys conducted within Area 3, 14 surveys conducted within Area 4, 10 surveys conducted within Area 6, 22 surveys conducted within Area 9, and 10 surveys conducted within Area 10. As a consequence more actual miles were driven to complete the surveys. In Phase IV 104 miles were driven per survey. In Phase V 158 miles were driven per survey, a 52% increase; and
3) Increases in fuel costs resulted in additional charges. The first two factors alone make up the difference in cost. If I had properly anticipated the number and geographic distribution of habitat surveys I would have projected $14,896 in vehicle rental charges.

IV. OUTLINE OF PROJECT RESULTS*:*

Result 1: Complete 30 shallow lake surveys

Description: A minimum of 30 shallow lake surveys will be conducted to help identify and prioritize restoration strategies conducted through HCP 2c and 3c. These strategies may include shore land protection, reducing undesirable fish, managing water levels, constructing fish barriers, and establishing beneficial vegetation. This work will primarily focus on Project Areas 1, 2, 3, 4, 6, 7, 8, 9, and 10 although work may be completed in other HCP Project Areas when appropriate. The majority of the work will occur during the 2009 field season with all work completed by October 30, 2009. Survey lakes will be identified through a collaborative process involving Ducks Unlimited, MNDNR, and U. S. Fish and Wildlife Service. The surveys will be targeted to support work conducted by Ducks Unlimited through HCP 2c and 3c.

Summary Budget Information for Result 1:	**Trust Fund Budget:**	**$ 73,500**
	Amount Spent:	**$ 73,339**
	Balance:	**$ 161**

Deliverable	**Completion Date**	**Budget**	**Status**
1. 30 lake surveys	October 30, 2009	$73,500	

Completion Date: June 30, 2010

Final Report Summary: Habitat surveys were conducted on 94 lakes within six HCP project areas. The lakes surveyed totaled over 45,500 acres. The surveys were distributed more broadly than in the past with 8 surveys conducted within Area 1, 30 surveys conducted within Area 3, 14 surveys conducted within Area 4, 10 surveys conducted within Area 6, 22 surveys conducted within Area 9, and 10 surveys conducted within Area 10. Eight of the surveys were for evaluating and monitoring the effect of management actions.

V. TOTAL TRUST FUND PROJECT BUDGET:

Staff or Contract Services: $57,623 (1 full-time temporary and up to 6 interns)
Equipment: $300 (repair and replace survey equipment as needed)
Development: $ (improvement to land or building)
Restoration: $ (how many acres)
Acquisition, including easements: $ (how many acres, also who will hold the title to the land)
Other: Supplies $ 252
Instate Travel $ 583
Vehicle Rental $ 14,821

TOTAL TRUST FUND PROJECT BUDGET: $ 73,500

Explanation of Capital Expenditures Greater Than $3,500:

VI. OTHER FUNDS & PARTNERS:

A. Project Partners:

B. Other Funds Proposed to be Spent during the Project Period:

C. Past Spending: 2001: $350,000; 2003: $98,300; 2005: $98,000

D. Time: This proposal requests a 12-month time frame starting approximately October 1, 2008 to be completed September 30, 2009.

VII. DISSEMINATION: Accomplishment Reports and press releases will be made available at http://www.mnhabitatcorridors.org

VIII. REPORTING REQUIREMENTS:

Periodic work program progress reports will be submitted not later than December 1, 2008. A final work program report and associated products will be submitted between June 30 and August 1, 2009 or 2010 as requested by the LCCMR. All reports will be generated using the HCP online reporting system.

IX. RESEARCH PROJECTS: NA

Attachment A: Final Budget Detail Projects June 30, 2010

Project Title: Shallow Lakes (2d)

Minnesota's Habitat Conservation Partnership (V)

Project Manager Name: Ray Norrgard

Trust Fund Appropriation: $ 73,500

1) See list of non-eligible expenses, do not include any of these items in your budget sheet

2) Remove any budget item lines not applicable

2008 Trust Fund Budget	**Result 1 Budget:**	**Revised Result 1 Budget**	**Amount Spent** *(date)*	**Balance** *(date)*	**TOTAL BUDGET**	**TOTAL BALANCE**
	Complete 30 shallow lake surveys					
BUDGET ITEM				0		
PERSONNEL: wages and benefits for 1 full time temporary and up to 6 interns	~~65,365~~	57,623	57,623	0	57,623	0
Contracts				0	0	0
Professional/technical *(with whom?, for what?)*				0	0	0
Other contracts *(with whom?, for what?) list out: personnel, equipment, etc.*				0	0	0
Other direct operating costs *(for what? – be specific)*				0	0	0
Equipment*	~~300~~	221	171	50	221	50
Office equipment & computers - NOT ALLOWED unless unique to the project				0	0	0
Other Capital equipment *(list specific items)*				0	0	0
Land acquisition				0	0	0
Land rights acquisition *(less than fee)*				0	0	0
Professional Services for Acq.				0	0	0
Printing				0	0	0
Other Supplies** *(list specific categories)*	252	252	252	0	252	0
Travel expenses in Minnesota	583	583	473	110	583	110
Travel outside Minnesota *(where?)*				0	0	0
Construction *(for what?)*				0	0	0
Other land improvement *(for what?)*				0	0	0
Other: Vehicle rental	~~7,000~~	14,821	14,821	0	14,821	0
COLUMN TOTAL	**$73,500**	**$73,500**	**$73,339**	**$161**	**$73,500**	**$161**

***Repair and replace survey equipment as needed to conduct surveys**

****Supplies for conducting and recording surveys**

Note for final report: Adjustments were made to deal with unplanned increases in fleet costs (increase $7000) due to higher fuel costs and lake survey supplies (increase $252). Budget reductions were made for travel (reduce $900), equipment (reduce $1200), and personnel (reduce $7000).

2008 Project Abstract
For the Period Ending June 30, 2010

PROJECT TITLE:
PROJECT MANAGER: John Ringle/ Steve Mortensen
AFFILIATION: Division of Resources Management, Leech Lake Band of Ojibwe
MAILING ADDRESS: Division of Resources Management, 115, 6th St., Suite E
CITY/STATE/ZIP: Cass Lake, MN 56633
PHONE: 218-335-7421
FAX: 218-335-7430
E-MAIL: smortensen@lldrm.org
WEBSITE: www.mnhabitatcorridors.org
FUNDING SOURCE: Environment and Natural Resources Trust Fund
LEGAL CITATION: ML 2008, Chapter 367, Sec. 2, Subd. 3(C)

APPROPRIATION AMOUNT: $ 30,000

Overall Project Outcome and Results:

The goal of this project was to continue to improve shallow lake and marsh habitats and forested impoundments for nesting and feeding waterfowl within the boundaries of the Leech Lake Reservation. The Leech Lake Reservation has considerable acreage of lakes, streams, and wetlands that have supported and produced large numbers of migratory waterfowl in the past. Due to continued changes and degradation of brood habitats, competition by other species and uncontrolled, fluctuating water levels, waterfowl production has been greatly reduced.

Activities that have been completed under this project include prescribed burns on 700 acres of sedge meadows and brushland, water level control on 18 forest impoundments with the decommissioning of one as well as drawdown on two, nesting box installation and renovation, bog and beaver dam removal to restore flow, and seeding of wild rice on 104 acres. All work associated with this project was completed by field staff of the DRM with the exception of heavy equipment operations and prescribed burns. The prescribed burns were conducted cooperatively with our wildland fire crew, and other cooperators.

Additionally, we decommissioned six forest roads that totaled about 5.9 miles some through wetlands, to restore hydrologic conductivity and improve habitat for wetland sensitive species by utilizing the Leech Lake Heavy Equipment Department. Road decommissioning will be used to reverse forest fragmentation and increase the areas inaccessible by motorized travel.

Project Results Use and Dissemination:

These projects have helped to improve habitat for species that utilize shallow lakes, Forests, or wetlands. All of the work proposed under this project has been completed. Maintenance and management of impoundments was completed and West Banks II was decommissioned to restore stream flow and fish passage. A total of six forest road decommissioning were worked on and 104 acres of wildrice was replanted. The cost of rice seed has increased considerable this year, limiting the number of acreage we were able to replant. All projects are conducted on public and/or tribal lands and provide valuable habitat restoration and management, especially for waterfowl production and maintaining good water quality.

LCCMR Work Program Final Report

Restoring Minnesota's Fish and Wildlife Habitat Corridors Phase 5
Habitat Conservation Partnership

2F:Shallow Lake & Impoundment Managment - Leech Lake Band of Ojibwe

Project Manager: Steve Mortensen

Affiliation: Leech Lake Band of Ojibwe

Address: 6530 HWY 2 NW
Cass Lake, MN 56633

Phone: (218)335-7400

Fax: (218)335-7430

E-mail: llfish@paulbunyan.net

Fund: Environment and Natural Resources Trust Fund

Legal Citation: ML 2008 First Special Section, Ch. 367, Sec. 2 Subd. 3(c).

Total Biennial Project Budget

Result	ENTF Allocation	ENTF Funds Spent	ENTF Balance	Other Funds Proposed	Other Funds Spent
Restoration	$30,000	$30,000	$0	$65,000	$10,602
Total	$30,000	$30,000	$0	$65,000	$10,602

Work Program Summary

Overall Project Outcome and Results

The goal of this project is to continue to improve shallow lake and marsh habitats and forested impoundments for nesting and feeding waterfowl within the boundaries of the Leech Lake Reservation. The Leech Lake Reservation has considerable acreage of lakes, streams, and wetlands that have supported and produced large numbers of migratory waterfowl in the past. Due to continued changes and degradation of brood habitats, competition by other species and uncontrolled, fluctuating water levels, waterfowl production has been greatly reduced.

Activities that were completed under this project include prescribed burns on 700 acres of sedge meadows and brushland, water level control on 18 forest impoundments with the decommissioning of one as well as drawdown on two, nesting box installation and renovation, bog and beaver dam removal to restore flow, and seeding of wild rice on 104 acres. All work associated with this project was completed by field staff of the DRM with the exception of heavy equipment operations and prescribed burns. The prescribed burns were conducted cooperatively with our wildland fire crew, and other cooperators.

Additionally, we decommissioned six forest roads that totaled about 5.9 miles some through wetlands, to restore hydrologic conductivity and improve habitat for wetland sensitive species by utilizing the Leech Lake Heavy Equipment Department. Road decommissioning will be used to reverse forest fragmentation and increase the areas inaccessible by motorized travel.

Project Results Use and Dissemination

These projects have helped to improve habitat for species that utilize shallow lakes, Forests, or wetlands. All of the work proposed under this project has been completed. Maintenance and management of impoundments was completed and West Banks II was decommissioned to restore stream flow and fish passage. A total of six forest road decommissioning were worked on and 104 acres of wildrice was replanted. The cost of rice seed has increased considerable this year, limiting the number of acreage we were able to replant. All projects are conducted on public and/or tribal lands and provide valuable habitat restoration and management, especially for waterfowl production and maintaining good water quality.

2F:Shallow Lake & Impoundment Managment - Leech Lake Band of Ojibwe

Restoration Activities

LCCMR Work Program Final Report

Restoring Minnesota's Fish and Wildlife Habitat Corridors Phase 5
Habitat Conservation Partnership

2F:Shallow Lake & Impoundment Managment - Leech Lake Band of Ojibwe

Project Area - 2 - Mississippi Headwaters

Project Name: Wabegon Lake
Township: 0, Range: 0, Section: 0

Activity: Wild Rice Restoration
Landtype: Tribal - Lake
Description: Wild rice was seeded into Wabegon Lake to enhance this resource for waterfowl feed and cover

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Restoration	$3,000.00	176.99	0.00
Other Funds	Restoration	$390.00	23.01	0.00
Wabegon Lake Total		**$3,390.00**	**200.00**	**0.00**

Project Name: Ball Club Impoundment
Township: 145, Range: 26, Section: 8

Activity: Nestbox Installed
Landtype: Tribal - Lake
Description: Nest boxes were monitored and maintained.

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Restoration	$261.91	0.00	0.00

Project Name: Experimental Impoundment
Township: 145, Range: 30, Section: 32

Activity: Nestbox Installed
Landtype: Tribal - Lake
Description: Nest boxes were monitored and maintained.

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Restoration	$71.43	0.00	0.00

Project Name: Cuba Hill Impoundment
Township: 144, Range: 30, Section: 16

Activity: Nestbox Installed
Landtype: Tribal - Lake
Description: Nest boxes were monitored and maintained.

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Restoration	$238.10	0.00	0.00
Other Funds	Restoration	$382.00	0.00	0.00
Cuba Hill Impoundment Total		**$620.10**	**0.00**	**0.00**

Project Name: West Banks 2 Impoundment
Township: 145, Range: 27, Section: 13

Activity: Grassland Restoration
Landtype: Public - Lake
Description: Maintenance was conducted on this impoundment.

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Restoration	$500.00	1.28	0.00
ENTF	Restoration	$3,114.00	7.98	0.00
ENTF	Restoration	$1,194.00	3.06	0.00
Other Funds	Restoration	$3,000.00	7.68	0.00
West Banks 2 Impoundment Total		**$7,808.00**	**20.00**	**0.00**

2F:Shallow Lake & Impoundment Managment - Leech Lake Band of Ojibwe

Project Name: Ketchum Impoundmant
Township: 144, Range: 30, Section: 1

Activity: Nestbox Installed
Landtype: Tribal - Lake
Description: Nest boxes were monitored and maintained.

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Restoration	$428.58	0.00	0.00

Project Name: Boy River meadows
Township: 143, Range: 28, Section: 27

Activity: Wetland Restoration
Landtype: Tribal - Land
Description: An interagency prescribed burn was conducted to enhance habitat for wildlife in a section of the Boy River Meadows East of Leech Lake.

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Restoration	$3,000.00	1,594.00	0.00

Project Name: Battle Point Prescribed Burn
Township: 143, Range: 29, Section: 36

Activity: Wetland Enhancement
Landtype: Tribal - Land
Description: A prescribed burn was conducted on the wildlife pond that are located below Winnie Dam to enhance habitat for wildlife.

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Restoration	$1,000.00	70.00	0.00

Project Name: Winnie Ponds
Township: 146, Range: 27, Section: 25

Activity: Nestbox Installed
Landtype: Tribal - Lake
Description: Nest boxes were monitored and maintained.

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Restoration	$238.10	0.00	0.00
Nestbox Installed Total		$238.10	0.00	0.00

Activity: Wetland Restoration
Landtype: Tribal - Lake
Description: A prescribed burn was conducted on the ponds to enhance habitat for wildlife.

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Restoration	$1,000.00	70.00	0.00
Wetland Restoration Total		$1,000.00	70.00	0.00
Winnie Ponds Total		**$1,238.10**	**70.00**	**0.00**

Project Name: Burns Lake nestboxes
Township: 146, Range: 30, Section: 1

Activity: Nestbox Installed
Landtype: Tribal - Lake
Description: Nest boxes were monitored and maintained.

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Restoration	$476.20	0.00	0.00

LCCMR Work Program Final Report

Restoring Minnesota's Fish and Wildlife Habitat Corridors Phase 5
Habitat Conservation Partnership

2F:Shallow Lake & Impoundment Managment - Leech Lake Band of Ojibwe

Project Name: Three Island Lake
Township: 141, Range: 28, Section: 7

Activity: Nestbox Installed
Landtype: Tribal - Lake
Description: Nest boxes were monitored and maintained.

Funding Type	Funds Use	Funding Amount	Prorated Acres	Prorated Shoreline
ENTF	Restoration	$333.34	0.00	0.00

Project Name: Cedar Lake
Township: 141, Range: 29, Section: 14

Activity: Nestbox Installed
Landtype: Tribal - Lake
Description: Nest boxes were monitored and maintained.

Funding Type	Funds Use	Funding Amount	Prorated Acres	Prorated Shoreline
ENTF	Restoration	$309.53	0.00	0.00

Project Name: Ten Section Lake
Township: 145, Range: 31, Section: 35

Activity: Nestbox Installed
Landtype: Tribal - Lake
Description: Nest boxes were monitored and maintained.

Funding Type	Funds Use	Funding Amount	Prorated Acres	Prorated Shoreline
ENTF	Restoration	$166.67	0.00	0.00

Project Name: Bear Island
Tract: 1
Township: 142, Range: 29, Section: 14

Activity: Nestbox Installed
Landtype: Tribal - Lake
Description: Nest boxes were monitored and maintained on Bear Island.

Funding Type	Funds Use	Funding Amount	Prorated Acres	Prorated Shoreline
ENTF	Restoration	$261.91	0.00	0.00

Project Name: Pelican Island
Township: 142, Range: 29, Section: 17

Activity: Nestbox Installed
Landtype: Tribal - Lake
Description: Nest boxes were monitored and maintained.

Funding Type	Funds Use	Funding Amount	Prorated Acres	Prorated Shoreline
ENTF	Restoration	$71.43	0.00	0.00

Project Name: Ottertail Point
Township: 143, Range: 30, Section: 14

Activity: Nestbox Installed
Landtype: Tribal - Lake
Description: Nest boxes were monitored and maintained.

Funding Type	Funds Use	Funding Amount	Prorated Acres	Prorated Shoreline
ENTF	Restoration	$95.24	0.00	0.00

LCCMR Work Program Final Report

Restoring Minnesota's Fish and Wildlife Habitat Corridors Phase 5
Habitat Conservation Partnership

2F:Shallow Lake & Impoundment Managment - Leech Lake Band of Ojibwe

Project Name: Lucille Pond
Township: 143, Range: 27, Section: 36

Activity: Nestbox Installed
Landtype: Public - Lake
Description: Nest boxes were monitored and maintained.

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Restoration	$166.67	0.00	0.00

Project Name: Mississippi River Beaver Pond
Township: 144, Range: 26, Section: 11

Activity: Nestbox Installed
Landtype: Tribal - Lake
Description: Nest boxes were monitored and maintained.

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Restoration	$166.67	0.00	0.00

Project Name: Big Lake
Township: 147, Range: 31, Section: 32

Activity: Nestbox Installed
Landtype: Tribal - Lake
Description: Nest boxes were monitored and maintained.

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Restoration	$309.53	0.00	0.00

Project Name: Fire Lake
Township: 145, Range: 28, Section: 27

Activity: Nestbox Installed
Landtype: Tribal - Lake
Description: Nest boxes were monitored and maintained.

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Restoration	$119.05	0.00	0.00

Project Name: Little LuLu Lake
Township: 145, Range: 29, Section: 23

Activity: Nestbox Installed
Landtype: Tribal - Lake
Description: Nest boxes were monitored and maintained.

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Restoration	$285.72	0.00	0.00

Project Name: Sucker Creek
Township: 144, Range: 30, Section: 11

Activity: Wild Rice Restoration
Landtype: Public - Lake
Description: Beaver dams were removed from Sucker Creek to enhance wild rice and allow for spawning fish passage.

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Restoration	$500.00	60.00	0.00

LCCMR Work Program Final Report

Restoring Minnesota's Fish and Wildlife Habitat Corridors Phase 5
Habitat Conservation Partnership

2F:Shallow Lake & Impoundment Managment - Leech Lake Band of Ojibwe

Project Name: Road Decommissioning 2322
Township: 144, Range: 28, Section: 27

Activity: Wetland Restoration
Landtype: Tribal - Land
Description: This road was decommissioned by blocking the road,tearing up the road bed, and replaning to native vegetation and a cover crop. This helps to restore wetlands that the road passes through and stop ATV traffic that was damaging the wetlands.

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Restoration	$1,167.00	0.00	7,399.00

Project Name: Road Decommissioning 2928
Township: 144, Range: 29, Section: 1

Activity: Wetland Restoration
Landtype: Tribal - Land
Description: This road was decommissioned by blocking the entrance, tearing up part of the road bed, and reseeding with native species as well as willow and conifer planting. This will prevent ATV traffic into the wetland and upland areas where rare species are found. This will also help to reduce the spread of non-native earthworms.

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Restoration	$1,451.50	0.00	8,258.00

Project Name: Road Decommissioning 2114
Township: 144, Range: 29, Section: 14

Activity: Wetland Restoration
Landtype: Tribal - Land
Description: This road was decommissioned by blocking the entrance, tearing up part of the road bed. This will prevent vehicle traffic into this area where rare species are found and will help to reduce the spread of non-native earthworms.

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Restoration	$1,069.00	0.00	1,521.00

Project Name: Road Decommissioning 2925
Township: 144, Range: 29, Section: 19

Activity: Wetland Restoration
Landtype: Tribal - Land
Description: This road was decommissioned by blocking the entrance, tearing up part of the road bed, and dropping trees across the trail. This will prevent vehicle traffic into this area where rare species are found, stop ATV damage to wetlands, and will help to reduce the spread of non-native earthworms.

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Restoration	$4,959.00	0.00	3,997.26
Other Funds	Restoration	$3,288.50	0.00	2,650.74
Road Decommissioning 2925 Total		**$8,247.50**	**0.00**	**6,648.00**

LCCMR Work Program Final Report

Restoring Minnesota's Fish and Wildlife Habitat Corridors Phase 5
Habitat Conservation Partnership

2F:Shallow Lake & Impoundment Managment - Leech Lake Band of Ojibwe

Project Name: Bag Lake Impoundment
Township: 141, Range: 30, Section: 16

Activity: Wetland Enhancement
Landtype: Tribal - Lake
Description: Bag Lake Impoundment is managed and maintained for the benefit of waterfowl and other species that utilize this type of habiat.

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Restoration	$1,381.00	68.22	0.00
ENTF	Restoration	$403.00	19.91	0.00
Other Funds	Restoration	$98.50	4.87	0.00
Bag Lake Impoundment Total		**$1,882.50**	**93.00**	**0.00**

Project Name: Road Decommissioning 2339
Township: 144, Range: 27, Section: 21

Activity: Wetland Restoration
Landtype: Tribal - Lake
Description: This road was decommissioned by blocking the entrance, and tearing up the road bed. This will prevent ATV damage to the wetland.

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Restoration	$1,259.00	0.00	5,486.00

Project Name: Road Decommissioning 2160
Township: 144, Range: 28, Section: 31

Activity: Wetland Restoration
Landtype: Tribal - Land
Description: This road was decommissioned by blocking the entrance, tearing up part of the road bed. This will prevent ATV traffic into the upland areas where rare species are found. This will also help to reduce the spread of non-native earthworms

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Restoration	$1,002.50	0.00	445.66
Other Funds	Restoration	$3,442.50	0.00	1,530.34
Road Decommissioning 2160 Total		**$4,445.00**	**0.00**	**1,976.00**

Restoration Project Totals (By Funding Type)

Funding Type	Funding Amount	Acres	Shoreline Feet
ENTF:	$30,000.08	2,071.44	27,106.92
Other Funds:	$10,601.50	35.56	4,181.08
Total:	**$40,601.58**	**2,107.00**	**31,288.00**

LCCMR Work Program Final Report

Restoring Minnesota's Fish and Wildlife Habitat Corridors Phase 5
Habitat Conservation Partnership

2F:Shallow Lake & Impoundment Managment - Leech Lake Band of Ojibwe

Funding Type Definitions

ENTF:	Grant dollars provided through the Minnesota Environment and Natural Resources Trust Fund
Other Funds:	Non-state, non-state leveraged dollars (if partner funds are leveraging State Funds (e.g. RIM) they are not eligible to be considered Other Funds)
State Funds:	State Funds expended on HCP projects (not eligible for use as Other Funds commitment)
Partner's State Leveraged Funds:	Non State Funds that have leveraged State Funds as part of an HCP project (not eligible for use as Other Funds commitment)
Other:	Any other expenditures (e.g. grant income funds)

Attachment A: Budget Detail for 2008 Projects - **Summary and a Budget page for each partner**

Project Title: Habitat Enhancement on Shallow Lakes and Forested Impoundments

Minnesota's Habitat Conservation Partnership (V)

Project Manager Name: John P. Ringle.

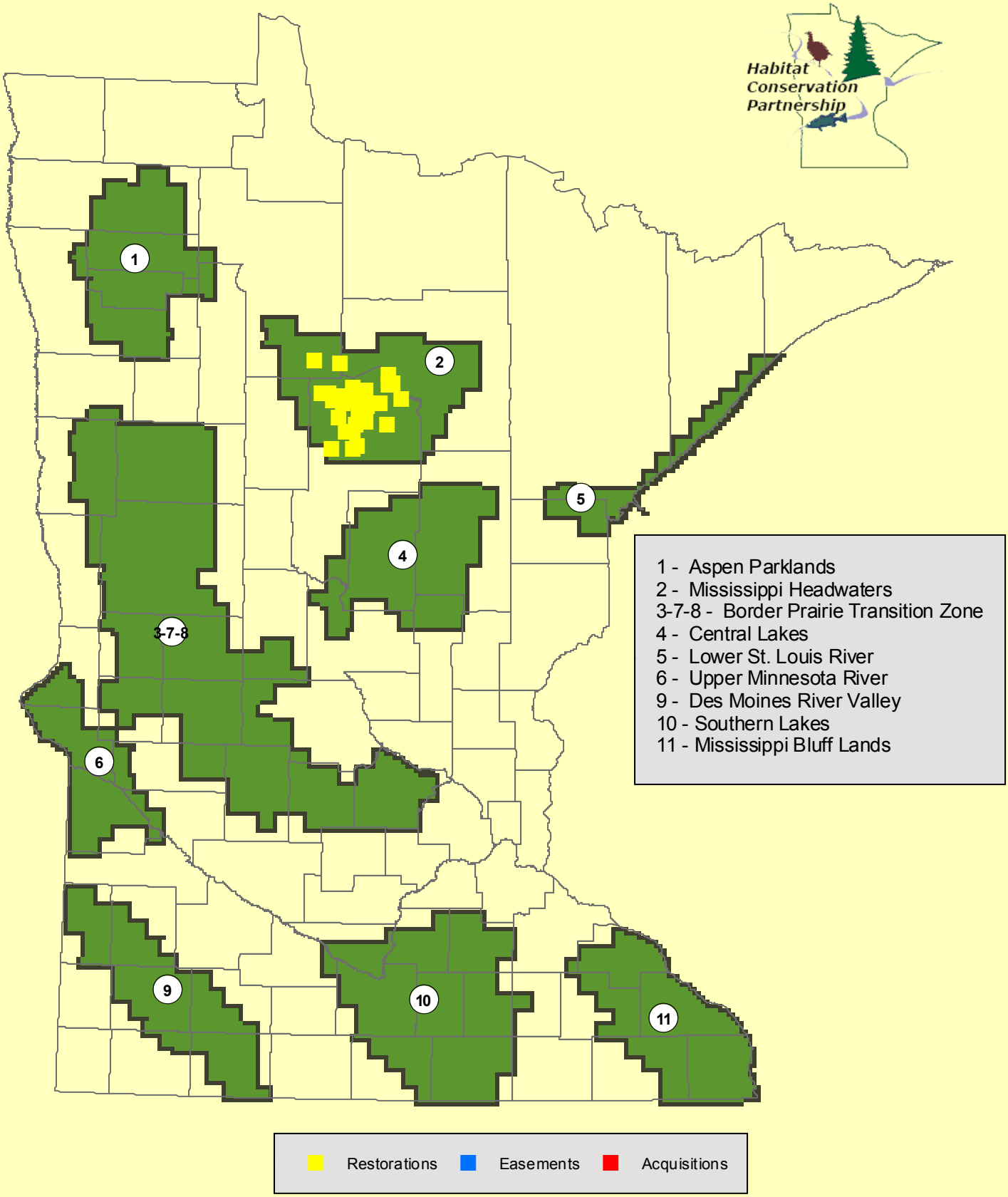
Trust Fund Appropriation: $30,000

1) See list of non-eligible expenses, do not include any of these items in your budget sheet

2) Remove any budget item lines not applicable

2008 Trust Fund Budget	**Result 1 Budget:**	**Amount Spent** *(date)*	**Balance 7/1/08**	**Result 2 Budget:**	**Amount Spent** *(date)*	**Balance 7/1/08**	**Result 3 Budget:**	**Amount Spent** *(date)*	**Balance** *(date)*	**TOTAL BUDGET**	**TOTAL BALANCE**
	Shallow Lake and Impoundment Management		$20,000	Decommissioning Forested Roads		10,000					
BUDGET ITEM			0			0			0	0	0
PERSONNEL: wages and benefits 750 hours at $20.00/hr. wage and fringe rate	15,000	15,000	0			0			0	15,000	0
Contracts			0			0			0	0	0
Professional/technical: Heavy equipment usage for roadbed excavating			0	10,000	10,000	10,000			0	10,000	0
Other contracts *(with whom?, for what?) list out: personnel, equipment, etc.*			0			0			0	0	0
Other direct operating costs *(for what? – be specific)*			0			0			0	0	0
Equipment / Tools *(what equipment? Give a general description and cost)*			0			0			0	0	0
Office equipment & computers - NOT ALLOWED unless unique to the project			0			0			0	0	0
Other Capital equipment *(list specific items)*			0			0			0	0	0
Land acquisition			0			0			0	0	0
Land rights acquisition *(less than fee)*						0			0	0	0
Professional Services for Acq.			0			0			0	0	0
Printing			0			0			0	0	0
Other Supplies : Lumber and hardware, gasoline for equipment, rice seed	5,000	5,000	0			0			0	5,000	0
Travel expenses in Minnesota			0			0			0	0	0
Travel outside Minnesota *(where?)*			0			0			0	0	0
Construction *(for what?)*			0			0			0	0	0
Other land improvement *(for what?)*			0			0			0	0	0
Other *(Describe the activity and cost) be specific*			0			0			0	0	0
COLUMN TOTAL	**$20,000**	**$20,000**	**$0**	**$10,000**	**$10,000**	**$0**	**$0**	**$0**	**$0**	**$30,000**	**$0**

Habitat Conservation Partnership
Phase 5 Accomplishments
2F - Shallow lakes & Impoundment Mgmt



2008 Project Abstract
For the Period Ending June 30, 2010

PROJECT TITLE: LCCMR-HCP-2G-Ph5-Wildlife Areas Management
PROJECT MANAGER: Suzann Willhite
AFFILIATION: MN-DNR, Division of Fish & Wildlife
MAILING ADDRESS: 500 Lafayette Road,
CITY/STATE/ZIP: St Paul, MN 55155
PHONE: 651-259-5235
E-MAIL: Suzann.willhite@state.mn.us
WEBSITE: http://www.mnhabitatcorridors.org/
FUNDING SOURCE: Environment and Natural Resources Trust Fund
LEGAL CITATION: ML 2008, Ch 367, Sec 2, Subd. 3(c)

APPROPRIATION AMOUNT: $ 30,000

Overall Project Outcome and Results
Citizens of the state of Minnesota benefit from this project by having an additional 248 acres of public hunting and recreation land acquired by Habitat Conservation Partners (HCP) available in high priority landscapes throughout the state. These new public lands are managed as State Wildlife Management Areas (WMAs) by the Minnesota Department of Natural Resources (DNR), Division of Fish and Wildlife- Section of Wildlife for wildlife habitat. DNR-Wildlife provides oversight for infrastructure management and habitat restoration on lands acquired by Habitat Conservation Partners (HCP).

Partners acquire priority wildlife habitat land and transfer it to the DNR for long term management as WMAs. This funding source ensures DNR will not incur a significant short-term liability for initial site development from these newly acquired lands. Temporary project staff or intermittent labor is hired as needed to implement development on lands acquired. Infrastructure management includes but is not limited to boundary surveys, boundary signing, professional services, public access, parking lots and user facilities, and clean up of old buildings or wells. Habitat restoration includes but is not limited to grassland development or improvement, wetland restoration or impoundment development, forest or woody cover development or improvement, brush land management, professional services, and food plot development. Digital boundary, habitat inventory and facilities files are developed as part of the management plans.

Completed Initial Development Project (IDP) Plans for 2008 LCCMR-HCP-2G-Phase 5 development and restoration funds included 248 acres on acquisitions to: Alvstad, Bench, Copeland, and Cambria WMAs.

All work was completed by June 30, 2010.

Project Results Use and Dissemination
Information on HCP project results have been shared and disseminated through all partner organizations. Signs are posted on completed project sites identifying the ENRTF funding source. The Environmental Trust Fund provides information to the general public on how the lottery funds are spent for natural resource activities.

LCCMR Work Program Final Report

Restoring Minnesota's Fish and Wildlife Habitat Corridors Phase 5
Habitat Conservation Partnership

2G:Wildlife Areas Management - DNR-Division of Fish & Wildlife

Project Manager: Suzann Willhite

Affiliation: DNR-Division of Fish & Wildlife

Address: 500 Lafayette Road

St. Paul, MN 55155

Phone: 6512595235

Fax: 6512974961

E-mail: suzann.willhite@dnr.state.mn.us

Fund: Environment and Natural Resources Trust Fund

Legal Citation: ML 2008 First Special Section, Ch. 367, Sec. 2 Subd. 3(c).

Total Biennial Project Budget

Result	ENTF Allocation	ENTF Funds Spent	ENTF Balance	Other Funds Proposed	Other Funds Spent
Restoration/Site Development	$30,000	$29,102	$898	$0	$0
Total	$30,000	$29,102	$898	$0	$0

Work Program Summary

Overall Project Outcome and Results

Citizens of the state of Minnesota benefit from this project by having an additional 248 acres of public hunting and recreation land acquired by Habitat Conservation Partners (HCP) available in high priority landscapes throughout the state. These new public lands are managed as State Wildlife Management Areas (WMAs) by the Minnesota Department of Natural Resources (DNR), Division of Fish and Wildlife- Section of Wildlife for wildlife habitat. DNR-Wildlife provides oversight for infrastructure management and habitat restoration on lands acquired by Habitat Conservation Partners (HCP).

Partners acquire priority wildlife habitat land and transfer it to the DNR for long term management as WMAs. This funding source ensures DNR will not incur a significant short-term liability for initial site development from these newly acquired lands. Temporary project staff or intermittent labor is hired as needed to implement development on lands acquired. Infrastructure management includes but is not limited to boundary surveys, boundary signing, professional services, public access, parking lots and user facilities, and clean up of old buildings or wells. Habitat restoration includes but is not limited to grassland development or improvement, wetland restoration or impoundment development, forest or woody cover development or improvement, brush land management, professional services, and food plot development. Digital boundary, habitat inventory and facilities files are developed as part of the management plans.

Completed Initial Development Project (IDP) Plans for 2008 LCCMR-HCP-2G-Phase 5 development and restoration funds included 248 acres on acquisitions to: Alvstad, Bench, Copeland, and Cambria WMAs.

All work was completed by June 30, 2010.

Project Results Use and Dissemination

Information on HCP project results have been shared and disseminated through all partner organizations. Signs are posted on completed project sites identifying the ENRTF funding source. The Environmental Trust Fund provides information to the general public on how the lottery funds are spent for natural resource activities.

LCCMR Work Program Final Report

Restoring Minnesota's Fish and Wildlife Habitat Corridors Phase 5
Habitat Conservation Partnership

2G:Wildlife Areas Management - DNR-Division of Fish & Wildlife

Restoration Activities

Project Area - 10 - Southern Lakes

Project Name: Cambria WMA
Tract: 1
Township: 109, Range: 29, Section: 22

Activity: Site / Access Development
Landtype: Public - WMA
Description: Remnant prairie. Collect seed, clean-up site, seal well.

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Site Development	$4,913.40	0.00	0.00

Project Area - 3-7-8 - Border Prairie Transition Zone

Project Name: Alvstad WMA
Township: 128, Range: 41, Section: 1

Activity: Site / Access Development
Landtype: Public - WMA
Description: Survey boundary and post boundary signs, review historical records, enhance prairie/grassland, provide public access and parking areas, complete site clean-up.

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Professional Services	$2,048.30	0.00	0.00
ENTF	Restoration	$640.79	8.80	0.00
ENTF	Site Development	$1,171.39	0.00	0.00
Alvstad WMA Total		**$3,860.48**	**8.80**	**0.00**

Project Name: Bench WMA
Tract: 3
Township: 122, Range: 39, Section: 26

Activity: Site / Access Development
Landtype: Public - WMA
Description: Survey boundary, install boundary fencing (.75 miles), install boundary signs (1.25 miles), provide public access road (.75 miles) and parking area, site clean-up to remove mobile homes (2), remove barbed fence/posts (.75 miles) and debris on site.

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Site Development	$17,078.10	0.00	0.00

Project Name: Copeland WMA
Tract: 3
Township: 131, Range: 44, Section: 32

Activity: Site / Access Development
Landtype: Public - WMA
Description: Post boundary, plant native grass, provide public access and parking areas.

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Restoration	$2,870.83	32.00	0.00
ENTF	Site Development	$379.17	0.00	0.00
Copeland WMA 3 Total		**$3,250.00**	**32.00**	**0.00**

Restoration Project Totals (By Funding Type)

Funding Type	Funding Amount	Acres	Shoreline Feet

2G:Wildlife Areas Management - DNR-Division of Fish & Wildlife

ENTF:	$29,101.98	40.80	0.00
Total:	**$29,101.98**	**40.80**	**0.00**

Attachment A: Budget Detail for 2008 Projects: Habitat Conservation Partnership (HCP) - Restoring Minnesota's Fish and Wildlife Habitat Corridors:

Updated: 8/16/2010

Project Title: HCP-2g-Ph5 Wildlife Areas Management, DNR – Section of Wildlife

Project Manager Name: Suzann Willhite

Trust Fund Appropriation: $ 30,000

1) See list of non-eligible expenses, do not include any of these items in your budget sheet

2) Remove any budget item lines not applicable

2008 Trust Fund Budget	**Result 1 Budget:**	**Amount Spent** *(date)*	**Amount Spent** *(date)*	**Amount Spent** *(date)*	**Amount Spent** *(date)*	**TOTAL BUDGET**	**TOTAL BALANCE**
		Alvstad WMA	Bench WMA	Cambria WMA	Copeland WMA		
BUDGET ITEM							
PERSONNEL: wages and benefits for temporary and seasonal staff.	1,000	$1,262.70	$2,654.67	$0.00	$676.51	4,594	
Contracts							
Professional/technical (for engineering vendors for boundary surveys on new acquisitions)	15,000	$2,048.30	$35.57	$0.00	$0.00	2,084	
Other direct operating costs (2MO, costs for vendor hauling debris and environmental waste disposal charges)	0	$0.00	$3,392.89	$0.00	$0.00	3,393	
Equipment / Tools (Vehicle expenses -fleet and equipment costs and fuel)	1,000	$549.48	$4,011.19	$641.25	$639.05	5,841	
Other Supplies (Habitat development and restoration supplies)	9,500	$0.00	$0.00	$0.00	$1,934.44	1,934	
Other land improvement (boundary management, site/building cleanup/well sealing, user facility development and improvement, access development and improvement)	3,500	$0.00	$6,983.78	$4,272.15		11,256	
COLUMN TOTAL	**$30,000**	**$3,860**	**$17,078**	**$4,913**	**$3,250**	**$29,102**	**$898**
							Remaining

2008 Project Abstract
For the Period Ending June 30, 2010

PROJECT TITLE: LCCMR-HCP-2H-Ph5-Fisheries Habitat
PROJECT MANAGER: Linda Erickson-Eastwood
AFFILIATION: MN-DNR, Division of Fish & Wildlife
MAILING ADDRESS: 500 Lafayette Road,
CITY/STATE/ZIP: St Paul, MN 55155
PHONE: 651-259-5206
E-MAIL: Linda.Erickson-Eastwood@state.mn.us
WEBSITE: http://www.mnhabitatcorridors.org/
FUNDING SOURCE: Environment and Natural Resources Trust Fund
LEGAL CITATION: ML 2008, Ch 367, Sec 2, Subd. 3(c)

APPROPRIATION AMOUNT: $ 200,000

Overall Project Outcome and Results
Twenty two projects were completed or begun with this funding to improve or restore aquatic habitat in the Mississippi Headwaters, Border Prairie, Central Lakes, Lower St. Louis River, Upper Minnesota River, Des Moines River Valley, Southern Lakes, and Mississippi Bluff Lands. Projects include planting of native plants on shorelands, beaver control, installing instream structures, fish passage, spawning habitat, and erosion control. A total of 2.81 acres or 73,668 shoreline feet were worked on. The Environment and Natural Resources Trust Fund (ENRTF) funded work on 2.32 acres or 73,012 shoreline feet.

Four of the projects (Coolridge, Deadhorse, Battle Point, Necktie, and Bungoshing) were started with the previous year's funds and were finished this spring due to flooding and wet weather and other delays in getting the projects done. Two other projects (Winnebago and Mills Lake) were designed and some materials bought with this funding but the actual installation will occur under the next round of funding due to delays in getting the designs done.

Project Results Use and Dissemination
These projects are very beneficial in being able to manage Minnesota's fishery to ensure the best fishing opportunities are provided in this state. Information on HCP project results have been shared and disseminated through all partner organizations. News releases, posting of completed projects on DNR web site, and partners' dissemination of project results happened at the completion of each project. Signs are posted on completed project sites identifying the ENRTF funding source were applicable.

LCCMR Work Program Update Report

Restoring Minnesota's Fish and Wildlife Habitat Corridors Phase 5
Habitat Conservation Partnership

2H:Fisheries Habitat Restoration - MN DNR - Division of Fisheries

Project Manager: Linda Erickson-Eastwood

Affiliation: MN DNR - Division of Fisheries

Address: 500 Lafayette Rd.
St. Paul, MN 55155

Phone: (651) 259-5206

Fax: (651) 297-4916

E-mail: linda.erickson-eastwood@dnr.state.mn.us

Fund: Environment and Natural Resources Trust Fund

Legal Citation: ML 2008 First Special Section, Ch. 367, Sec. 2 Subd. 3(c).

Total Biennial Project Budget

Result	ENTF Allocation	ENTF Funds Spent	ENTF Balance	Other Funds * Proposed	Other Funds * Spent
Restoration	$200,000	$198,760	$1,240	$0	$38,825
Total	$200,000	$198,760	$1,240	$0	$38,825

*Other Funds are classified as non-state, non-state leveraged dollars (if partner funds are leveraging State Funds (e.g. RIM) they are not eligible to be considered Other Funds). Please note, however, that this work program has spent the following amounts not shown in the above table:

State Funds: $37,084.00
Other: $21,500.00

See the tables and funding type definitions at the end of this report for further explanation.

Work Program Summary

Project Summary and Results
This project will restore or maintain up to 25 acres and/ or 1.5 miles of critical shoreland and/or aquatic habitat. Priority will be given to restoring regionally significant fish and wildlife habitat.

This project will focus on habitat linkages that endeavor to improve fish habitat and protect water quality on streams and lakes. Examples of projects include stream channel restorations, installation of aeration systems, spawning area development, dam modifications, bank stabilization, and fish barrier projects that occur adjacent to or in lakes and streams.

Funds will be used to pay for professional services as needed, such as the costs of signage, design work, engineering and surveys. A portion of the funds will also be used to pay for our SE Habitat Construction Crew and Statewide Construction Crew staff time.

Summary of Progress as of November 2009
All work is expected to be complete by June 30, 2010.

Summary of Progress as of May 1st, 2009
Dam modification restoration work being done by contractors has begun and will be completed by this fall. Work on a southeast stream project (Trout Run) was begun this spring (2009). This project is being done in cooperation with local trout groups. This work has been held up due to weather conditions and getting designs approved. We are working with a contractor to do design work for fish passage projects for the North Shore streams. Shoreline planting and restoration work on Serpent Lake, Pelican Lake, Big Detroit, Lake Hubert, Sugar Lake, and Pickerel Lake will be completed by this fall.

Summary of Progress as of May 1, 2010
All projects have been designed and contractors have been hired. Work in the spring of 2010 was delayed due to some

flooding. Streams and weather are cooperating now; consequently, we anticipate that all projects will be done by June 30, 2010. The Long Lake Shoreline project was cancelled due to complications with getting crews contracted to do the work and be finished by the June deadline. Instead, that money will be moved to complete other projects in Lanesboro. The Lake Superior barrier design was also cancelled since all bids came in higher than what we had funding for. That money will also be moved to Lanesboro

Summary of Progress as of May 1, 2010

Twenty two projects were done using these funds. Four were those completed from the previous funding year. Two were started this year and will be completed with next year's funding. Due to a materials bill being less than what was expected for the Jewett Lake project, we will be turning back $1240.00 dollars. See rest of report for accomplishments.

LCCMR Work Program Update Report

Restoring Minnesota's Fish and Wildlife Habitat Corridors Phase 5
Habitat Conservation Partnership

2H:Fisheries Habitat Restoration - MN DNR - Division of Fisheries

Restoration Activities

Project Area - 2 - Mississippi Headwaters

Project Name: Battle Point Prescribed Burn
Township: 143, Range: 29, Section: 36

Activity: Shoreline Habitat Restoration / Stabilization
Landtype: Public - Lake
Description: This project was started with Phase 4 dollars and acreage and feet were reported then. Project restored native plants to shoreland. Cooperative with Sauk River WD and City of Osakis

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Restoration	$6,579.00	0.00	0.00
Other Funds	Restoration	$1,500.00	0.00	0.00
Battle Point Prescribed Burn Total		**$8,079.00**	**0.00**	**0.00**

Project Name: Necktie River
Township: 145, Range: 32, Section: 7

Activity: Dam Modification
Landtype: Public - River
Description: Continued work from Phase IV. Contracted local person to remove beaver and their dams so that flow and fish passage were restored.

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Restoration	$2,400.00	0.00	20,064.00

Project Name: Bungoshing Creek
Township: 145, Range: 32, Section: 29

Activity: Dam Modification
Landtype: Public - River
Description: Continued work from Phase IV. Contracted with USDA-APHIS to remove beaver and their dams to maintain fish passage on 1.1 miles of stream and maintain adequate water quality and temperatures for trout management.

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Professional Services	$155.00	0.00	0.00
ENTF	Restoration	$412.00	0.10	5,800.00
State Funds	Professional Services	$1,000.00	0.00	0.00
Bungoshing Creek Total		**$1,567.00**	**0.10**	**5,800.00**

LCCMR Work Program Update Report

Restoring Minnesota's Fish and Wildlife Habitat Corridors Phase 5
Habitat Conservation Partnership

2H:Fisheries Habitat Restoration - MN DNR - Division of Fisheries

Project Area - 3 - Border Prairie

Project Name: Big Detroit
Township: 138, Range: 41, Section: 10

Activity: Shoreline Habitat Restoration / Stabilization
Landtype: Public - Lake
Description: Along Hwy 10, native plants were planted as part of the Hwy 10 realignment project. Educational signs will be established along the road in cooperation with MN DOT. The plantings also included spawning and rearing habitat for bass, crappie, bluegill, and northern pike. Worked with the Pelican River Watershed, City of Detroit Lake, BWSR, and Becker Co SWCD.

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Restoration	$40,000.00	0.54	947.04
Other	Restoration	$1,500.00	0.02	35.51
Other Funds	Restoration	$8,500.00	0.12	201.25
State Funds	Restoration	$684.00	0.01	16.19
Big Detroit Total		**$50,684.00**	**0.69**	**1,200.00**

Project Name: Sugar Lake
Township: 121, Range: 27, Section: 2

Activity: Shoreline Habitat Restoration / Stabilization
Landtype: Public - Lake
Description: Restored two sites as part of the requirements being done for three workshops to build local capacity to do these types of projects. The planting of vegetation at the sites provided spawning and rearing habitat for a variety of game fish. Worked with Sugar Lake Association, Wright Co. SWCD and contracted with Fortin Consulting.

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Restoration	$14,000.00	0.11	189.56
Other Funds	Restoration	$3,500.00	0.03	47.39
State Funds	Restoration	$4,657.00	0.04	63.05
Sugar Lake Total		**$22,157.00**	**0.17**	**300.00**

Project Name: Deadhorse Creek
Township: 138, Range: 38, Section: 4

Activity: Dam Modification
Landtype: Public - River
Description: Continued work from Phase IV. Contracted with USDA- APHIS to remove beaver and their dams to maintain fish passage and water quality for trout management on four miles of stream

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Professional Services	$155.00	0.00	0.00
ENTF	Restoration	$1,622.00	0.00	21,120.00
State Funds	Site Development	$500.00	0.00	0.00
Deadhorse Creek Total		**$2,277.00**	**0.00**	**21,120.00**

LCCMR Work Program Update Report

Restoring Minnesota's Fish and Wildlife Habitat Corridors Phase 5
Habitat Conservation Partnership

2H:Fisheries Habitat Restoration - MN DNR - Division of Fisheries

Project Area - 4 - Central Lakes

Project Name: Serpent Lake
Township: 46, Range: 28, Section: 7

Activity: Shoreline Habitat Restoration / Stabilization
Landtype: Public - Lake
Description: Restored the shoreline along the public access, fishing pier, campground, and city hall. The runoff project was done in cooperation with Crow Wing SWCD and Board of Water Soil Resoruces. This project includes a number of rain gardens that are planted with native vegetation. We also did plantings to enhance the spawning and rearing habitat for a variety of fish. Also worked with the Serpent Lake Association, and City of Crosby.

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Restoration	$35,000.00	0.12	211.51
Other	Restoration	$10,000.00	0.03	60.43
Other Funds	Restoration	$20,500.00	0.07	123.89
State Funds	Restoration	$690.00	0.00	4.17
Serpent Lake Total		**$66,190.00**	**0.23**	**400.00**

Project Name: Pelican Lake
Township: 135, Range: 28, Section: 2

Activity: Shoreline Habitat Restoration / Stabilization
Landtype: Public - Lake
Description: In cooperation with Crow Wing County Pelican Lake Association, and SWCD, native plants were planted as a demonstration area. The Thirty Lakes Watershed District is using the site to encourage better shoreline management within their jurisdiction. Worked with Pelican Lake Assoc., Thirty Lakes Watershed, and Crow Wing SWCD.

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Restoration	$5,000.00	0.05	89.01
Other Funds	Restoration	$1,500.00	0.01	26.70
State Funds	Restoration	$522.00	0.01	9.29
Pelican Lake Total		**$7,022.00**	**0.07**	**125.00**

Project Name: Stoney Brook
Township: 135, Range: 29, Section: 8

Activity: Shoreline Habitat Restoration / Stabilization
Landtype: Public - River
Description: This project contracted the MCC crew to repair areas of erosion. This work assists in improving the aquatic habitats for fish and other aquatic and terrestrial animals that use this waterbody.

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Restoration	$10,435.00	0.10	20,000.00
State Funds	Site Development	$100.00	0.00	0.00
Stoney Brook Total		**$10,535.00**	**0.10**	**20,000.00**

LCCMR Work Program Update Report

Restoring Minnesota's Fish and Wildlife Habitat Corridors Phase 5
Habitat Conservation Partnership

2H:Fisheries Habitat Restoration - MN DNR - Division of Fisheries

Project Name: Hubert Lake
Township: 135, Range: 29, Section: 25

Activity: Shoreline Habitat Restoration / Stabilization
Landtype: Private - Lake
Description: Worked with Hubert Lake Association and Crow Wing County SWCD to plant native plants. Crow Wing will be using this as a demonostration site to encourage others to manage their shorelines in this manner.

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Restoration	$3,000.00	0.05	76.59
Other Funds	Restoration	$750.00	0.01	19.15
State Funds	Restoration	$167.00	0.00	4.26
Hubert Lake Total		**$3,917.00**	**0.06**	**100.00**

Project Name: Rice Lake - Crow Wing
Township: 45, Range: 30, Section: 18

Activity: Shoreline Habitat Restoration / Stabilization
Landtype: Public - Lake
Description: Worked with landowner's, Rice Lake Association, SWCD, and local master gardeners to plant native plants on this shoreline.

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Restoration	$751.36	0.01	0.00
Other Funds	Restoration	$500.00	0.01	0.00
State Funds	Restoration	$2,875.00	0.03	0.00
Rice Lake - Crow Wing Total		**$4,126.36**	**0.05**	**0.00**

Project Area - 5 - Lower St. Louis River

Project Name: Knife River
Tract: 27
Township: 52, Range: 11, Section: 19

Activity: Shoreline Habitat Restoration / Stabilization
Landtype: Public - River
Description: To modify the fish passage on the second falls by creating a small jumping pool. This allows for easier passage by the fish during low flows. Worked with Lake Superior Steelhead Association and St. Louis Co.

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Restoration	$5,962.00	0.00	0.00
State Funds	Site Development	$5,000.00	0.00	0.00
Knife River 27 Total		**$10,962.00**	**0.00**	**0.00**

LCCMR Work Program Update Report

Restoring Minnesota's Fish and Wildlife Habitat Corridors Phase 5
Habitat Conservation Partnership

2H:Fisheries Habitat Restoration - MN DNR - Division of Fisheries

Project Area - 6 - Upper Minnesota River

Project Name: Big Stone Lake AMA
Tract: 1
Township: 122, Range: 47, Section: 10

Activity: Wetland Restoration
Landtype: Public - Lake
Description: This project is developing a northern pike spawning area. This spawning area will help ensure that pike can be maintained in this system by natural reproduction. The pike produced from this effort will create great fishing for the nearby state park.

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Professional Services	$720.00	0.00	0.00
ENTF	Restoration	$2,946.00	1.00	1.00
State Funds	Personnel Expenditures	$1,500.00	0.00	0.00
Big Stone Lake AMA 1 Total		**$5,166.00**	**1.00**	**1.00**

Project Area - 9 - Des Moines River Valley

Project Name: Shetek AMA
Tract: 1A
Township: 108, Range: 41, Section: 11

Activity: Dam Modification
Landtype: Public - AMA
Description: Updated the 50-year old concrete water level control structure with an Agri Drain water level control system. This will allow better control of water flows into the system and allow fish to move more freely.

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Professional Services	$200.00	0.00	0.00
ENTF	Restoration	$5,244.00	0.10	8.00
State Funds	Site Development	$1,000.00	0.00	0.00
Shetek AMA 1A Total		**$6,444.00**	**0.10**	**8.00**

Project Name: Fish Lake
Township: 101, Range: 35, Section: 4

Activity: Shoreline Habitat Restoration / Stabilization
Landtype: Public - Lake
Description: Worked with landowner, Fish Lake Association, SWCD, and local master gardners to plant native plants on shoreline.

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Restoration	$325.51	0.00	0.00
Other Funds	Restoration	$500.00	0.01	0.00
State Funds	Restoration	$3,150.00	0.04	0.00
Fish Lake Total		**$3,975.51**	**0.05**	**0.00**

LCCMR Work Program Update Report

Restoring Minnesota's Fish and Wildlife Habitat Corridors Phase 5

Habitat Conservation Partnership

2H:Fisheries Habitat Restoration - MN DNR - Division of Fisheries

Project Area - 10 - Southern Lakes

Project Name: Mills Lake Barrier
Township: 107, Range: 28, Section: 11

Activity: Dam Modification
Landtype: Public - Lake
Description: Purchase materials for installation of rock gabions next funding cycle. Working with Blue EarthCo. to install the barrier within the county road right of way. This will isolate Mills Lake from the downsream Loon and Crystal lakes eliminating rough fish migration. This will increase water clarity and improve habitat in Mills lake. Acreage restored to be reported in next funding report.

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Restoration	$2,318.00	0.00	0.00

LCCMR Work Program Update Report

Restoring Minnesota's Fish and Wildlife Habitat Corridors Phase 5
Habitat Conservation Partnership

2H:Fisheries Habitat Restoration - MN DNR - Division of Fisheries

Project Area - 11 - Mississippi Bluff Lands

Project Name: Trout Run
Township: 104, Range: 10, Section: 8

Activity: Shoreline Habitat Restoration / Stabilization
Landtype: Public - River
Description: This was a cooperative project with Trout Unlimited to install instream structures, and slope and seed an eroding stream bank. Trout Unlimited volunteered labor.

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Restoration	$14,896.00	0.00	2,200.00
Other	Personnel Expenditures	$10,000.00	0.00	0.00
State Funds	Site Development	$12,654.00	0.00	0.00
Trout Run Total		**$37,550.00**	**0.00**	**2,200.00**

Project Name: Coolridge Creek
Township: 105, Range: 5, Section: 26

Activity: Dam Modification
Landtype: Public - River
Description: This is the completion of the rock wier project begun in phase 4.

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Professional Services	$1,061.00	0.00	0.00
ENTF	Restoration	$903.53	0.00	0.00
State Funds	Site Development	$1,000.00	0.00	0.00
Coolridge Creek Total		**$2,964.53**	**0.00**	**0.00**

Project Name: Winnebago Cree
Township: 101, Range: 5, Section: 15

Activity: Shoreline Habitat Restoration / Stabilization
Landtype: Public - River
Description: This is the design and preperation phase of the project. This also bought seed for the project that will be done with Phase 6 monies. It is being done cooperatively with Trout Unlimited Driftless Area Restoration efforts, NRCS, and the private owner.

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Restoration	$15,799.00	0.00	0.00

Project Name: Kedron Creek
Township: 104, Range: 13, Section: 36

Activity: Shoreline Habitat Restoration / Stabilization
Landtype: Public - River
Description: This project installed instream cover for trout. It also restored eroding banks. This type of work assists in providing trout fishing opportunities.

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Professional Services	$1,000.00	0.00	0.00
ENTF	Restoration	$20,533.00	0.00	2,150.00
Kedron Creek Total		**$21,533.00**	**0.00**	**2,150.00**

LCCMR Work Program Update Report

Restoring Minnesota's Fish and Wildlife Habitat Corridors Phase 5
Habitat Conservation Partnership

2H:Fisheries Habitat Restoration - MN DNR - Division of Fisheries

Project Area - 3-7-8 - Border Prairie Transition Zone

Project Name: Pickerel Lake
Township: 102, Range: 22, Section: 13

Activity: Shoreline Habitat Restoration / Stabilization
Landtype: Private - Lake
Description: Worked with the Pickerel Lake Association and Ottertail County SWCD to plant native plants on two areas. Ottertail County will be using the areas to encourage others to manage their shorelines in this manner.

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Restoration	$4,313.00	0.09	156.18
Other Funds	Restoration	$1,075.00	0.02	38.93
State Funds	Restoration	$135.00	0.00	4.89
Pickerel Lake Total		**$5,523.00**	**0.11**	**200.00**

Project Name: Jewitt Lake - Ottertail
Township: 134, Range: 43, Section: 23

Activity: Shoreline Habitat Restoration / Stabilization
Landtype: Public - Lake
Description: Worked with landowner, Jewett Lake association, and local master gardners to plant native plants on shoreline.

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Restoration	$3,030.07	0.05	0.00
Other Funds	Restoration	$500.00	0.01	0.00
State Funds	Restoration	$1,450.00	0.02	0.00
Jewitt Lake - Ottertail Total		**$4,980.07**	**0.08**	**0.00**

Restoration Project Totals (By Funding Type)

Funding Type	Funding Amount	Acres	Shoreline Feet
ENTF:	$198,760.47	2.32	73,012.89
Other Funds:	$38,825.00	0.28	457.30
State Funds:	$37,084.00	0.16	101.86
Other:	$21,500.00	0.06	95.95
Total:	**$296,169.47**	**2.81**	**73,668.00**

Funding Type Definitions

ENTF:	Grant dollars provided through the Minnesota Environment and Natural Resources Trust Fund
Other Funds:	Non-state, non-state leveraged dollars (if partner funds are leveraging State Funds (e.g. RIM) they are not eligible to be considered Other Funds)
State Funds:	State Funds expended on HCP projects (not eligible for use as Other Funds commitment)
Partner's State Leveraged Funds:	Non State Funds that have leveraged State Funds as part of an HCP project (not eligible for use as Other Funds commitment)
Other:	Any other expenditures (e.g. grant income funds)

Attachment A: Budget Detail for 2008 Projects - Summary and a Budget page for each partner

Project Title: *Fish Habitat Improvement - 2H August 2010 version*

Minnesota's Habitat Conservation Partnership (V)

Project Manager Name: Linda Erickson-Eastwood

Trust Fund Appropriation: $200,000

1) See list of non-eligible expenses, do not include any of these items in your budget sheet

2) Remove any budget item lines not applicable

2008 Trust Fund Budget	**Result 1 Budget:**	**Amount Spent** *(date)*	**Balance** *(date)*	**Result 2 Budget:**	**Amount Spent** *(date)*	**Balance** *(date)*	**Result 3 Budget:**	**Amount Spent** *(date)*	**Balance** *(date)*	**TOTAL BUDGET**	**TOTAL BALANCE**
BUDGET ITEM	Restoration					0			0		0
PERSONNEL: wages and benefits			0			0			0	0	0
Contracts			0			0			0	0	0
Professional/technical *(Engineering and Attorney General Office)*	20,000	3,291	16,709			0			0	20,000	16,709
Other contracts *(with contractors that are qualified to do the work or have the materials*	180,000	195,469	-15,469			0			0	180,000	-15,469
Other direct operating costs *(for what? – be specific)*			0			0			0	0	0
Equipment / Tools *(what equipment? Give a general description and cost)*			0			0			0	0	0
Office equipment & computers - NOT ALLOWED unless unique to the project			0			0			0	0	0
Other Capital equipment *(list specific items)*			0			0			0	0	0
Land acquisition			0			0			0	0	0
Land rights acquisition *(less than fee)*			0			0			0	0	0
Professional Services for Acq.			0			0			0	0	0
Printing			0			0			0	0	0
Other Supplies *(list specific categories)*			0			0			0	0	0
Travel expenses in Minnesota			0			0			0	0	0
Travel outside Minnesota *(where?)*			0			0			0	0	0
Construction *()*			0			0			0	0	0
Other land improvement *(for what?)*			0			0			0	0	0
Other *(Describe the activity and cost) be specific*			0			0			0	0	0
COLUMN TOTAL	**$200,000**	**$198,760**	**$1,240**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$200,000**	**$1,240**

2008 Project Abstract
For the Period Ending June 30, 2010

PROJECT TITLE: 2i Set Out Seedlings
PROJECT MANAGER: Dave Neu
AFFILIATION: National Wild Turkey Federation
MAILING ADDRESS: PO Box 83
CITY/STATE/ZIP: De Pere, WI 54115
PHONE: (920) 427-2335
E-MAIL: dneu@nwtf.net
WEBSITE: www.nwtf.org
FUNDING SOURCE: Environment and Natural Resources Trust Fund
LEGAL CITATION: ML 2008 First Special Section, Ch. 367, Sec. 2 Subd. 3(c).

APPROPRIATION AMOUNT: $15,000

Overall Project Outcome and Results

NWTF and DNR planted 4,675 seedlings of oaks, other hardwoods and native shrubs on 23 acres of public land on Beaver Creek, Talcot Lake and Clear Lake WMAs within Area 9 of the HCP corridors. The number of acres completed was less than originally planned due to the use of tree tubes, stakes, and weed mats for the projects which occurred on state lands. DNR ordered the trees, tree tubes, stakes, weed mats and stakes.

Tree and shrub plantings greatly increase the ability of the wild turkey to survive severe Minnesota winters. Research has shown the wild turkey can withstand temperatures in excess of 40 degrees below zero for up to two weeks. However, the limiting factor could be the availability of natural food sources, such as the ones that provided by the tree and shrub plantings proposed by this program. Location of fruit and berry shrub plantings will be coordinated, if possible, with known wintering and roost sites of wild turkey. The goal of the program is to help the populations of wild turkey to survive the winter in greater numbers to create more opportunity for Minnesota sportsmen/women to pursue, observe, and experience the gobble of the wild turkey in the spring.

Through the work of NWTF's local chapters, natural food cover will be planted on public lands; thereby, complementing public investments in habitat for wildlife and native plant communities. In addition, these natural food sources will help facilitate wildlife population sustainability during the winter month. Through the use of our private volunteers working with the public entities to plant these winter food sources, this project will engage a segment of Minnesota sportsmen interested in wild turkey habitat and conservation.

Scientists believe there may be many more adverse consequences of artificial feeding than there are instances where it might be beneficial. Therefore, a more innovative approach, as this project provides, is to model nature as a tool to solving the natural resource issue associated with winter wildlife feeding. This project provides a demonstrated measurable outcome of planting seedlings and direct seeding of oaks on 23 acres. This project also has statewide applicability and the natural food source will ensure a long-term beneficial impact to wildlife.

SOS relies on local NWTF chapters and private landowners for management and stewardship of sites planted on private land through the Set Out Seedlings program.

Project Results Use and Dissemination

Accomplishment Reports and press releases will be made available at http://www.mnhabitatcorridors.org, as well as through NWTF publications.

LCCMR Work Program Final Report

Restoring Minnesota's Fish and Wildlife Habitat Corridors Phase 5
Habitat Conservation Partnership

2I:Set Out Seedlings - National Wild Turkey Federation

Project Manager: Dave Neu

Affiliation: National Wild Turkey Federation

Address: 265 Lorrie Way
De Pere, WI 54115

Phone: (920)347-0312

Fax: (920)427-2335

E-mail: neunwtf@sbcglobal.net

Fund: Environment and Natural Resources Trust Fund

Legal Citation: ML 2008 First Special Section, Ch. 367, Sec. 2 Subd. 3(c).

Total Biennial Project Budget

Result	ENTF Allocation	ENTF Funds Spent	ENTF Balance	Other Funds Proposed	Other Funds Spent
Restoration	$15,000	$12,833	$2,167	$18,000	$0
Total	$15,000	$12,833	$2,167	$18,000	$0

Work Program Summary

Overall Project Outcome and Results

NWTF and DNR planted 4,675 seedlings of oaks, other hardwoods and native shrubs on 23 acres of public land on Beaver Creek, Talcot Lake and Clear Lake WMAs within Area 9 of the HCP corridors. The number of acres completed was less than originally planned due to the use of tree tubes, stakes, and weed mats for the projects which occured on state lands. DNR ordered the trees, tree tubes, stakes, weed mats and stakes.

Tree and shrub plantings greatly increase the ability of the wild turkey to survive severe Minnesota winters. Research has shown the wild turkey can withstand temperatures in excess of 40 degrees below zero for up to two weeks. However, the limiting factor could be the availability of natural food sources, such as the ones that provided by the tree and shrub plantings proposed by this program. Location of fruit and berry shrub plantings will be coordinated, if possible, with known wintering and roost sites of wild turkey. The goal of the program is to help the populations of wild turkey to survive the winter in greater numbers to create more opportunity for Minnesota sportsmen/women to pursue, observe, and experience the gobble of the wild turkey in the spring.

Through the work of NWTF's local chapters, natural food cover will be planted on public lands; thereby, complementing public investments in habitat for wildlife and native plant communities. In addition, these natural food sources will help facilitate wildlife population sustainability during the winter month. Through the use of our private volunteers working with the public entities to plant these winter food sources, this project will engage a segment of Minnesota sportsmen interested in wild turkey habitat and conservation.

Scientists believe there may be many more adverse consequences of artificial feeding than there are instances where it might be beneficial. Therefore, a more innovative approach, as this proposal will provide, is to model nature as a tool to solving the natural resource issue associated with winter wildlife feeding. This project will also have statewide applicability and the natural food source will ensure a long-term beneficial impact to wildlife.

SOS relies on local NWTF chapters and private landowners for managment and stewardship of sites planted on private land through the Set Out Seedlings program. Set Out Seedlings(private land) does not currently have a landowner agreement.

Project Results Use and Dissemination

Accomplishment Reports and press releases will be made available at http://www.mnhabitatcorridors.org

LCCMR Work Program Final Report

Restoring Minnesota's Fish and Wildlife Habitat Corridors Phase 5
Habitat Conservation Partnership

2I:Set Out Seedlings - National Wild Turkey Federation

Restoration Activities

Project Area - 9 - Des Moines River Valley

Project Name: Beaver Creek WMA
Tract: 1
Township: 107, Range: 41, Section: 24

Activity: Woodland Restoration
Landtype: Public - WMA
Description: Five acres were planted with bur oaks on two site withing beaver Creek WMA in spring 2009. These sites will connect existing riparian woodlands along the creek.

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*	*ProratedTrees Planted*
ENTF	Restoration	$2,357.37	5.00	0.00	

Project Name: Talcot Lake WMA
Tract: 1
Township: 105, Range: 38, Section: 19

Activity: Woodland Restoration
Landtype: Public - WMA
Description: Eight acres were planted to oaks, hardwood and native shrubs on Talcot Lake WMA in Murray and Cottonwood Counties in spring 2009. This planting enlarges an existing woodlot, creating additional wildlife habitat.

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*	*ProratedTrees Planted*
ENTF	Restoration	$3,766.96	8.00	0.00	

Project Name: Clear Lake WMA
Tract: 1
Township: 105, Range: 38, Section: 33

Activity: Woodland Restoration
Landtype: Public - WMA
Description: Ten acres of oaks, other hardwoods and native shrubs were planted on the Clear Lake WMA in Cottonwood County in the spring of 2009. This planting provides much needed woody cover near the lake.

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*	*ProratedTrees Planted*
ENTF	Restoration	$4,708.70	10.00	0.00	

Restoration Project Totals (By Funding Type)

Funding Type	Funding Amount	Acres	Shoreline Feet	# Trees Planted
ENTF:	$10,833.03	23.00	0.00	
Total:	**$10,833.03**	**23.00**	**0.00**	

LCCMR Work Program Final Report

Restoring Minnesota's Fish and Wildlife Habitat Corridors Phase 5
Habitat Conservation Partnership

2I:Set Out Seedlings - National Wild Turkey Federation

Work Program Expenditures - Not Attributable to Specific Projects

FundingType	*Category*	*Amount*	*Description*
ENTF	Personnel Expenditures	$2,000.00	Hours and expenses for NWTF Regional Wildlife Biologist
	Total:	**$2,000.00**	

Work Program Expenditures (Not Attributable to Specific Projects) By Funding Type

Funding Type	Amount
ENTF	$2,000.00
Total	**$2,000.00**

Work Program Expenditures Breakdown

Funding Type:	Restoration Projects	Not Attributable to Specific Projects	Total
ENTF	$10,833.03	$2,000.00	$12,833.03
State Funds	$0.00	$0.00	$0.00
Total	$10,833.03	$2,000.00	$12,833.03

Funding Type Definitions

ENTF:	Grant dollars provided through the Minnesota Environment and Natural Resources Trust Fund
Other Funds:	Non-state, non-state leveraged dollars (if partner funds are leveraging State Funds (e.g. RIM) they are not eligible to be considered Other Funds)
State Funds:	State Funds expended on HCP projects (not eligible for use as Other Funds commitment)
Partner's State Leveraged Funds:	Non State Funds that have leveraged State Funds as part of an HCP project (not eligible for use as Other Funds commitment)
Other:	Any other expenditures (e.g. grant income funds)

Attachment A: Budget Detail for 2008 Projects - Summary and a Budget page for each partner

Project Title: *Set Out Seedlings - 2i*

Minnesota's Habitat Conservation Partnership (V)

Project Manager Name: *Dave Neu - NWTF Senior Regional Biologist*

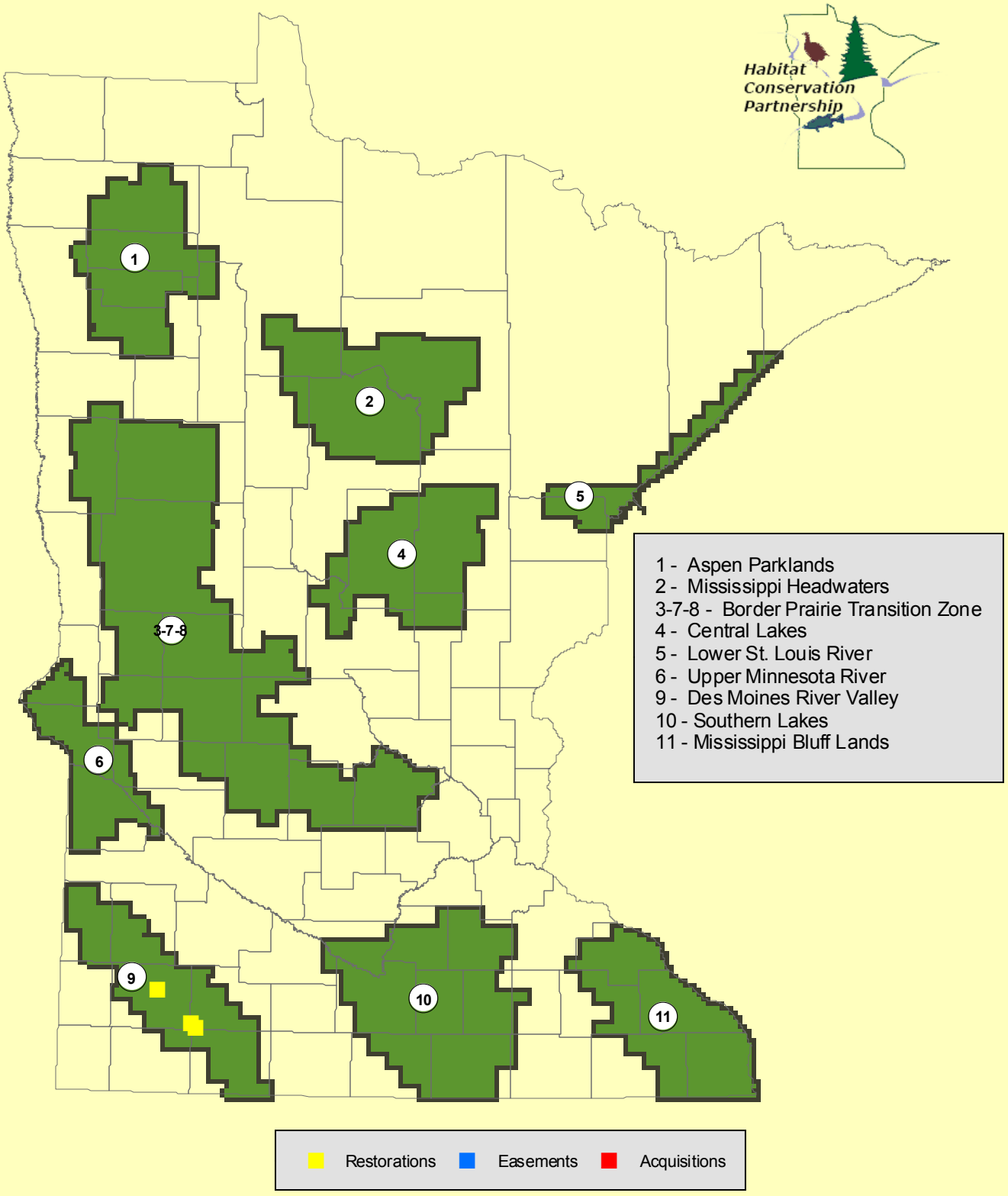
Trust Fund Appropriation: $ *15,000*

1) See list of non-eligible expenses, do not include any of these items in your budget sheet

2) Remove any budget item lines not applicable

2008 Trust Fund Budget	**Result 1 Budget:**	**Amount Spent** *(date)*	**Balance** *(date)*	**TOTAL BUDGET**	**TOTAL BALANCE**
	Direct seed and plant seedlings on up to 140 acres				
BUDGET ITEM			0		
PERSONNEL: wages and benefits	2,000	2,000	0	2,000	0
Other land improvement *(seedlings, stakes, mats, tubes))*	13,000	10,681	2,319	13,000	0
COLUMN TOTAL	**$15,000**	**$12,681**	**$2,319**	**$15,000**	**$0**

Habitat Conservation Partnership
Set Out Seedlings
2I



2008 Project Abstract
For the Period Ending June 30, 2010

PROJECT TITLE: Minnesota Habitat Conservation Partnership Phase V. Item 2J, Lakescaping
PROJECT MANAGER: Carrol L. Henderson
AFFILIATION: Minnesota Department of Natural Resources
MAILING ADDRESS: Nongame Wildlife Program, Box 25, DNR, 500 Lafayette Road,
CITY/STATE/ZIP: St. Paul, MN 55155
PHONE: 651-259-5104
E-MAIL: carrol.henderson@dnr.state.mn.us
WEBSITE: www.dnr.state.mn.us
FUNDING SOURCE: Environment and Natural Resources Trust Fund
LEGAL CITATION: M.L. 2008, Chp. 367, Sec. 2 Subd 3c

APPROPRIATION AMOUNT: $75,000

Overall Project Outcome and Results

Since 1999, the Nongame Wildlife Program has been using Environment and Natural Resources Trust Fund dollars to create lakeshore buffer zone demonstration sites as a way to promote this new approach to lakeshore habitat restoration and management. The program has received $1,049,000 in appropriations since FY '00 and those funds have been used to create 68 lakeshore habitat demonstration sites through June 30, 2010. Over the course of this effort, a total of 43 workshops have been presented to 1482 participants who represented homeowners, nursery owners, resource agency staff, realtors, and officials from local units of government. The effectiveness of this long term effort is now reflected in the fact that 24,944 copies of Lakescaping for Wildlife and Water Quality have been sold to date.

In this phase, six lakescaping buffer zone demonstration sites were identified, planned, and installed as part of the Wildlife Habitat Conservation Partnership including four sites in Habitat Corridor # 9: Murray County (Fulda Lake, Lake Sarah (2 locations) and Jackson County (Fish Lake), one site in Habitat Corridor # 2: Itasca County (Sugar Lake), and one site in Habitat Corridor # 4 in Crow Wing county (Hartley Lake). All projects were completed successfully and within the established budget. These sites totaled 695 feet of shoreline frontage and were restored with native, local origin vegetation. Eight sites completed in previous years on Stump Lake, Movil Lake, Blackduck Lake, Perch Lake, Roosevelt Lake, Nisswa Lake, Lake Plantagenet, and Lake Julia were rechecked for vegetation maintenance were also rechecked for vegetation maintenance and assistance to homeowners.

Four additional buffer zone sites will be completed next spring to complete this ten-year effort.

Trust Fund 2008 Work Program, Phase 5.

Final Report
Date of Work program Approval: June 10, 2008
Project Completion Date: June 30, 2010

I. PROJECT TITLE: Minnesota Habitat Conservation Partnership
Phase V. Item 2J, Lakescaping

Project Manager: Carrol L. Henderson
Affiliation: Minnesota Department of Natural Resources
Mailing Address: Nongame Wildlife Program, Box 25, DNR, 500 Lafayette Road,
City / State / Zip : St. Paul, MN 55155
Telephone Number: 651-259-5104
E-mail Address: carrol.henderson@state.mn.us
FAX Number: 651-296-1811
Web Page address: www.mndnr.gov

Location: The lakescaping demonstration sites and field trips will all be carried out from selections made in the following wildlife corridor project areas: 2) Mississippi Headwaters, 4) Central Lakes, and 9) Des Moines River.

Total Trust Fund Project Budget:	**Trust Fund Appropriation:**	**$**	**75,000**
	Amount Spent:	**$**	**75,000**
	Balance:	**$**	**0**

Legal Citation: ML 2008, Ch. 367, Sec. 2 Subd 3c2j.

Appropriation Language: $3,150,000 is from the trust fund for the fifth appropriation for acceleration of agency programs and cooperative agreements. Of this appropriation, $250,000 is to the Board of Water and Soil Resources; $733,500 is to the commissioner of natural resources for agency programs; and $2,166,500 is for agreements as follows: $420,000 with Pheasants Forever; $30,000 with Minnesota Deer Hunters Association; $597,500 with Ducks Unlimited, Inc.; $85,000 with National Wild Turkey Federation; $317,000 with the Nature Conservancy; $210,000 with Minnesota Land Trust; $350,000 with the Trust for Public Land; $50,000 with Minnesota Valley National Wildlife Refuge Trust, Inc.; $30,000 with U. S. Fish and Wildlife Service; $30,000 with the Leech Lake Band of Chippewa; $27,000 with the Fond du Lac Band of Chippewa; and $20,000 with Friends of Detroit Lakes Watershed Management District to plan, restore, and acquire fragmented landscape corridors that connect areas of quality habitat to sustain fish, wildlife, and plants. The USDA Natural Resources Conservation Service is a cooperating partner in the appropriation. Expenditures are limited to the project corridor areas as defined in the work program. Land acquired with this appropriation must be sufficiently improved to meet at least minimum habitat and facility management standards as determined by the commissioner of natural resources. This appropriation may not be used for the purchase of residential structures, unless

expressly approved in the work program. All conservation easements must be perpetual and have a natural resource management plan. Any land acquired in fee title by the commissioner of natural resources with money from this appropriation must be designated as an outdoor recreation unit under Minnesota Statutes, section 86A.07. The commissioner may similarly designate any lands acquired in less than fee title. A list of proposed restorations and fee title and easement acquisitions must be provided as part of the required work program. All funding for conservation easements must include a long-term stewardship plan and funding for monitoring and enforcing the agreement.

(b) Minnesota Habitat Corridors Partnership - Phase V

PROJECT SUMMARY AND RESULTS: In 1994 the Minnesota Minnesota DNR Nongame Wildlife Program identified natural lakeshore habitat with native vegetation as the second most endangered natural habitat in Minnesota, after native prairies. When people buy lakeshore property they typically remove the natural shoreline and emergent aquatic vegetation and replace it with exotic plants, extensive bluegrass lawns, and riprak along the water's edge. The Nongame Wildlife Program staff initiated a plan to produce a new ecologically-based book on landscaping for shoreland homeowners that would be patterned after the highly successful Landscaping for Widllife book that had been produced by the Nongame Wildlife Program in 1987. The book, Lakescaping for Wildlife and Water Quality was published in 1997 and co-authored by Carrol Henderson, Fred Rozumalksi, and Carolyn Dindorf. published in 1997. The goal of the book was to create a new vision of the"perfect lakeshore lot" that included a shoreline buffer zone of local origin native plants along at least 75% of a property frontage. After the book came out, the Nongame Wildlife Program recognized that they needed to work with private landowners to create demonstration sites on private land that would show how this landscaping approach could be planned and carried out in an economical, esthetically pleasing, and ecologically sound manner. Local origin native plants needed to be used for such efforts to avoid problems from spread of exotic species and to take advantage of the hardiness of native shoreline plants to local extremes of heat, drought, and cold typical of the upper Midwest. "Lakescaping for Wildlife" created a new standard for lakeshore properties by contributing to the preservation and restoration of water quality and reducing shoreline erosion.

Beginning in 1999, the Nongame Wildlife Program has requested biennial funding from the LCMR/ LCCMR to use ENRTF monies to create lakeshore buffer zone demonstration sites to promote this new approach to lakeshore habitat restoration and management. It has received $1,049,000 in appropriations since FY '00 and those funds have been used to create 68 lakeshore habitat demonstration sites through June 30, 2010. Over the course of this effort, a total of 43 workshops have been presented to 1482 participants who represented homeowners, nursery owners, resource agency staff, realtors, and officials from local units of government. The effectiveness of this long term effort is now reflected in the fact that 24,944 copies of Lakescaping for Wildlife and Water Quality have been sold to date.

Six lakescaping buffer zone demonstration sites were identified, planned, and installed as part of the Wildlife Habitat Conservation Partnership including four sites in Habitat Corridor # 9: Murray County (Fulda Lake, Lake Sarah (2 locations) and Jackson County (Fish Lake), one site in Habitat Corridor # 2: Itasca County (Sugar Lake), and one site in Habitat Corridor # 4 in Crow Wing county (Hartley Lake). Eight sites completed in previous years on Stump Lake, Movil Lake, Blackduck Lake, Perch Lake, Roosevelt Lake, Nisswa Lake, Lake Plantagenet, and Lake Julia were rechecked for vegetation maintenance.

All projects were completed successfully and within the established budget. These sites totaled 695 feet of shoreline frontage and were restored with native, local origin, vegetation. This brings the number of buffer zone demonstration sites completed with Environmental Trust Fund allocations from the LCCMR since year 2000 to 68.

IV. OUTLINE OF PROJECT RESULTS*:*

Result 1: Lakescaping demonstration sites

Description: A total of six lakescaping buffer zone demonstration sites will be selected, planned, and installed. Included in sites to be planned and installed with this funding are: Fulda Lake and Lake Sarah (two sites) in Murray County (Corridor 9, Fish Lake in Jackson County (Corridor 9), Sugar Lake in Itasca County (Corridor 2), and Hartley Lake in Crow Wing County (Corridor 4). In addition, at least six lakescaping sites formerly planted as part of the Wildlife Corridors Project in the two previous biennia will be checked and replanted or improved as necessary.

Summary Budget Information for Result 1:	**Trust Fund Budget:**	**$ 75,000**
	Amount Spent:	**$ 75,000**
	Balance:	**$ 0**

Deliverable	**Completion Date**	**Budget**	**Status**
1. Three demonstration sites for shoreland owners May 1-June 30, 2009	October 1, 2008	$35,000	done
2. Three demonstration sites for shoreland owners, July 1-Sept 1, 2009	June 30, 2009	$35,000	done
3. Six former demonstration sites revisited/repaired/replanted	June 30, 2009	5,000	done

Completion Date: June 30, 2010

Final Report Summary: Six lakescaping projects were selected, planned, and installed as of August 2009: Fulda Lake and two sites on Lake Sarah in Murray County (Corridor 9), Fish Lake in Jackson County (Corridor 9), Sugar Lake in Itasca

County (Corridor 2), and Hartley Lake in Crow Wing County (Corridor 4). These sites totaled 695 feet of shoreline. Four of these sites were in the Des Moines River Habitat corridor where no demonstration sites had previously been established. Former lakescaping sites where maintenance and replanting were carried out include plantings on Stump Lake, Movil Lake, Blackduck Lake, Perch Lake, Roosevelt Lake, Nisswa Lake, Lake Plantagenet, and Lake Julia.

Total Trust Fund Project Budget: All deliverables were provided within the project budget of $75,000.

Staff or Contract Services: $70,000
Equipment: 0
Development (plants/supplies/ travel): $ 5,000
Restoration: 6 lakeshore lot parcels averaging one acre each; and 8 sites rechecked/repaired totaling one acre each
Acquisition, including easements: 0

TOTAL TRUST FUND PROJECT BUDGET: $ 75,000

V. OTHER FUNDS, POSITIONS FUNDED & PROJECT PARTNERS: The positions paid from this proposal will be the same as for Phases I, II, III, and IV. Lindy Ekola is a DNR Fisheries Technician from Glenwood who is a Rule 10 unclassified employee. Her salary is paid with these funds. She visits potential sites on private lands, evaluates their potential, participates in selecting sites for restoration, plans the site restoration, and carries out the restoration activities. A total of $ 5,000 each is budgeted for Nongame Wildlife Program Technicians Bruce Lenning of Bemidji and Kevin Woizeschke of Brainerd to assist Lindy. They assist with site visits and evaluations, site selection, and installation of the selected sites. Both Kevin and Bruce were 90% seasonal technicians until the beginning of Phase I in FY '02 when the $ 5,000 that was allocated to each of their salaries was allocated so that they could be upgraded to 100% classified positions. They had never been assigned at full time status previously and for that reason the change in classification was not considered to be supplanting other state funds with the use of the LCMR dollars. This was the arrangement that explained to LCMR staff and approved in FY '02. This arrangement has been very successful and has been continued through all four phases of the HCP Lakescaping project to date.

V. A. Project Partners: Project partners within the DNR include the Section of Fisheries' Shoreland Management Program staff and program supervisor. We are part of the Habitat Corridors Partnership Phase V proposal. Please see main proposal partner list.

B. Other Funds: Other funds proposed to be spent during the Project Period: Private cooperators from the six sites selected will provide a minimum of $8,000 in funds to carry out the installation of the buffer zones that are planned, plus a minimum of $12,000 in state funds will used for project funding.

C. Past Spending: 2001: $331,000 2003: $223,100 2005: $205,000

D. Time: This project began in June of 2009 and was completed by June 30, 2010.

VI. DISSEMINATION: Information about the lakescaping buffer zone projects accomplished was posted on the Section of Fisheries portion of the Department of Natural Resources website.

Attachment A: Budget Detail for 2008 Projects - Summary and a Budget page for each partner							
Project Title: Lakescaping, Item 2J.							
	Minnesota's Habitat Conservation Partnership (V)						
Project Manager Name: Carrol L. Henderson							
Trust Fund Appropriation: $75,000							
2008 Trust Fund Budget	**Result 1 Budget:**	**Adjusted Budget ***	**Amount Spent** *(date)*	**Balance (6/30/10)**	**Match**	**TOTAL BUDGET**	**TOTAL BALANCE**
	Lakescaping Demo Sites						
BUDGET ITEM							
PERSONNEL: wages and benefits. One fisheries spec. (100%) and two wildlife techs (10%)	70,000	68,968	68,968	0	0	68,968	0
Supplies: Plants and bioengineering materials.	3,500	4,802	4,802	0	8,000	12,802	0
Travel in Minnesota	1,500	1,230	1,230	0	0	1,230	0
COLUMN TOTAL	**$75,000**	**$75,000**	**$75,000**	**$0**	**$8,000**	**$81,000**	**$0**
*Budget adjusted to accommodate lower personnel and travel expenses and increase in purchases of plants and bioengineering materials.							

Lakescaping Demo Sites

Year	Phase	Project #	Corridor Name	Corridor	County	Lake or site name	Nearest city	Zip	Date Installed	GPS Corridinates	Front	Twsp	Rng	S	DOW#
00-01	0	FPR05000	N/A		Cass	Ada	Pine River	56474	1-Jun-01	396249 5186399	120	139	29	28	11-0250-00
00-01	0	FPR01000	Alexandria Moraine	7	Pope	Barsness Park	Glenwood	56334	3-Jun-02	314219 5056772	1650	125	37	18	
00-01	0	FPR04000	Border Prairie	3	Becker	Beseau	Lake Park	56554	7-Jul-00	259764 5190557	140	139	43	29	03-0638-00
00-01	0	FPR06000	Ms Headwaters	2	Hubbard	Kabekona	Laporte	56461	12-Jun-00	368834 5225023	139	143	32	28	29-0075-00
00-01	0	FPR14000	N/A		Dakota	Marion	Lakeville	55044	12-Jun-00	477766 4946545	315	114	21	24	19-0026-00
00-01	0	FPR09000	Central Lakes	4	Crow Wing	North Long	Brainerd	56401	3-Aug-00	402626 5144118	175	134	29	1	18-0372-00
00-01	0	FPR07000	Ms Headwaters	2	Itasca	Siseebakwet	Cohasset	55721	19-Jun-00	447884 5223587	150	54	26	18	31-0554-00
00-01	0	FPR03000	N/A		Becker	Two Inlets	Park Rapids	56470	5-Jun-00	333295 5211502	315	141	36	14	03-0017-00
00-01	0	FPR02000	Border Prairie	3	Ottertail	Wall	Fergus Falls	56537	1-May-00	270920 5129354	130	132	42	4	56-0658-00
00-01	0	FPR10000	Border Prairie	3	Meeker	Washington	Darwin	55324	26-Jun-00	392200 4990124	120	118	29	6	47-0046-00
00-01	0	FPR13000	Mississippi Bluff Lands	11	Winona	Winona	Winona	55987	9-Aug-00	608292 4877378	121	107	7	27	85-0011-00
02-03	0	FPR15000	N/A		Hennepin	Fish	Maple Grove	55311	8-Jul-04	463684 4993343	85	119	22	27	27-0118-00
02-03	1	FPR16000	N/A		Washington	Big Carnelian	Stillwater	55082	22-May-01	545431 4998574	50	31	20	26	82-0049-00
02-03	I	FPR19000	Border Prairie	3	Ottertail	Clitherall	Battle Lake	56515	28-May-02	292756 5124565	180	132	40	15	56-0238-00
02-03	I	FPR25000	Border Prairie	3	Ottertail	Stalker	Dalton	56501	15-May-03	279890 5121571	150	132	41	29	56-0437-00
02-03	I	FPR20000	Border Prairie	3	Grant	Elk	Hoffman	56339	10-Jun-02	282907 5082571	285	128	41	26	26-0040-00
02-03	I	FPR21000	Central Lakes	4	Cass	Roosevelt	Baxter	56425	24-Jun-02	427985 5185447	350	139	26	27	11-0043-00
02-03		FPR24000	Border Prairie	3	Becker	Curfman	Detroit Lakes	56501	28-May-03	282247 5184727	140	138	41	10	03-0363-00
02-03	I	FPR26000	Central Lakes	4	Cass	Hardy	Pillager	56473	15-Jun-03	397487 5128586	240	133	29	28	11-0209-00
02-03	I	FPR28000	Southern Lakes	10	Waseca	Reeds	Medford	55049	15-Jun-03	450615 4892372	110	108	23	5	81-0055-00
02-03	I	FPR17000	Ms Headwaters	2	Cass	Leech	Walker	56484	15-Jul-02	380816 5213043	123	141	31	2	11-0203-00
02-03	I	FPR18000	Ms Headwaters	2	Itasca	Little Jay Gould	Cohasset	55721	17-Jun-02	453436 5232073	128	55	26	14	31-0566-00
02-03	I	FPR23000	Ms Headwaters	2	Beltrami	Stump	Bemidji	56601	15-Jun-03	368707 5260702	240	146	32	4	04-0130-01
2004	1	FPR32000	Border Prairie	3	Ottertail	Buchanan	Ottertail	56571	19-Jun-04	303668 5146119	90	134N	39W	11	56-0209-00
2004	1	FPR31000	Central Lakes	4	Crow Wing	Gilbert	Brainerd	56401	2-Jun-04	408867 5137643	175	134N	28W	28	18-0320-00
2004	1	FPR30000	Alexandria Moraine	7	Kandiyohi	Andrew	Spicer	56288	7-Jun-04	341194 5019999	185	121N	35W	12	34-0206-00
2004	1	FPR33000	Ms Headwaters	2	Beltrami	Movil	Bemidji	56601	24-Jun-04	359349 5273093	66	148N	33W	33	04-0152-00
2005	2	FPR38000	Border Prairie	3	Douglas	Red Rock	Hoffman	56339	15-May-05	288809 5082922	104	128	40	29	21-0291-00
2005	2	FPR36000	Border Prairie	3	Ottertail	Franklin	Pelican Rapids	56572	21-May-05	272605 5167501	125	136	42	4	56-0759-00
2005	2	FPR41000	Border Prairie	3	Becker	Sallie	Detroit Lakes	56501	6-Jun-05	278815 5182456	150	138	41	20	03-0359-00
2005	2	FPR37000	Central Lakes	4	Crow Wing	Serpent	Deerwood	56444	10-Jun-05	429255 5147671	110	46	28	7	18-0090-00
2005	2	FPR39000	Alexandria Moraine	7	Kandiyohi	Middle Fork-Crow R	New London	56273	27-Jun-05	347999 5017916	100	121	34	10	34-0158-00
2005	2	FPR40000	Ms Headwaters	2	Beltrami	Julia	Bemidji	56601	27-Jun-05	358448 5280828	200	148	33	4	04-0166-00
2006	3	ELKS1000	Ms Headwaters	2	Hubbard	Plantagenet	Bemidji	56601	1-Jun-06	353406 5249245	100	145	34	13	29-0156-00
2006	3	ELKS2000	Border Prairie	3	Ottertail	Long	Erhard	56534	14-Jun-06	266093 5147004	140	134	43	12	56-0784-00
2006	3	ELKS2000	Border Prairie	3	Ottertail	Long	Erhard	56534	7-Jun-06	265767 5147040	160	134	43	12	56-0784-00
2006	3	ELKS2000	Border Prairie	3	Ottertail	Little MacDonald	Ramsey	55303	12-Jun-06	291015 5165141	160	136	40	9	56-0328-00
2006	3	ELKS2000	Border Prairie	3	Douglas	Brophy	Alexandria	56308	25-May-06	311182 5086452	82	128	38	10	21-0102-00
2006	3	ELKS2000	Border Prairie	3	Becker	Floyd	Detroit Lakes	56501	30-May-06	281188 5193398	100	139	41	16	03-0387-00
2006	3	ELKS3000	Central Lakes	4	Crow Wing	Perch	Baxter	56425	30-May-06	402477 5132613	90	133	29	13	18-0371-00
2007	3	ELKS3000	Central Lakes	4	Crow Wing	White Sand	Baxter		16-May-07	401520 5134669	100	137	27	29	18-0310-00
2007	3	ELKS2000	Border Prairie	3	Becker	Big Cormorant	Audubon	56511	7-Jun-07		91	138	42	19	03-0576-00

Lakescaping Demo Sites

Year	Phase	Project #	Corridor Name	Corridor	County	Lake or site name	Nearest city	Zip	Date Installed	GPS Corridinates	Front	Twsp	Rng	S	DOW#	
2007	3	ELKS1000	Ms Headwaters	2	Cass	Upper Gull	Nisswa		14-Jun-07	397500 5153942	74	135	29	4	11-0218-00	
2008	3	ELKS2000	Border Prairie	3	Ottertail	Ottertail	Battle Lake	56515	3-Jul-07	291922 5141861	65	134	40	22	56-0242-00	
2008	3	ELKS2000	Border Prairie	3	Douglas	Darling	Alexandria	56308	9-Aug-07	313969 5086671	79	128	38	12	21-0080-00	
2008	4		Central Lakes	3	Crow Wing	Lower Hay Lake	Pequot Lakes	56003	Aug 6-7, 2007	401703 5170052	75	137	29	13		
2008	4		Central Lakes	3	Crow Wing	Upper Hay Lake	Pequot Lakes	50662	July 9-11, 2007	401063 5165825	70	137	29	36		
2008	4	ELKS2000	Border Prairie	3	Stevens	Charlotte	Cyrus	56323	June 11-12, 2008	284723 5055462	80	125	41	24	75-0046-00	
2008	4	ELKS2000	Border Prairie	8	Meeker	Lake Jennie			June 23-24, 2008	393612 4983417	120	118	29	29	47-0015-00	
2008	4		Central Lakes	4	Crow Wing	Nisswa Lake	Nisswa	56468	June 11-13, 08		135	135	29	15		
2009	4	ELKS3000	Central Lakes	4	Crow Wing	Lower Whitefish	Cross Lake		Aug 12-13, 2008	408149 5172450	200	137	27	29	18-0310-00	
2009	4	ELKS3000	Central Lakes	4	Crow Wing	Sibley	Pequot Lakes		Sept. 9-10, 2008	398630 5160546	75	136	29	15	18-0404-00	
2009	4	ELKS2000	Border Prairie	3	Ottertail	Round	Ottertail	56571	Aug 13-15, 2008	302010 5151737	120	135	36	22	56-0214-00	
2009	4	ELKS2000	Border Prairie	3	Becker	Middle Cormorant	Lake Park	56554	June 1-5, 2009	263650 5183039	480	138	43	22	03-0602-00	
2009	4		Border Prairie	3	Douglas	Lake Andrew	Alexandria	56308	May 20-21, 2009	0313486 5077484	100	127	38	12	21-0085-00	
2009	4		Border Prairie	3	Grant	Pelican Lake	Ashby	56309	June 11-13, 2009	2800978 5104072	100	130	41	22	26-0002-00	
2009	4		Central Lakes	4	Crow Wing	Lower Cullen			June 10-11,2009	E4019970 N 5454658	100	135	29	1		
2009	4		Central Lakes	4	Crow Wing	Lower Cullen			June 10-11,2009	E 401967 N 544640	100	135	29	1		
2009	5		Des Moines	9	Murray	Fulda	Fulda	56131	June -- 2009	E291424 N4858795	120	105	40	36	51-0021	
	5		Des Moines	9	Murray	Sarah # 1	Garvin	56132	10-Aug-09	E280291 N4892560	100	108	41	15	51-0063	
	5		Des Moines	9	Murray	Sarah # 2	Garvin	56132	10-Aug-09	E280309 N4892551	100	108	41	15	51-0063	
2009	5		Ms Headwaters	2	Itasca	Sugar Lake	Grand Rapids	55744	15-16 July, 2009	E774810 N52223609	85	54	26	18	31-0554-00	
2009	5		Des Moines	9	Jackson	Fish Lake	Windom	56101	June 7-9, 2010	E335272 N4856956	110	104	35	4	32-0018	
	5		Central Lakes	4	Crow Wing	Hartley	Brainerd	56401	July 21-22, 2009	399213 5141438	180	134	29	15	18-0392	done
2010	6		Central Lakes	4	Crow Wing	Rice Lake	Brainerd	56401	4-May-10	410810 5136611	125	45	30	17	18-145	
2010	6		Central Lakes	4	Morrison	Lake Alexander	Pillager	56473	14-Jun-10	383642 5154961	100	132	25	30	49-79	
2010	6		Border Prairie	3	Ottertail	Jewett Lake	Fergus Falls	56537	June 9-10, 2010	E264784 N5143816	140	134	43	23	56-0877-00	
2010	6		Border Prairie	3	Douglas	Lake Vermont	Parkers Prairie	56361	June 17-18, 2010	E316353 N5106906	100	130	37	7	21-0073-00	
	6		Alexandria Moraine	7	Pope	Lake Villard	Villard	56385	Spring 2011	E321600 N5065442	400	126	37	14	61-0067-00	
	6					TBD										
2010	6					TBD										
2010	6					TBD										

2008 Project Abstract
For the Period Ending June 30, 2010

PROJECT TITLE: 2K: Prairie Management – MN DNR – Scientific and Natural Areas Program
PROJECT MANAGER: Jason Garms
AFFILIATION: MN DNR
MAILING ADDRESS: 500 Lafayette Rd
CITY/STATE/ZIP: St. Paul, MN 55155
PHONE: 651-259-5130
E-MAIL: jason.garms@state.mn.us
WEBSITE: www.dnr.state.mn.us
FUNDING SOURCE: Environment and Natural Resources Trust Fund
LEGAL CITATION: ML 2008 First Special Section, Ch.367, Sec.2 Subd.3(c)

APPROPRIATION AMOUNT: $75,000

Overall Project Outcome and Results
This project continued the initiative to tackle the 'backlog' of prairie management needs in priority prairie landscapes, focusing on the highest quality prairies identified by the MN County Biological Survey program. All projects were on permanently protected lands in DNR ownership. Seven woody encroachment control projects were completed on Native Prairie Bank easements, Scientific and Natural Areas, and MN State Parks for a total of 240.5 acres. These projects ranged from small hand cutting to large mechanical cutting operations. Target species included buckthorn, siberian elm, boxelder, cottonwood, and red cedar. Reconstruction activities took place on 3 different sites, 1 Native Prairie Bank, 1 State Park and 1 SNA. All three projects included seed harvesting activities and site preparation for future reconstructions. Seed from the Glacial Lake State Park project was installed. Six prescribed burns were completed on 424 acres, which includes firebreaks and other preparations. Three prescribed fire projects were on SNA's, 2 projects were on Native Prairie Banks, and 1 burn was on a State Park. Five invasive species control projects were completed on 190.5 acres. Projects involved Leafy Spurge beetle releases, Birdsfoot Trefoil pulling, and Canada thistle treatments. Two projects were on SNA's and 3 projects were on Native Prairie Banks.

Project Results Use and Dissemination
Project activities are recorded by DNR - SNA staff in the program management files. This information is later used in evaluating long-term management goals.

LCCMR Work Program Final Report

Restoring Minnesota's Fish and Wildlife Habitat Corridors Phase 5

Habitat Conservation Partnership

2K:Prairie Management - MN DNR - Scientific and Natural Areas Program

Project Manager: Jason Garms

Affiliation: MN DNR - Scientific and Natural Areas Program

Address: 500 Lafayette Rd

St. Paul, MN 55155

Phone: 651-259-5130

Fax: 651-259-5130

E-mail: jason.garms@dnr.state.mn.us

Fund: Environment and Natural Resources Trust Fund

Legal Citation: ML 2008 First Special Section, Ch. 367, Sec. 2 Subd. 3(c).

Total Biennial Project Budget

Result	ENTF Allocation	ENTF Funds Spent	ENTF Balance	Other Funds Proposed	Other Funds Spent
Restoration	$75,000	$74,700	$300	$0	$0
Total	$75,000	$74,700	$300	$0	$0

Work Program Summary

Overall Project Outcome and Results

Woody encroachment - 7 woody encraochment control projects have been completed on Native Prairie Bank easements, Scientific and Natural Areas, and MN State Parks for a total of 240.5 acres. Projects range from small hand cutting to large mechanical cutting operations. Target species include buckthorn, siberian elm, boxelder, cottonwood, and red cedar.

Restoration/reconstruction - Reconstruction activities took place on 3 different sites (1 Native Prairie Bank, 1 State Park, and 1 SNA). All three projects included seed harvesting activities and site preparation. Seed from the Glacial Lake State Park project was installed.

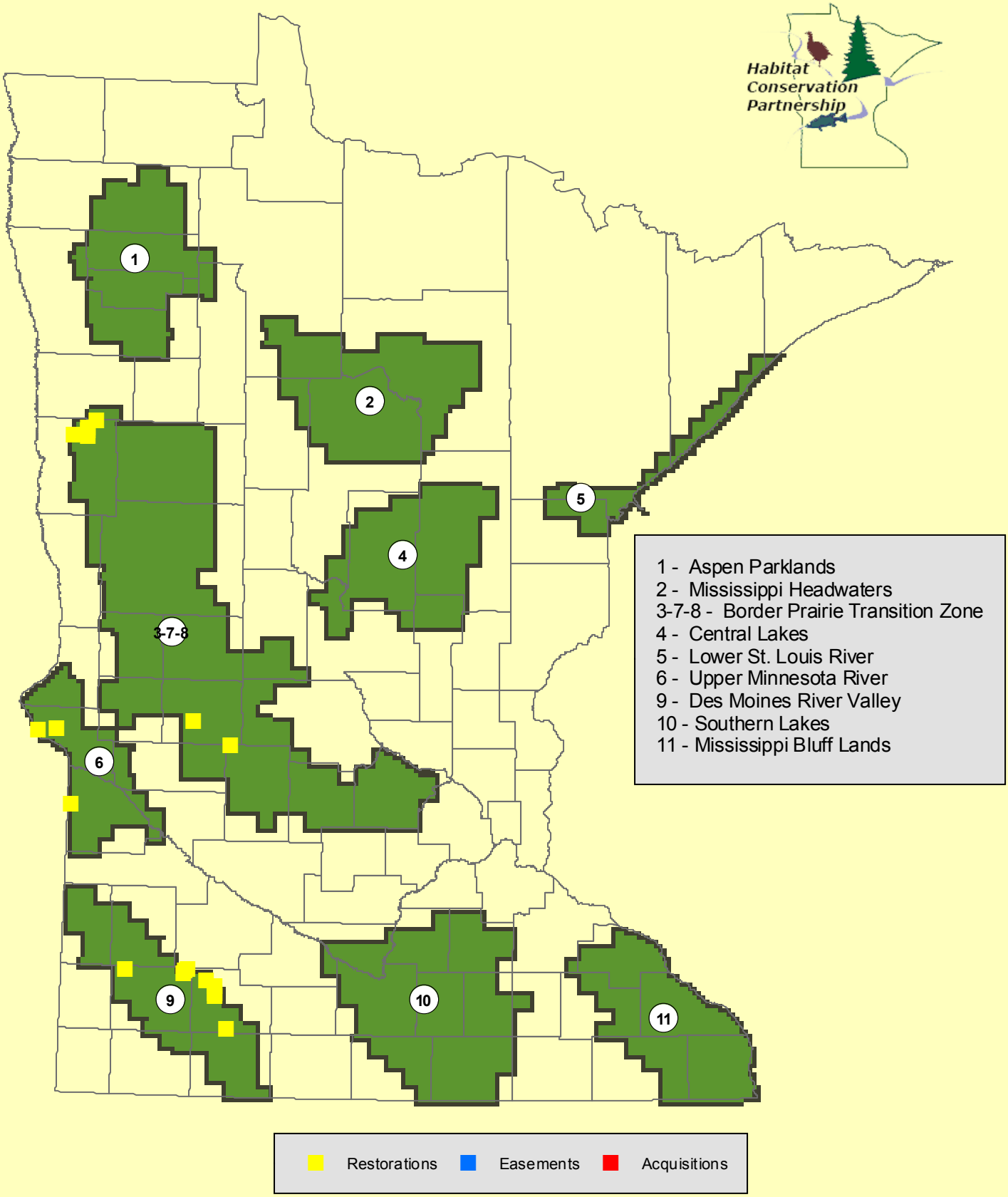
Prescribed burn - 6 rxburns were completed on 424 acres, which includes firebeaks and other preparations. 3 projects were on SNA's, 2 projects were on Native Prairie Banks, and 1 burn was on a State Park.

Invasive species control - 5 invasive species control projects have been completed on 190.5 acres. Projects involved Leafy Spurge beetle releases, Birdsfoot Trefoil pulling, and Canada thistle treatments. 2 projects were on SNA's and 3 projects were on Native Prairie Banks.

Project Results Use and Dissemination

Project activities are recorded by DNR - SNA staff in the program management files. This information is later used in evaluating long-term management goals.

Habitat Conservation Partnership
Phase 5 Accomplishments
2K - Prairis Management



2K:Prairie Management - MN DNR - Scientific and Natural Areas Program

Restoration Activities

LCCMR Work Program Final Report

Restoring Minnesota's Fish and Wildlife Habitat Corridors Phase 5

Habitat Conservation Partnership

2K:Prairie Management - MN DNR - Scientific and Natural Areas Program

Project Area - 3 - Border Prairie

Project Name: Glacial Lakes State Park
Township: 124, Range: 39, Section: 24

Activity: Grassland Enhancement
Landtype: Public - SNA
Description: Ash and Boxelder trees were removed stumps treated on 15 acres of native prairie and savanna. Siberian Elm and Buckthorn

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Restoration	$7,800.00	30.00	0.00

Project Name: Glacial Lakes State Park
Township: 124, Range: 39, Section: 24

Activity: Grassland Enhancement
Landtype: Public - SNA
Description: A 48-acre mix if native and reconstructed prairie was burned using a DNR and MCC staff. Firebreaks were also constructed prior to the burn.

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Restoration	$3,200.00	0.00	0.00

Project Name: Glacial Lakes State Park
Township: 124, Range: 39, Section: 24

Activity: Grassland Restoration
Landtype: Public - SNA
Description: Native prairie seeds were collected from 48 acres of native prairie. Seeds were used for a reconstruction projects on the same project site.

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Restoration	$5,800.00	48.00	0.00

Project Name: Felton Prairie
Township: 142, Range: 45, Section: 2

Activity: Grassland Restoration
Landtype: Private - Land
Description: 160 acres were harvested by both contractors and DNR crews. Seed will be used on the same project site in the following year.

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Restoration	$3,495.00	160.00	0.00

Project Name: Felton Prairie SNA
Tract: Assinaboia
Township: 142, Range: 45, Section: 20

Activity: Grassland Enhancement
Landtype: Private - Lake
Description: 30 acres of native prairie was burned.

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Restoration	$1,950.00	30.00	0.00

2K:Prairie Management - MN DNR - Scientific and Natural Areas Program

Project Name: Felton Prairie SNA
Tract: Bicentennial
Township: 142, Range: 45, Section: 29

Activity: Grassland Enhancement
Landtype: Public - SNA
Description: 53 acres of native prairie was burned

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Restoration	$3,445.00	53.00	0.00

Project Name: Felton Prairie SNA
Tract: Shrike
Township: 141, Range: 45, Section: 5

Activity: Grassland Enhancement
Landtype: Public - SNA
Description: 45 acres of native prairie was burned.

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Restoration	$2,145.00	45.00	0.00

Project Name: B-B Prairie Bank
Township: 141, Range: 46, Section: 5

Activity: Grassland Enhancement
Landtype: Private - Land
Description: 146 acres of native prairie was burned on the B-B Ranch Prairie Bank

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Restoration	$2,390.00	146.00	0.00

Project Area - 6 - Upper Minnesota River

Project Name: Clinton Prairie SNA
Township: 123, Range: 47, Section: 16

Activity: Grassland Enhancement
Landtype: Public - SNA
Description: Inventory and treatment of invasive species on native prairie.

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Restoration	$1,700.00	78.00	0.00

Project Name: Bonanza Prairie SNA
Township: 123, Range: 48, Section: 20

Activity: Grassland Enhancement
Landtype: Public - SNA
Description: MCC crew hand cut woody species invading the native prairie on Bonanza Prairie SNA. Woody species were cut and stumps treated.

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Restoration	$3,000.00	30.00	0.00

LCCMR Work Program Final Report

Restoring Minnesota's Fish and Wildlife Habitat Corridors Phase 5

Habitat Conservation Partnership

2K:Prairie Management - MN DNR - Scientific and Natural Areas Program

Project Area - 7 - Alexandria Moraine

Project Name: Norway Lake 5
Township: 122, Range: 36, Section: 5

Activity: Grassland Enhancement
Landtype: Private - Land
Description: Red cedar trees were cut from 20 acres of native prairie. Project site is enrolled in Native Prairie Bank.

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Restoration	$4,000.00	20.00	0.00
ENTF	Restoration	$4,000.00	44.00	0.00
Grassland Enhancement Total		$8,000.00	64.00	0.00
Norway Lake 5 Total		**$8,000.00**	**64.00**	**0.00**

LCCMR Work Program Final Report

Restoring Minnesota's Fish and Wildlife Habitat Corridors Phase 5

Habitat Conservation Partnership

2K:Prairie Management - MN DNR - Scientific and Natural Areas Program

Project Area - 9 - Des Moines River Valley

Project Name: Holly 2 Prairie Bank
Township: 108, Range: 39, Section: 2

Activity: Grassland Restoration
Landtype: Private - Land
Description: Native Prairie Bank harvested in preparation for a future prairie restoration on cropped land adjacent to the native prairie.

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Restoration	$1,800.00	2.00	0.00

Project Name: Ann 25 PB
Township: 108, Range: 38, Section: 25

Activity: Grassland Restoration
Landtype: Private - Land
Description: Scattered boxelder, ash, and cotttonwood trees cut and removed from 24.5 acres of native prairie. Project area is enrolled in Native Prairie Bank Program.

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Restoration	$8,200.00	24.50	0.00

Project Name: Pilegaard PB
Township: 108, Range: 43, Section: 11

Activity: Grassland Enhancement
Landtype: Private - Land
Description: Boxelder and cottonwood trees were removed from 25 acres of native prairie and 19 acres of adjacent reconstructed prairie that is enrolled in RIM. Native prairies are enrolled in Native Prairie Bank Program.

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Restoration	$7,875.00	44.00	0.00

Project Name: Storden 4 PB
Township: 107, Range: 37, Section: 4

Activity: Grassland Enhancement
Landtype: Private - Land
Description: Scattered siberian elm, buckthorn, and cottonwoods were cut and stumps treated on 43 acres of native prairie enrolled in the Native Prairie Bank Program. Birdsfoot Trefoil was also pulled from 1-acre.

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Restoration	$6,935.00	44.00	0.00

Project Name: Wahl Prairie
Township: 108, Range: 39, Section: 16

Activity: Grassland Restoration
Landtype: Private - Land
Description: Encroaching woody species were cut and removed from 4 acres of native prairie on private land. The project area is under a DNR Private Landowner Agreement.

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Restoration	$1,235.00	4.00	0.00

LCCMR Work Program Final Report

Restoring Minnesota's Fish and Wildlife Habitat Corridors Phase 5

Habitat Conservation Partnership

2K:Prairie Management - MN DNR - Scientific and Natural Areas Program

Project Name: Yellow Bank Hills SNA
Township: 118, Range: 46, Section: 4

Activity: Grassland Enhancement
Landtype: Public - SNA
Description: Leafy spurge populations were inventoried and treated on 78 acres of native prairie.

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Restoration	$1,350.00	78.00	0.00

Project Name: Storden 21 Prairie Bank
Township: 107, Range: 37, Section: 21

Activity: Grassland Enhancement
Landtype: Private - Land
Description: Canada thistle was treated on 1 acre of native prairie on a native prairie bank easement. Surrounding acres also benefitted.

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Restoration	$370.00	1.00	0.00
ENTF	Restoration	$1,390.00	2.50	0.00
Grassland Enhancement Total		$1,760.00	3.50	0.00
Storden 21 Prairie Bank Total		**$1,760.00**	**3.50**	**0.00**

Project Name: Storden 28 Prairie Bank
Township: 107, Range: 37, Section: 28

Activity: Grassland Enhancement
Landtype: Private - Land
Description: Birdsfoot Trefoil was pulled from a native prairie bank easement. 1-acre was treated.

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Restoration	$300.00	1.00	0.00

Project Name: Holly 10
Township: 108, Range: 39, Section: 10

Activity: Grassland Enhancement
Landtype: Private - Land
Description: Leafy Spurger beetles were released on 30 acres of native prairie.

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Restoration	$540.00	30.00	0.00

Project Name: Great Bend 29 Prairie Bank
Township: 105, Range: 36, Section: 29

Activity: Grassland Enhancement
Landtype: Private - Land
Description: 102 acres of native and reconstructed prairie was burned.

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Restoration	$1,780.00	102.00	0.00

Restoration Project Totals (By Funding Type)

Funding Type	Funding Amount	Acres	Shoreline Feet
ENTF:	$74,700.00	1,017.00	0.00
Total:	**$74,700.00**	**1,017.00**	**0.00**

Attachment A: Budget Detail for 2008 Projects - Summary and a Budget page for each partner					
Project Title: 2K Prairie Management					
	Minnesota's Habitat Conservation Partnership (V)				
Project Manager Name: Jason Garms					
Trust Fund Appropriation: $75,000					
1) See list of non-eligible expenses, do not include any of these items in your budget sheet					
2) Remove any budget item lines not applicable					
2008 Trust Fund Budget	**Result 1 Budget:**	**Amount Spent** *(Nov 1, 2009)*	**Balance** *(Nov 1, 2009)*	**TOTAL BUDGET**	**TOTAL BALANCE**
	Prairie Management and Restoration				
BUDGET ITEM			0	0	0
PERSONNEL: wages and benefits	37,500	37,750	-250	37,500	-250
Contracts			0	0	0
Professional/technical (with whom?, for what?)			0	0	0
Other contracts (contracts for prescribed burning, prairie reconstructions, woody encroachment, etc)	26,500	25,950	550	26,500	550
Equipment / Tools (vehicle fleet costs e.g. ATV, Pick-up, ASV tracked vehicle)	7,500	7,500	0	7,500	0
Other Supplies (herbicide, safety supplies, etc.)	3,500	3,500	0	3,500	0
COLUMN TOTAL	**$75,000**	**$74,700**	**$300**	**$75,000**	**$300**

2008 Project Abstract
For the Period Ending June 30, 2010

PROJECT TITLE: Campaign for Conservation
PROJECT MANAGER: Michael Pressman
AFFILIATION: The Nature Conservancy
MAILING ADDRESS: 1101 west River Parkway, Suite 200
CITY/STATE/ZIP: Minneapolis/MN/55415-1291
PHONE:612-331-0706
FAX:612-331-0770
E-MAIL:mpressman@tnc.org
WEBSITE: www.nature.org
FUNDING SOURCE: Environment and Natural Resources Trust Fund
LEGAL CITATION: ML 2008 First Special Section, Ch. 367, Sec. 2, Subd. 3(c)

APPROPRIATION AMOUNT: $317,000

Overall Project Outcome and Results:
This project focused on 5 habitat restoration projects. Additional details, beyond the short summaries below, are located within the Final Report's more detailed reporting.

NE MN Forest Restoration – 162 acres of State and County land were planted with long lived conifers and/or fenced to protect them from deer browse.

Chippewa Prairie – Fencing of 1,318 acres (5.5 miles of fence), as part of a comprehensive effort to implement a rotational grazing system on 2,866 acres of TNC and MN DNR land along the Minnesota River in Chippewa and Swift Counties. This helps to maintain and enhance the quality of the native prairie found at this location by mimicking the historic disturbance pattern resulting from bison grazing.

Prairie Forest Border – TNC accelerated management activities on TNC and public lands to help return lands to highly diverse ecosystems and fight the invasion of non-native plants and brush. Work included 2,359 acres of prescribed fire, 265 acres mechanically or chemically treated for invasive species, and 75 acres of brush removed. In addition, 1,760 additional acres were prepared for future prescribed fire, brush control, and invasive species control efforts.

Ordway Glacial Lakes (OGL) – Under this appropriation, 140 acres of native prairie were enhanced through removal of woody vegetation by prescribed fire and mechanical means. In addition to other places, this work showed the dramatic increase in acres that could be treated using the new skid steer loader and brush cutting attachments.

Agassiz Beach Ridges – Prairie was restored on 160 acres of the Bluestem Prairie -Williams Tract as part of a larger effort with multiple funding sources that to date includes 837 acres of wetland and prairie restoration with an additional 438 acres planned. The overriding project goal is to restore prairie communities for wildlife habitat, improvement of landscape hydrology, and to build connectivity between the Bluestem Prairie complex and the Margherita/Audubon Prairie preserve.

Project Results Use and Dissemination:
All restored lands are open to the public. TNC continues to coordinate with public and private partners to apply lessons learned from this project to other efforts. Investments in skid steer loader, brush cutting attachments, and pumper units will continue to have an impact beyond this project time period through continued use to restore additional land beyond this grant period.

LCCMR Work Program Final Report

Restoring Minnesota's Fish and Wildlife Habitat Corridors Phase 5
Habitat Conservation Partnership

2N:Campaign for Conservation - The Nature Conservancy

Project Manager: Michael Pressman

Affiliation: The Nature Conservancy

Address: 1101 West River Parkway
Minneapolis, MN 55415

Phone: 612-331-0706

Fax: 612-331-0770

E-mail: mpressman@tnc.org

Fund: Environment and Natural Resources Trust Fund

Legal Citation: ML 2008 First Special Section, Ch. 367, Sec. 2 Subd. 3(c).

Total Biennial Project Budget

Result	ENTF Allocation	ENTF Funds Spent	ENTF Balance	Other Funds Proposed	Other Funds Spent
Restoration	$317,000	$317,000	$0	$317,000	$340,062
Total	$317,000	$317,000	$0	$317,000	$340,062

Work Program Summary

Overall Project Outcome and Results

The Nature Conservancy's (TNC) 2007 work program focused on 5 habitat restoration projects. Additional details, beyond the short summary below, are located within each project's more detailed reporting.

NE MN Forest Restoration – 162 acres of State and County land were planted with long lived conifers and/or fenced to protect them from deer browse.

Chippewa Prairie – Fencing of 1,318 acres (5.5 miles of fence), as part of a comprehensive effort to implement a rotational grazing system on 2,866 acres of TNC and MN DNR land along the Minnesota River in Chippewa and Swift Counties. This helps to maintain and enhance the quality of the native prairie found at this location by mimicking the historic disturbance pattern resulting from bison grazing.

Prairie Forest Border – TNC accelerated management activities on TNC and public lands to help return lands to highly diverse ecosystems and fight the invasion of non-native plants and brush. Work included 2,359 acres of prescribed fire, 265 acres mechanically or chemically treated for invasive species, and 75 acres of brush removed. In addition, 1,760 additional acres were prepared for future prescribed fire, brush control, and invasive species control efforts.

Ordway Glacial Lakes (OGL) – Under this appropriation, 140 acres of native prairie were enhanced through removal of woody vegetation by prescribed fire and mechanical means. In addition to other places, this work showed the dramatic increase in acres that could be treated using the new skid steer loader and brush cutting attachments.

Agassiz Beach Ridges – Prairie was restored on 160 acres of the Bluestem Prairie -Williams Tract as part of a larger effort with multiple funding sources that to date includes 837 acres of wetland and prairie restoration with an additional 438 acres planned. The overriding project goal is to restore prairie communities for wildlife habitat, improvement of landscape hydrology, and to build connectivity between the Bluestem Prairie complex and the Margherita/Audubon Prairie preserve.

Project Results Use and Dissemination

All restored lands are open to the public. TNC continues to coordinate with public and private partners to apply lessons learned from this project to other efforts. Investments in skid steer loader, brush cutting attachments, and pumper units will continue to have an impact beyond this project time period through continued use to restore additional land beyond this grant period.

LCCMR Work Program Final Report

Restoring Minnesota's Fish and Wildlife Habitat Corridors Phase 5
Habitat Conservation Partnership

2N:Campaign for Conservation - The Nature Conservancy

Restoration Activities

Project Area - 3 - Border Prairie

Project Name: Agassiz Beach Ridges
Tract: multiple
Township: 139, Range: 46, Section: 22

Activity: Grassland Restoration
Landtype: Private - Land
Description: Prairie was reconstructed/restored on 160 acres of the Williams Tract near the Bluestem Prairie complex in Clay County, Minnesota. Prior to reconstruction the area was a degraded field composed of non-native plant species. TNC contracted Prairie Restorations, INC. for site preparation and seeding. The restoration area was sprayed with glyphosate three times by aerial application in 2008 and 2009 to prepare the site. Seed was harvested by combine from 72 acres of nearby native prairie areas in September and October, 2008. Seeding with native harvest was completed August 12, 2009.

The restoration funded through this appropriation was part of a larger restoration effort funded through multiple sources. The overall effort includes wetland and prairie reconstruction/restoration on 837 acres so far with an additional 438 acres planned.

The overriding goal of the project is to restore prairie communities for wildlife habitat, for improvement of the landscape hydrology, and to build connectivity between the Bluestem Prairie complex and the Margherita/Audubon Prairie preserve.

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Restoration	$80,149.03	47.93	0.00
Other Funds	Restoration	$187,407.80	112.07	0.00
Agassiz Beach Ridges multiple Total		**$267,556.83**	**160.00**	**0.00**

Project Area - 5 - Lower St. Louis River

Project Name: Northeast Minnesota Forest Restoration
Tract: Multiple
Township: 55, Range: 8, Section: 30

Activity: Woodland Restoration
Landtype: Public - State Forest
Description: The Nature Conservancy is working collaboratively with the MNDNR, Lake and St. Louis Counties and the US Forest Service on forest planning, timber management, and biodiversity conservation in large landscape sized areas in Northeast Minnesota including the St. Louis River Habitat Conservation Partnership project area that encompasses Lake Superior's North shore. Conifer restoration has been identified by all partners as a key management and conservation strategy on the North Shore. The goal for the LCCMR funded portion of this project was to plant long lived conifers and fence a portion of those plantings to protect them from deer browse. During the 2009 field season, 162 acres were planted and/or fenced on State and County land within the "North Shore" Corridor.

Restoration is being done on lands managed as State Parks, Wildlife Management Areas, State Forest, and Lake County lands.

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Restoration	$22,598.36	162.00	0.00

LCCMR Work Program Final Report

Restoring Minnesota's Fish and Wildlife Habitat Corridors Phase 5
Habitat Conservation Partnership

2N:Campaign for Conservation - The Nature Conservancy

Project Area - 6 - Upper Minnesota River

Project Name: Chippewa Prairie
Tract: multiple
Township: 119, Range: 43, Section: 12

Activity: Grassland Restoration
Landtype: Private - Land
Description: The Nature Conservancy and the Minnesota Department of Natural Resources (DNR) are cooperating on a Prairie Coteau Restoration Project affecting 2,866 acres along the Minnesota River in Chippewa and Swift Counties. TNC owns and manages 1,142 of this as the Chippewa Prairie Preserve. DNR owns and manages 1,724 acres as part of the Lac qui Parle Wildlife Management Area. The project's goal is to implement a rotational grazing system. This involves intensive grazing on limited portions of the project area for short periods. These areas are then rested for a longer period. This helps to maintain and enhance the quality of the native prairie found at this location by mimicking the historic disturbance pattern resulting from bison grazing.

As part of this appropriation, TNC completed fencing of 1,318 acres (5.5 miles of fence). Additional work is planned under the 2009 appropriation and is pending a 2010 LCCMR recommendation.

$13,625.79 of Other Funds in the 11/09 report are salary expenses. They have been coded as restoration expenses to facilitate proper acre proration in the online reporting system.

$14,693.42 of Other Funds in the 2/10 report are salary expenses. They have been coded as restoration expenses to facilitate proper acre proration in the online reporting system.

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Restoration	$20,000.00	523.02	0.00
Other Funds	Restoration	$30,399.18	794.98	0.00
Chippewa Prairie multiple Total		**$50,399.18**	**1,318.00**	**0.00**

LCCMR Work Program Final Report

Restoring Minnesota's Fish and Wildlife Habitat Corridors Phase 5
Habitat Conservation Partnership

2N:Campaign for Conservation - The Nature Conservancy

Project Area - 7 - Alexandria Moraine

Project Name: Ordway Glacial Lakes
Tract: Multiple
Township: 122, Range: 36, Section: 2

Activity: Grassland Restoration
Landtype: Private - Land
Description: In the Ordway Glacial Lakes (OGL) landscape woody vegetation encroachment into the native prairies has become our number one theat. TNC, DNR and USFWS have all identified this threat and begun working diligently on this issue. The Nature Conservancy owns and manages 3 preserves totaling 2,486 acres on which woody vegetation removal is actively being pursed. As part of this appropriation, 140 acres of native prairie has been enhanced by the removal of woody vegetation by mechanical removal. This was done at three TNC preserves - Leif Mountain, Ordway Prairie and Sheepberry Fen (the latter was an acquisition partially funded with prior ENTF appropriation). Additional acres were treated by prescribed fire and are accounted for under the Prairie Forest Border project. The use of private contractors often makes up much of the work load, however with purchase of the skid loader more work is accomplished by TNC staff. In addition to other places, this work showed the dramatic increase in acres that could be treated using the new skid steer loader and brush cutting attachments.

The wood that was removed has been separated into two piles: one is a brush pile that consists of all woody material too small to be counted as fire wood, two, is the wood large enough to be used as fire wood. The brush piles will be burned in the next Rx fire planned for the unit and the other wood will be hauled to the side of the road to let whomever come and cut it up and haul away. The stumps remain and have been chemically treated to prevent resprout.

$9,900 in Other Funds in 11/09 report are salary expenses. They have been listed as restoration expenses to facilitate proper proration of acres in the online reporting system.

2/10 prior sentece was incorrect in last report. The $9,900 was a contract expense and are correctly coded as a restoration expense.

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Restoration	$30,000.00	105.26	0.00
Other Funds	Restoration	$9,900.00	34.74	0.00
Ordway Glacial Lakes Multiple Total		**$39,900.00**	**140.00**	**0.00**

LCCMR Work Program Final Report

Restoring Minnesota's Fish and Wildlife Habitat Corridors Phase 5
Habitat Conservation Partnership

2N:Campaign for Conservation - The Nature Conservancy

Project Area - 3-7-8 - Border Prairie Transition Zone

Project Name: Prairie Forest Border - Multiple Sites
Tract: Multiple
Township: 122, Range: 36, Section: 2

Activity: Grassland Restoration
Landtype: Private - Land
Description: Within the Prairie Forest Border Ecoregion, TNC owns and manages 23 preserves, and collaborates with other conservation partners to maintain and restore these preserves as well as public and private lands in the landscapes surrounding preserves. Most of these lands are fire-dependent ecosystems. In the absence of fire, many of these preserves have been invaded by fire-intolerant invasive species and/or brush over time. The goal of this project was to accelerate the management activities on these TNC and public lands to help return these lands to highly diverse ecosystems and fight the invasion of non-native plants and brush.

TNC hired seasonal employees to conduct restoration work on eight of these nature preserves and surrounding public lands. This restoration work included 2,359 acres burned, 265 acres mechanically or chemically treated for invasive species, and 75 acres of brush removed. In addition, 1,760 additional acres were prepared for future prescribed fire, brush control, and invasive species control efforts. These additional acres will be completed with funds outside this appropriation, including TNC's 2009 Trust Fund appropriation.

Work was completed at the following preserves: Lake Alexander, Paul Bunyan Savanna, Ottawa Bluffs, Weaver Dunes, Leif Mountains, Ordway Prairie, Regal Meadow, and Sheepberry Fen.

$1,527.68 in 12/08 report are for personnel expenditures. They were listed as restoration to facilitate proper acres proration in the online reporting system.

The wood that was removed has been separated into two piles: one is a brush pile that consists of all woody material too small to be counted as fire wood, two, is the wood large enough to be used as fire wood. The brush piles will be burned in the next Rx fire planned for the unit and the other wood will be hauled to the side of the road to let whomever come and cut it up and haul away. The stumps remain and have been chemically treated to prevent resprout.

$7,934.42 in 5/09 report are personnel expenses. They were listed as restoration to facilitate proper acres proration in the online reporting system.

$9,465.84 in 11/09 report are personnel expenses. They were listed as restoration to facilitate proper acres proration in the online reporting system.

2/10 - the November 2009 workprogram update included an error in the Other Funds reported for this project. This error is corrected in this final report.

$27,852.11 of ENTF funds and $4,300.44 of Other Funds in 2/10 report are personnel expenses. They were listed as restoration to facilitate proper acres proration in the online reporting system.

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Restoration	$36,858.71	2,417.00	0.00
Other Funds	Restoration	$4,300.44	282.00	0.00
Prairie Forest Border - Multiple Sites Multiple Total		**$41,159.15**	**2,699.00**	**0.00**

Restoration Project Totals (By Funding Type)

Funding Type	Funding Amount	Acres	Shoreline Feet
ENTF:	$189,606.10	3,255.22	0.00

2N:Campaign for Conservation - The Nature Conservancy

Other Funds:	$232,007.42	1,223.78	0.00
Total:	**$421,613.52**	**4,479.00**	**0.00**

LCCMR Work Program Final Report

Restoring Minnesota's Fish and Wildlife Habitat Corridors Phase 5
Habitat Conservation Partnership

2N:Campaign for Conservation - The Nature Conservancy

Work Program Expenditures - Not Attributable to Specific Projects

FundingType	*Category*	*Amount*	*Description*
ENTF	Equipment Costs	$97,590.28	New Holland C190 tracked skid loader with the following attachments: Carbide Cutter, tree sheer, grapple, sweeper, and a bucket. Also included is $544 in license fees for the skid steer loader (and postage on pumper unit supplies) and $1,125.93 in supplies necessary for regular upkeep of the skid steer loader. All will be used to manage woody vegetation on native prairie sites.
ENTF	Equipment Costs	$29,803.42	Pumper Units for prescribed fire and associated attachments and supplies (equipment - $21,271.60; supplies - $8,531.82).
Other Funds	Admin	$108,054.35	The Conservancy's federally approved indirect cost recovery rate (23.28% through 6/30/09, 23.05% effective 7/1/09) has been applied to the $228,125.97 of reimbursable expenses and $237,172.82 of other funds(but not including the skid steer loader and attachments) incurred through the restoration portion of the grant. This rate is approved by the Conservancy's federal cognizant agency, the US Department of the Interior. A copy of the official negotiated indirect rate agreement can be provided upon request.
	Total:	**$235,448.05**	

Work Program Expenditures (Not Attributable to Specific Projects) By Funding Type

Funding Type	Amount
ENTF	$127,393.70
Other Funds	$108,054.35
Total	**$235,448.05**

Work Program Expenditures Breakdown

Funding Type:	Restoration Projects	Not Attributable to Specific Projects	Total
ENTF	$189,606.10	$127,393.70	$316,999.80
Other Funds	$232,007.42	$108,054.35	$340,061.77
State Funds	$0.00	$0.00	$0.00
Total	$421,613.52	$235,448.05	$657,061.57

LCCMR Work Program Final Report

Restoring Minnesota's Fish and Wildlife Habitat Corridors Phase 5
Habitat Conservation Partnership

2N:Campaign for Conservation - The Nature Conservancy

Funding Type Definitions

ENTF:	Grant dollars provided through the Minnesota Environment and Natural Resources Trust Fund
Other Funds:	Non-state, non-state leveraged dollars (if partner funds are leveraging State Funds (e.g. RIM) they are not eligible to be considered Other Funds)
State Funds:	State Funds expended on HCP projects (not eligible for use as Other Funds commitment)
Partner's State Leveraged Funds:	Non State Funds that have leveraged State Funds as part of an HCP project (not eligible for use as Other Funds commitment)
Other:	Any other expenditures (e.g. grant income funds)

Attachment A: Budget Detail for 2008 Projects - Summary and a Budget page for each partner

Project Title: *Campaign for Conservation*

Minnesota's Habitat Conservation Partnership (V)

Project Manager Name: *Michael Pressman*

Trust Fund Appropriation: $ *317,000*

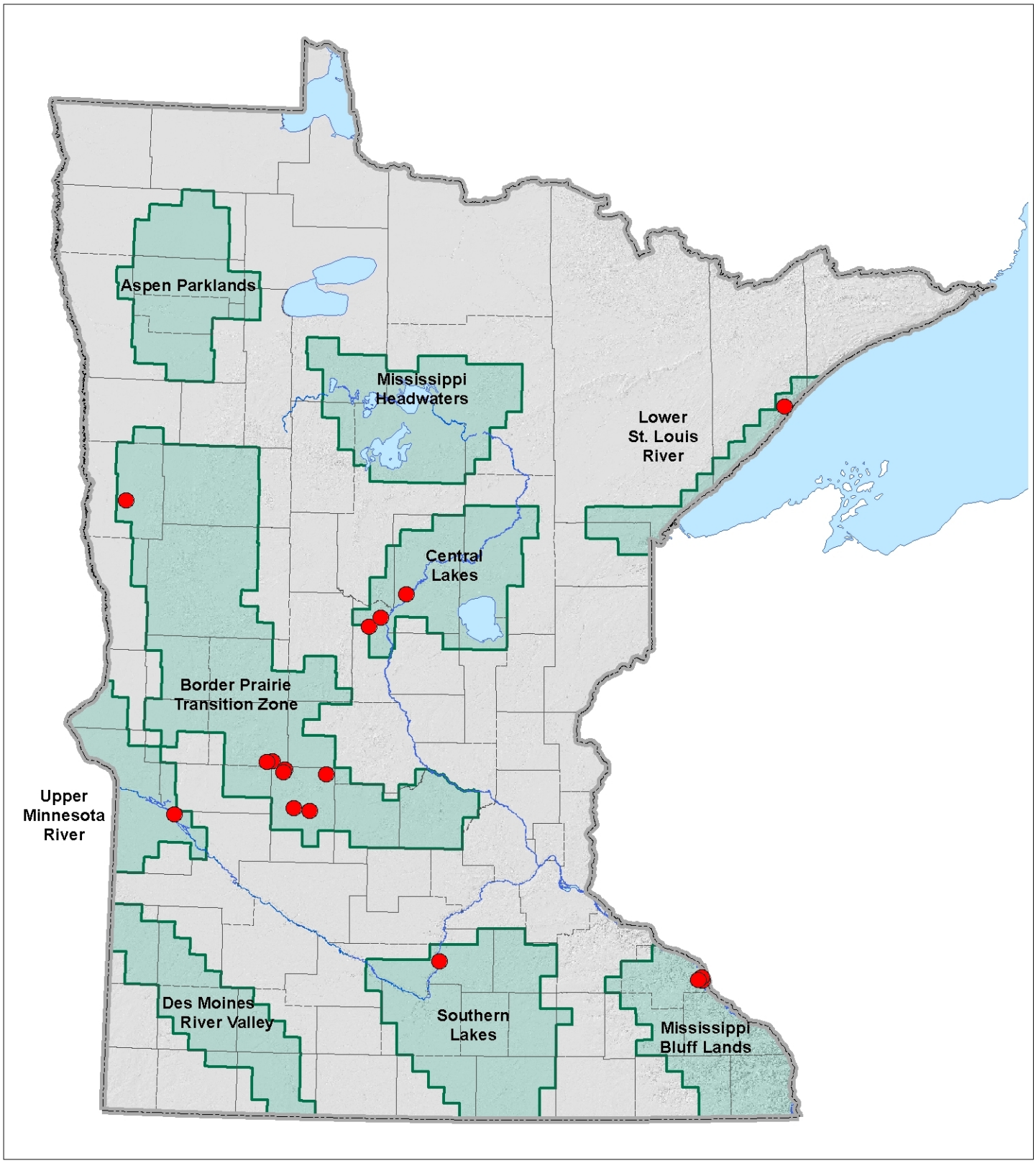
2008 Trust Fund Budget	**Result 1 Budget: 1st Revised Budget 5/15/09**	**Result 1 Budget: 2nd Revised Budget 11/3/09**	**Amount Spent** *(12/31/09)*	**Balance** *(12/31/09)*	**TOTAL BUDGET**	**TOTAL BALANCE**
	Restoration	*Restoration*				
BUDGET ITEM					0	0
PERSONNEL: wages and benefits	~~18,000~~	27,852	27,852	0	27,852	0
Contracts					0	0
Professional/technical (seeding, tree removal, fencing, reforestation, weed control, etc.)	~~157,535~~	142,860	142,868	-8	142,860	-8
Equipment / Tools *(Skid steer loader w/ brush cutting & firebreak attachments and trailer. Not included in this figure is $1,125.93 in supplies related to the skid steer loader. TNC's accounting systems tracks supplies and those expenses are included in the Other Supplies category. $530.43 in license fees related to the skid steer loader trailer have been moved to the Other category.)*	~~100,000~~	95,920	95,920	0	95,920	0
Equipment / Tools *(Pumper units for prescribed fire. There are an additional $8,614 in expenses related to the pumper units that TNC's accounting system categorizes as supplies and those expenses are reflected in the Other Supplies category. $13.93 for shipping expenses for pumper unit supplies has been moved to the Other category.)*	~~30,000~~	21,272	21,272	0	21,272	0
Other Supplies *(herbicide & sprayers, fuel for chainsaws, etc. This figure also includes $1,125.93 in supplies related to the skid steer loader and $8,614 in supplies related to the pumper units. $2,500 for deer fencing materials for NE MN forest restoration.)*	~~11,465~~	28,552	28,544	8	28,552	8
Other *(License fees for trailer to haul skid steer loader, postage for pumper unit supplies.)*	0	544	544	0	544	0
COLUMN TOTAL	**$317,000**	**$317,000**	**$317,000**	**$0**	**$317,000**	**$0**

Update as of 5/15/09: Revised budget figures reflect the shifting of $10,465 from the NE MN Contracts budget to supplies per 4/21/09 email request. Also included is a change in the Chippewa Prairie budget that shifts $7,500 from supplies to contracts.

Update as of 11/3/09: Revised budget figures reflect the Conservancy's request to shift $9,852 from the Contracts budget to Personnel, a request to shift $4,823 from the Contracts budget to Supplies, and a request to shift $2,500 ($2,400 from the skid steer loader and $100 from the pumper units) to supplies. Request approved 11/3/09.

Campaign for Conservation

Habitat Conservation Partnership
Phase 5 Accomplishments



Legend

- Restoration Project Locations
- Acquisition Project Locations
- Habitat Conservation Partnership Project Areas

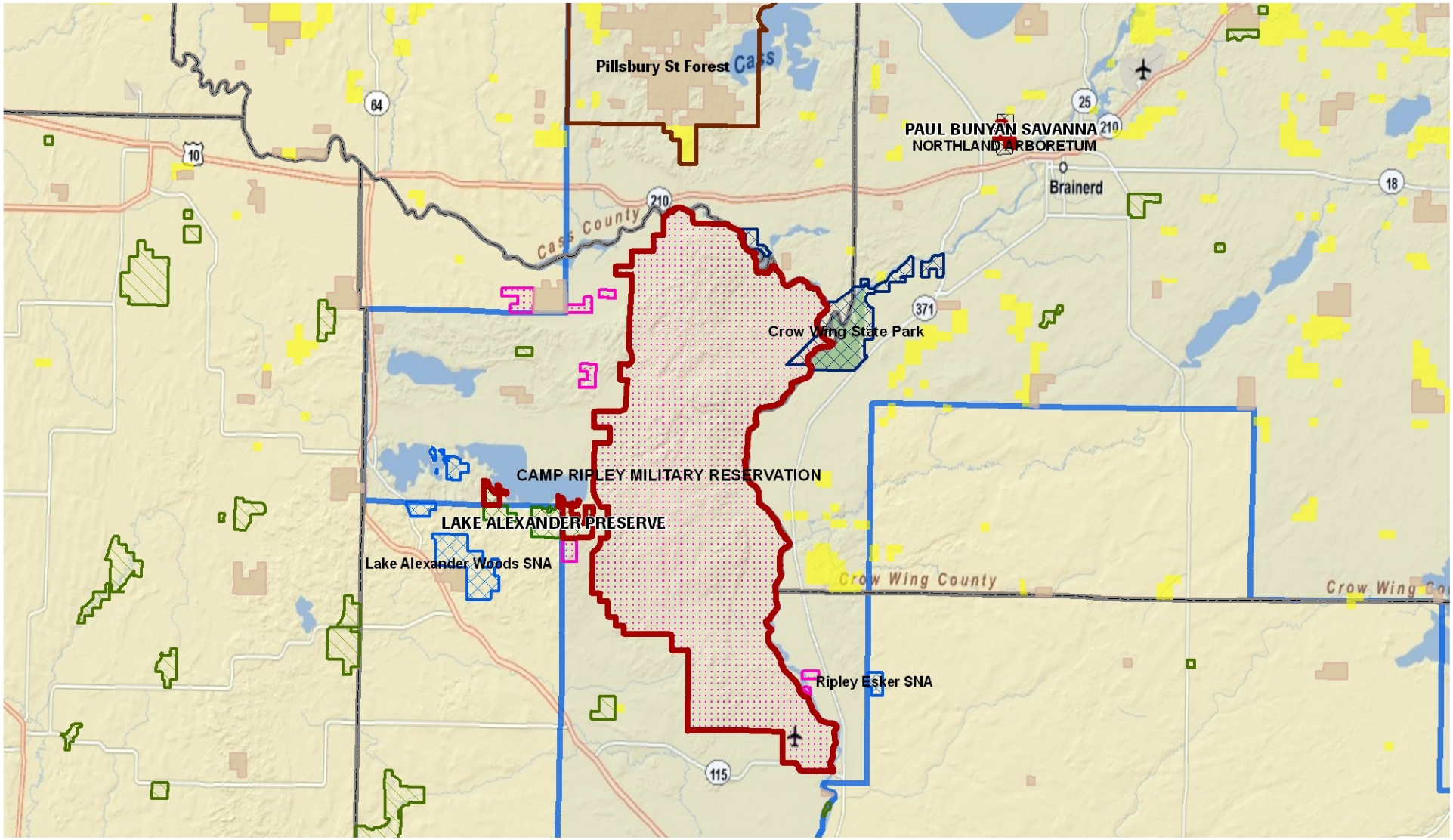
The Nature Conservancy

0 12.5 25 50 Miles

Map Created by: RCJ, TNC Is MN-ND-SD, 2010.0.0
M:\mxd\Special Project\MN\LCCMR\LCCMR Phase V Final Report\Map.mxd

Prairie Forest Border Restoration - 1 of 4

Crow Wing & Morrison Counties, MN



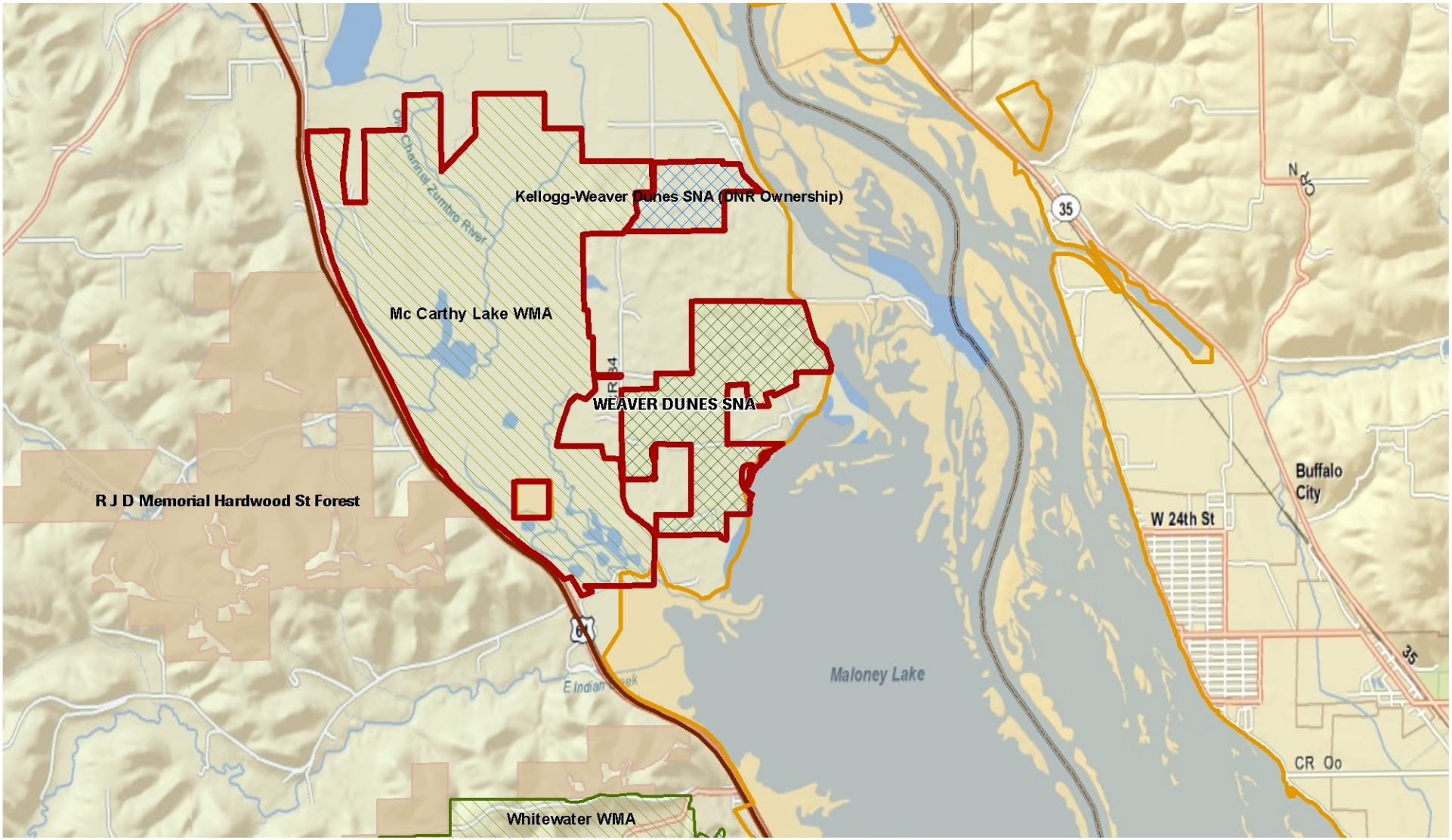
HCP Action Areas
Restoration Project
TNC Preserve - TNC, 2010
State Park - DNR, 2009
Scientific & Natural Area - DNR, 2009
Wildlife Management Area - DNR, 2009
State Forest (Authorized) - DNR
State Forest (Ownership) - DNR
Camp Ripley Military Reservation
Other Conservation Ownership
County Ownership - DNR

4 2 0 4 Miles

M:\mxd\Prairie Forest Border\Grant\LCCMR\
Prairie Forest Border Restoration - 1 of 4 - 2009.mxd
Map created by: RCJ, TNC in MN/ND/SD, 2010/2/22

Prairie Forest Border Restoration - 2 of 4

Wabasha County, MN



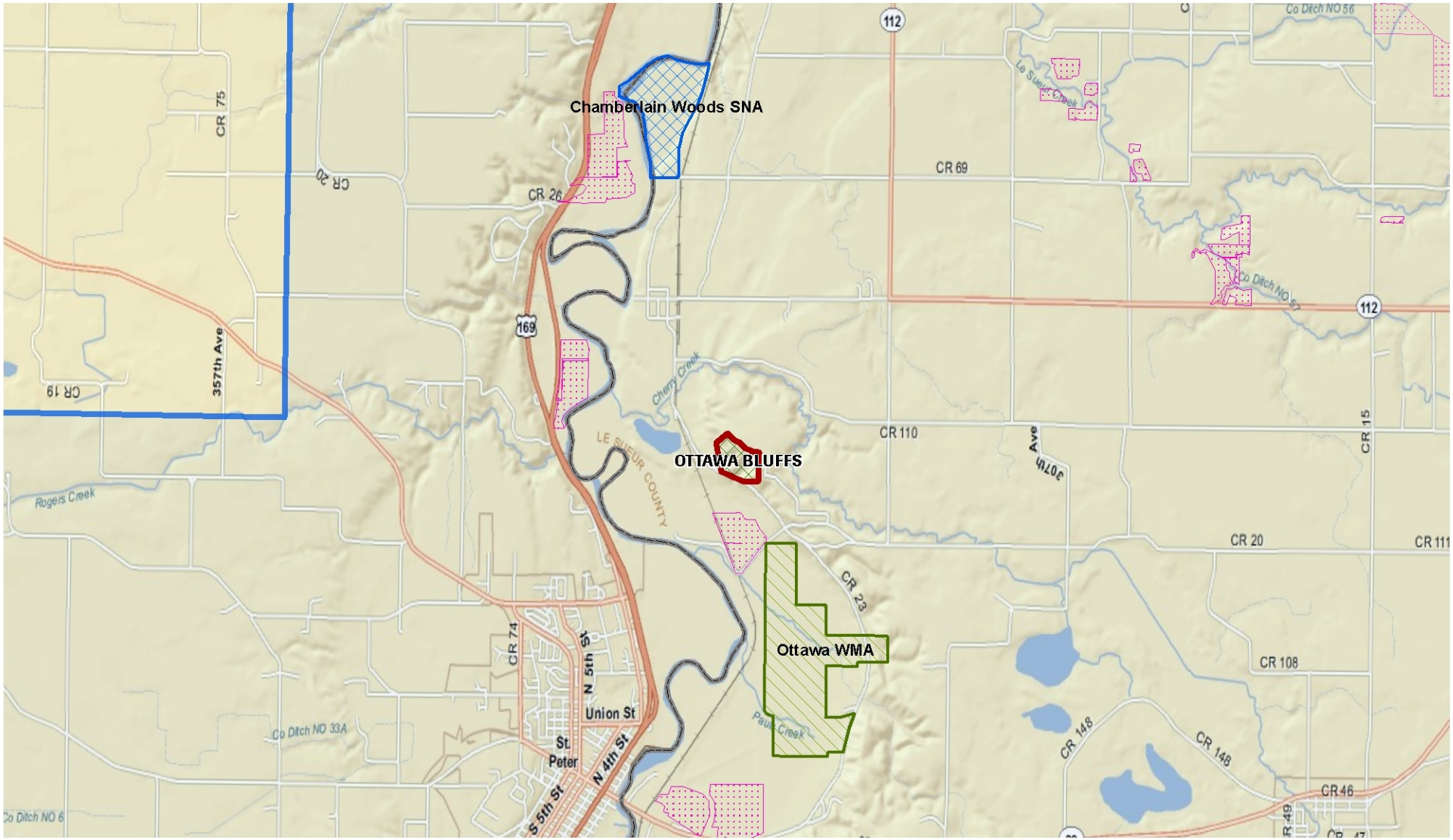
HCP Action Areas
Restoration Project
TNC Preserve - TNC, 2010
Scientific & Natural Area - DNR, 2009
Wildlife Management Area - DNR, 2009
State Forest (Authorized) - DNR
State Forest (Ownership) - DNR
National Wildlife Refuge - FWS, 2008
USFWS Ownership - FWS, 2008

1 0.5 0 1 Miles

M:\mxd\Prairie Forest Border\Grant\LCCMR\
Prairie Forest Border Restoration - 2 of 4 - 2009.mxd
Map created by: RCJ, TNC in MN/ND/SD, 2010/2/22

Prairie Forest Border Restoration - 3 of 4

Le Sueur County, MN



Legend

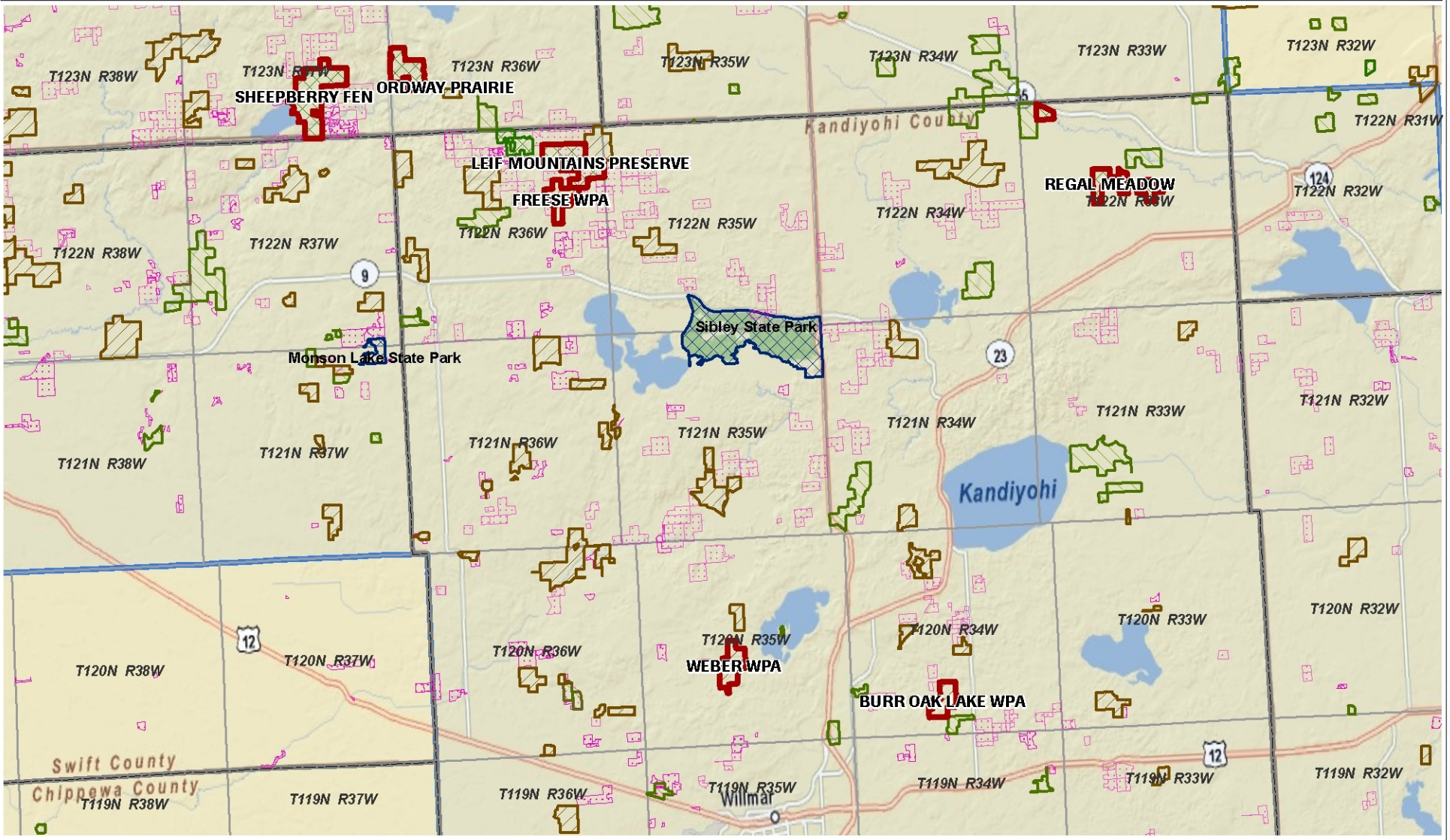
- HCP Action Areas
- Restoration Project
- TNC Preserve - TNC, 2010
- Scientific & Natural Area - DNR, 2009
- Wildlife Management Area - DNR, 2009
- Permanent Conservation Easement

1 0.5 0 1 Miles

M:\mxd\Prairie Forest Border\Grant\LCCMR\
Prairie Forest Border Restoration - 3 of 4 - 2009.mxd
Map created by: RCJ, TNC in MN/ND/SD, 2010/2/22

Prairie Forest Border Restoration - 4 of 4

Kandiyohi & Pope Counties, MN



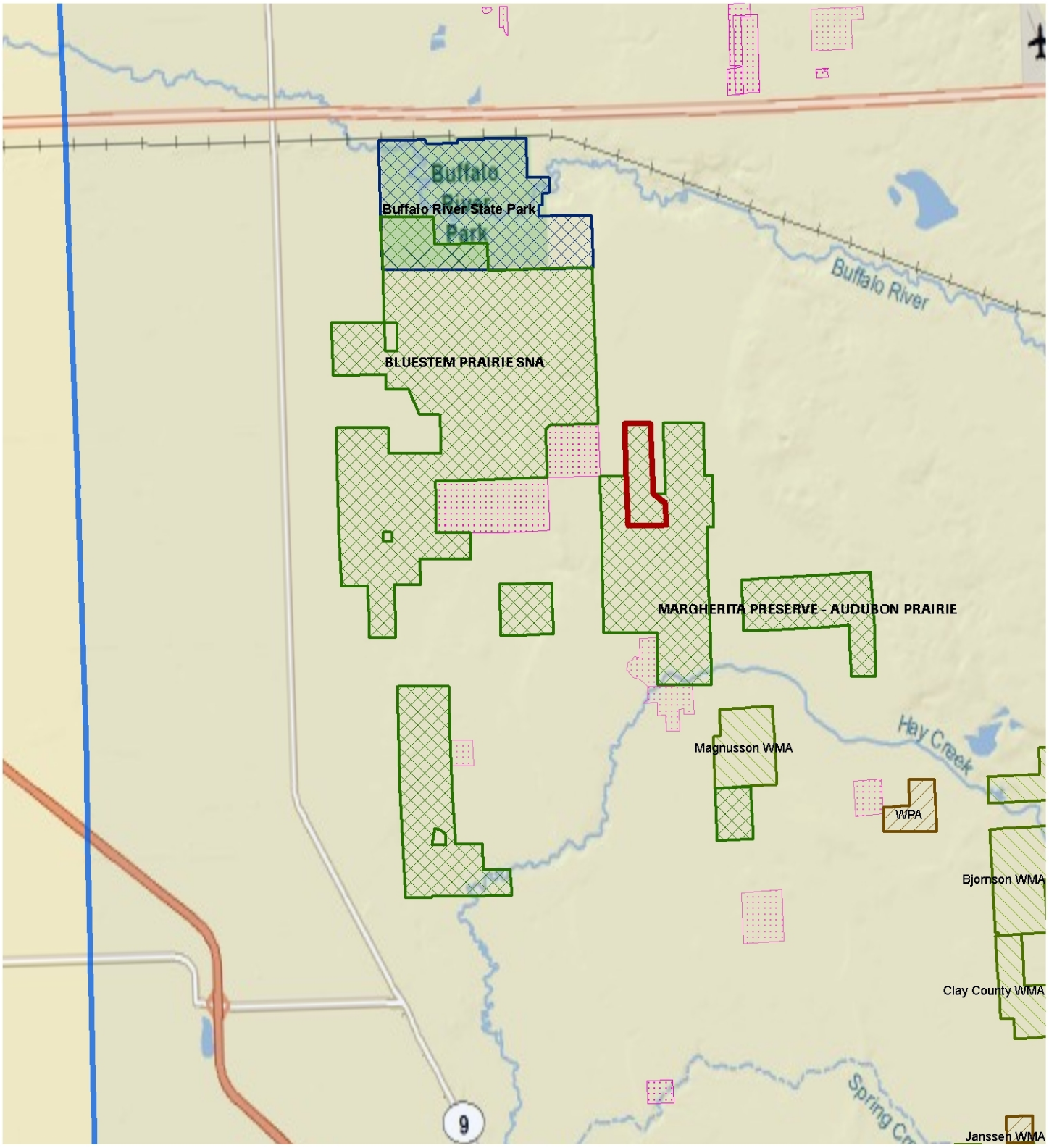
HCP Action Areas
Restoration Project
TNC Preserve - TNC, 2010
State Park - DNR, 2009
Wildlife Management Area - DNR, 2009
USFWS Ownership - FWS, 2008
Permanent Conservation Easement - Various

3 1.5 0 3 Miles

M:\mxd\Prairie Forest Border\Grant\LCCMR\
Prairie Forest Border Restoration - 4 of 4 - 2009.mxd
Map created by: RCJ, TNC in MN/ND/SD, 2010.03.03

Agassiz Beach Ridges Restoration

Clay County, MN - T139N R46W Sec 25



HCP Action Areas
Restoration Project
TNC Preserve - TNC, 2010
State Park - DNR, 2009
Wildlife Management Area - DNR, 2009
USFWS Ownership - FWS, 2008
Permanent Conservation Easement - Various

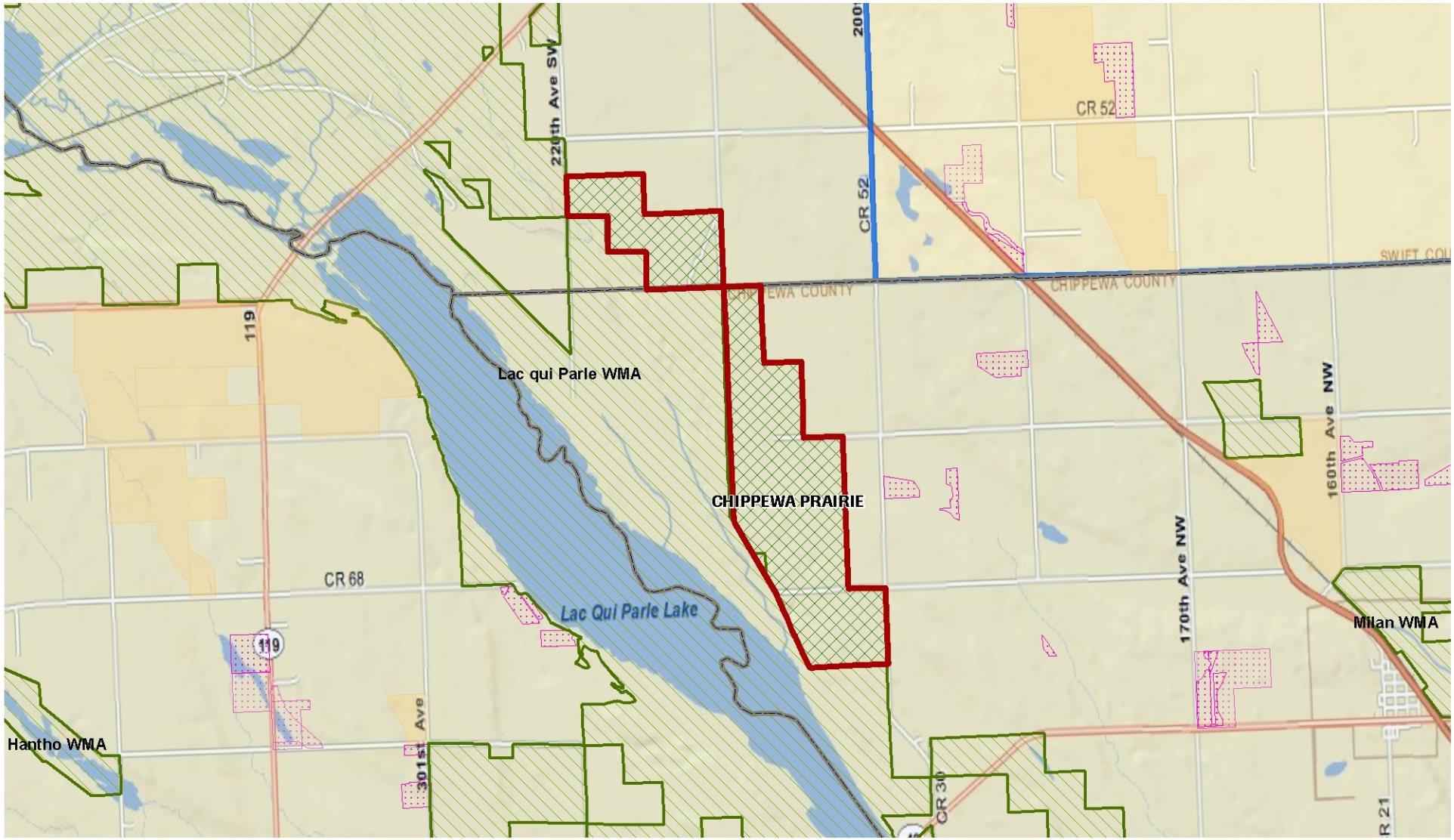
1 0.5 0 1 Miles

N W E S

M:\mxd\Northern Tallgrass Prairie\Bluestem Prairie\Grant\LCCMR\
Bluestem Prairie (Williams) Restoration - 2009.mxd
Map created by: RCJ, TNC in MN/ND/SD, 2010/2/22

Chippewa Prairie Restoration

Chippewa & Swift Counties, MN



Legend

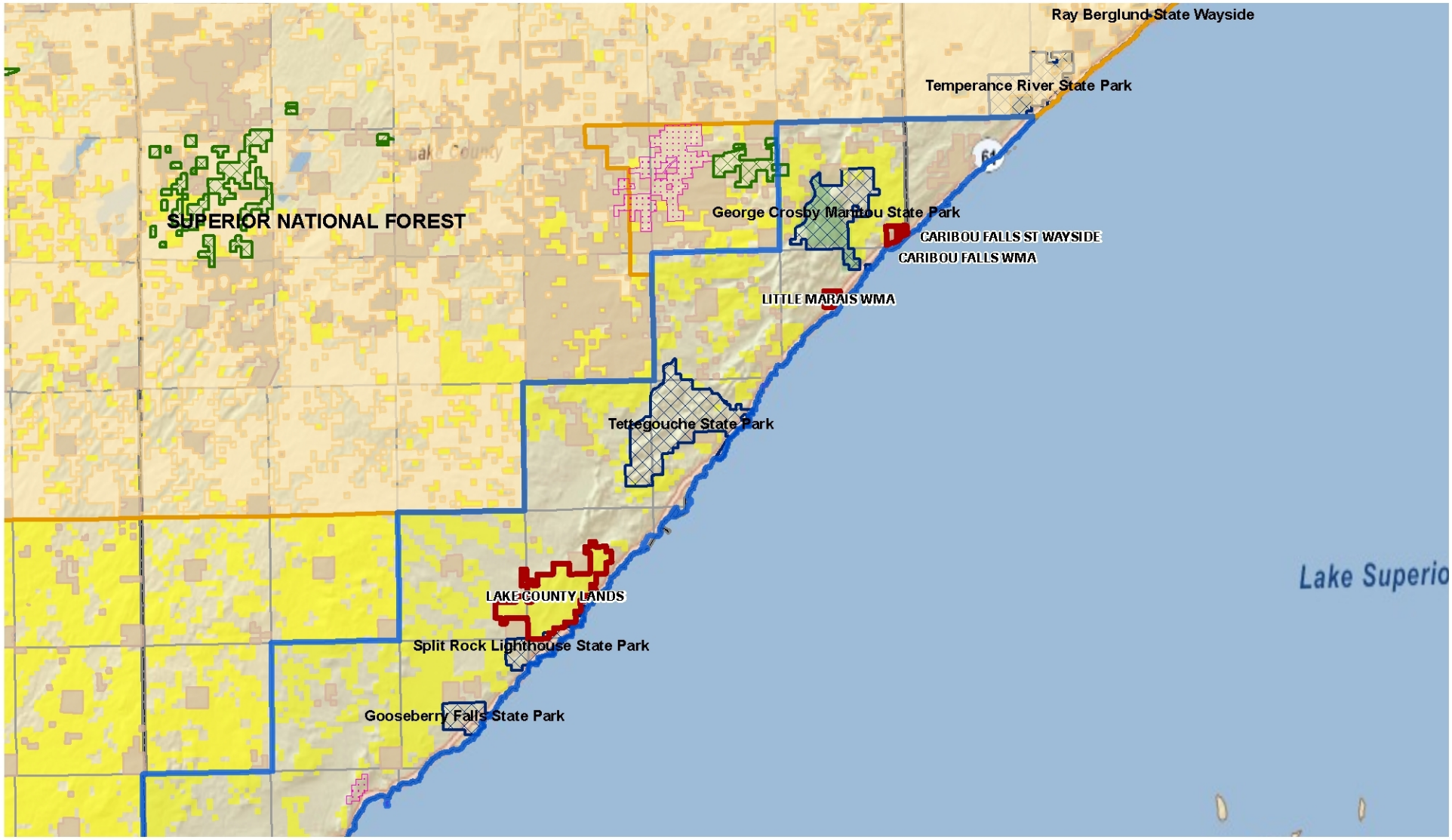
- HCP Action Areas
- Restoration Project
- TNC Preserve - TNC, 2010
- Wildlife Management Area - DNR, 2009
- USFWS Ownership - FWS, 2008
- Permanent Conservation Easement

1 0.5 0 1 Miles

M:\mxd\Prairie Forest Border\Grant\LCCMR\
Chippewa Prairie Restoration - 2009.mxd
Map created by: RCJ, TNC in MN/ND/SD, 2010/2/22

NE Minnesota Forest Restoration

Lake County, MN



HCP Action Areas
Restoration Project
TNC Preserve - TNC, 2010
National Forest (Authorized) - USFS
US Forest Service (Ownership) - DNR
State Park - DNR, 2009
Wildlife Management Area - DNR, 2009
State Forest (Ownership) - DNR
County Ownership - DNR
Permanent Conservation Easement - Various

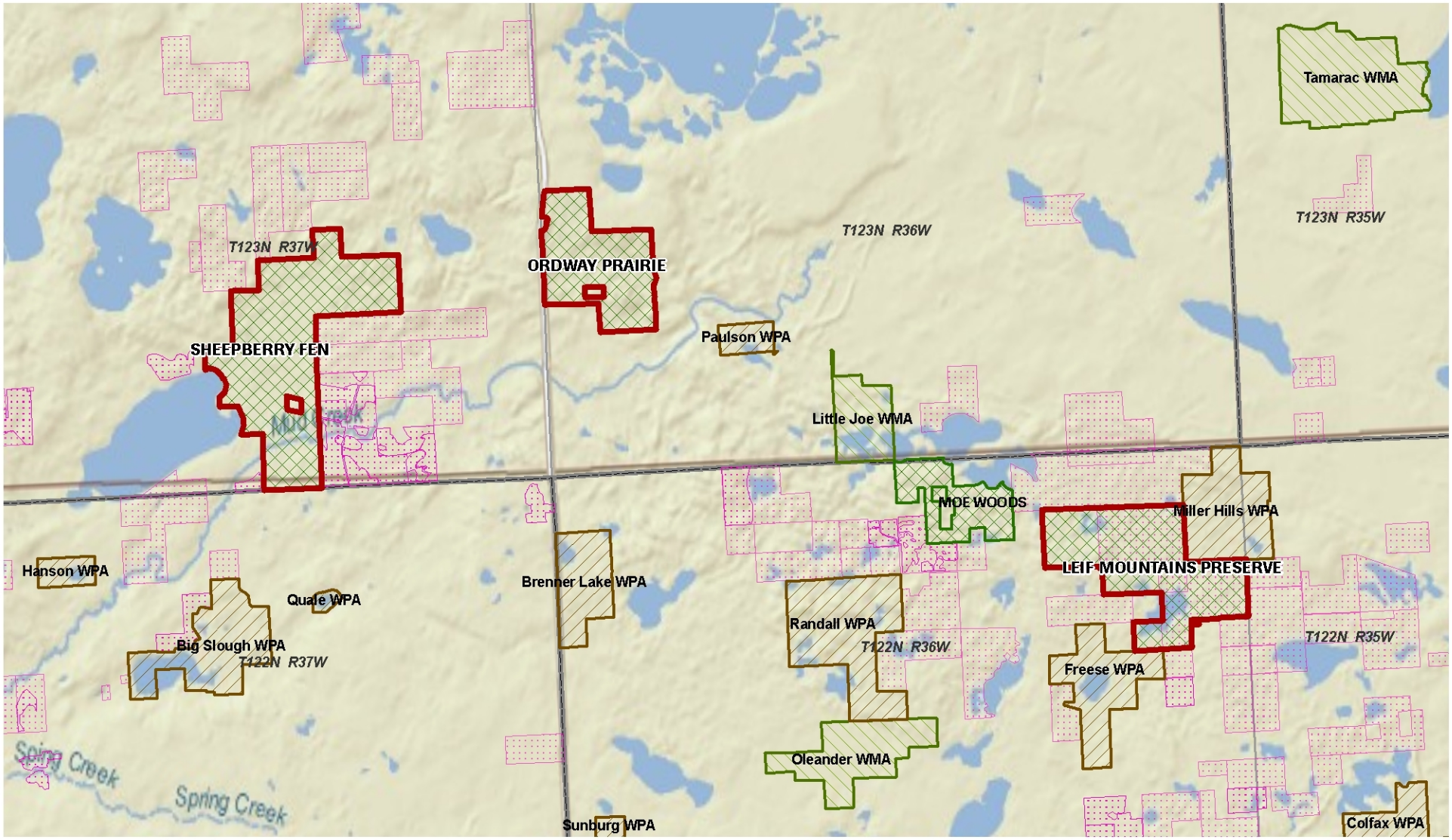
5 2.5 0 5 Miles

M:\mxd\Superior Mixed Forest - Great Lakes\Grants\LCCMR\
NE Minnesota Forest Restoration - 2009.mxd
Map created by: RCJ, TNC in MN/ND/SD, 2010.03.04

N W E S

Ordway - Glacial Lakes Restoration

Kandiyohi & Pope Counties, MN



HCP Action Areas
Restoration Project
TNC Preserve - TNC, 2010
Wildlife Management Area - DNR, 2009
USFWS Ownership - FWS, 2008
Permanent Conservation Easement - Various

1 0.5 0 1 Miles

N W E S

M:\mxd\Prairie Forest Border\Ordway - Glacial Lakes\Grant\LCCMR \Ordway-Glacial Lakes Restoration - 2009.mxd
Map created by: RCJ, TNC in MN/ND/SD, 2010.02.22

2008 Project Abstract
For the Period Ending June 30, 2010

Project Title:
Project Manager: Greg Hoch
Affiliation: Friends of the Detroit Lakes Wetland Management District
Mailing Address: 26624 N Tower Rd
City/State/Zip: Detroit Lakes MN 56501
Phone: 218-844-3400
Fax: 218-847-4156
E-mail: hoch@cord.edu
Funding Source: Environment and Natural Resources Trust Fund

Appropriations Amount: $20,000

Overall Project Outcomes and Results

The goal of this project was to restore wetlands on Waterfowl Production Areas (WPAs). This is part of a larger strategy to restore all wetlands (~390) on WPAs in four years in the Detroit Lakes Wetland Management District. This project restored 35 Type I wetlands totaling 16 acres on Vesledahl WPA. USFWS staff delineated and flagged the wetlands and adjacent ditches. A private contractor, Strom Construction, used heavy equipment to remove silt/sediment from the wetland basin. This sediment was then used to fill in the length of the ditch and smooth the surrounding soil. Many wetland restorations are completed by simply placing a ditch plug in the ditch. By removing the sediment we increased the volume and water-holding capacity of the wetland as well as revealed the seed bank buried under the silt. By completely filling in the ditches we hope to restore the original hydrology of the site and the larger landscape. In March 2010, USFWS staff will reseed the areas of disturbed or exposed soil with locally collected forb and grass seed. The results include more habitat for waterfowl and shorebirds, as well as increased water holding capacity in the flood-prone Red River Valley.

Project Results Use and Dissemination

While not directly addressing the restoration results on this property, staff and volunteers from the Detroit Lakes WMD frequently give tours to community groups and occasionally Congressional delegations. This site will be included in future tours and the cooperative effort between state and Federal funding. One of the best uses of this results was matching these dollars through a Federal NAWCA grant to conduct wetland restorations on nearby WPAs, doubling the work under this grant.

LCCMR Work Program Final Report

Restoring Minnesota's Fish and Wildlife Habitat Corridors Phase 5
Habitat Conservation Partnership

2O:Working Lands Partnership - Friends of the Detroit Lakes Wetland Managment Dis

Project Manager: Greg Hoch

Affiliation: Friends of the Detroit Lakes Wetland Managment Dis

Address: 24426 N Tower Rd

Detroit Lakes, MN 56501

Phone: 218-443-0476

Fax: 218-8474156

E-mail: hoch@cord.edu

Fund: Environment and Natural Resources Trust Fund

Legal Citation: ML 2008 First Special Section, Ch. 367, Sec. 2 Subd. 3(c).

Total Biennial Project Budget

Result	ENTF Allocation	ENTF Funds Spent	ENTF Balance	Other Funds Proposed	Other Funds Spent
Restoration	$20,000	$19,849	$151	$20,000	$0
Total	$20,000	$19,849	$151	$20,000	$0

Work Program Summary

Overall Project Outcome and Results

The goal of this project was to restore wetlands on Waterfowl Production Areas (WPAs). This is part of a larger strategy to restore all wetlands (~390) on WPAs in four years in the Detroit Lakes Wetland Management District. This project restored 35 Type I wetlands totaling 16 acres on Vesledahl WPA. USFWS staff delineated and flagged the wetlands and adjacent ditches. A private contractor, Strom Construction, used heavy equipment to remove silt/sediment from the wetland basin. This sediment was then used to fill in the length of the ditch and smooth the surrounding soil. Many wetland restorations are completed by simply placing a ditch plug in the ditch. By removing the sediment we increased the volume and water-holding capacity of the wetland as well as revealed the seed bank buried under the silt. By completely filling in the ditches we hope to restore the original hydrology of the site and the larger landscape. In March 2010, USFWS staff will reseed the areas of disturbed or exposed soil with locally collected forb and grass seed. The results include more habitat for waterfowl and shorebirds, as well as increased water holding capacity in the flood-prone Red River Valley.

Project Results Use and Dissemination

While not directly addressing the restoration results on this property, staff and volunteers from the Detroit Lakes WMD frequently give tours to community groups and occasionally Congressional delegations. This site will be included in future tours and the cooperative effort between state and Federal funding. One of the best uses of this results was matching these dollars through a Federal NAWCA grant to conduct wetland restorations on nearby WPAs, doubling the work under this grant.

LCCMR Work Program Final Report

Restoring Minnesota's Fish and Wildlife Habitat Corridors Phase 5
Habitat Conservation Partnership

2O:Working Lands Partnership - Friends of the Detroit Lakes Wetland Managment Dis

Restoration Activities

Project Area - 1 - Aspen Parklands

Project Name: Vesledahl Section WPA
Township: 147, Range: 43, Section: 24

Activity: Wetland Restoration
Landtype: Public - WPA
Description: Project restored 35 prairie pothole wetland basins (totaling 16 acres) on Vesledahl Waterfowl Production Area. We removed sediment from the wetland to increase water holding capacity and used the sediment to fill in the complete length of the ditch. This helps to restore the hydrology and function of the system.

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Restoration	$4,804.51	3.87	0.00
ENTF	Restoration	$5,107.96	4.12	0.00
ENTF	Restoration	$4,938.46	3.98	0.00
ENTF	Restoration	$4,998.21	4.03	0.00
Vesledahl Section WPA Total		**$19,849.14**	**16.00**	**0.00**

Restoration Project Totals (By Funding Type)

Funding Type	Funding Amount	Acres	Shoreline Feet
ENTF:	$19,849.14	16.00	0.00
Total:	**$19,849.14**	**16.00**	**0.00**

Attachment A: Budget Detail for 2008 Projects - Summary and a Budget page for each partner					
Project Title: *Working Lands Partnership II*					
	Minnesota's Habitat Conservation Partnership (V)				
Project Manager Name: *Greg Hoch/Scott Kahan*					
Trust Fund Appropriation: $ *20,000*					
1) See list of non-eligible expenses, do not include any of these items in your budget sheet					
2) Remove any budget item lines not applicable					
2008 Trust Fund Budget	**Result 1 Budget:**	**Amount Spent** *(date)*	**Balance** *(date)*	**TOTAL BUDGET**	**TOTAL BALANCE**
BUDGET ITEM					
Other contracts/Construction (contracted wetland restoration under USFWS IDIQ construction contract)- Contracted hours of excavator, D4, and D6 Dozer	**$20,000**				
Contract with Strom Construction for sediment removal, using sediment to fill in ditch, and leveling soil in ditch		**$19,849**			
COLUMN TOTAL	**$20,000**	**$19,849**	**$151**	**$20,000**	**$151**

2008 Project Abstract
For the Period Ending June 30, 2010

PROJECT TITLE: 2p Bluffland Restoration
PROJECT MANAGER: Dave Neu
AFFILIATION: National Wild Turkey Federation
MAILING ADDRESS: PO Box 83
CITY/STATE/ZIP: De Pere, WI 54115
PHONE: (920) 427-2335
E-MAIL: dneu@nwtf.net
WEBSITE: www.nwtf.org
FUNDING SOURCE: Environment and Natural Resources Trust Fund
LEGAL CITATION: ML 2008 First Special Section, Ch. 367, Sec. 2 Subd. 3(c).

APPROPRIATION AMOUNT: $70,000

Overall Project Outcome and Results

The Southeastern Minnesota bluffland is one of the 11 HCP project areas. The bluffland corridor runs along the Mississippi River across three counties, Wabasha, Winona, and Houston. Minnesota's Comprehensive Wildlife Conservation Strategy (Strategy for Tomorrow's Habitat for the Wild and Rare) identifies the Bluffland subsection of southeastern MN as having the highest percentage of species of greatest conservation need, particularly reptiles, with 11 of 15 species considered in great conservation need. This strategy further identifies bluff prairies and oak savannas as two of the most rare habitats remaining across Minnesota. The Timber rattlesnake is a state threatened species occurring exclusively in the southeastern Minnesota counties of Goodhue, Fillmore, Houston, Olmsted, Wabasha, and Winona. Since rattlesnake dens are central to their lives, protecting dens and enhancing surrounding habitat is critical to conserving this species. This project implemented habitat restoration activities directed at reducing the amount of canopy cover to 30% or less around the den sites by controlling invasive plant species such as Eastern red cedar, buckthorn, honeysuckle, and prickly ash. A multiple treatment approach was utilized that included hand cutting of red cedars and invasive brush species, prescribed burns, and exotic species control. Three sites were treated, for a total of 43.5 acres restored.

This project complimented the existing Landowner Incentive Program (LIP) Blufflands Landscape project. Approximately 60 acres of habitat were restored utilizing LIP funding. LIP assists eligible, private landowners, who wish to voluntarily manage their land to benefit listed species, with the development of habitat management plans and financial assistance for habitat enhancement and restoration. Through this project one of the most critical habitats in Minnesota was conserved and enhanced. The project focused on the population sustainability of the timber rattlesnake (C. horridus), three other at-risk snake species (racer, bullsnake, and hognose snake) and other numerous at-risk plant species in the Bluffland subsection of southeastern MN.

This project helped to take a more holistic restoration management approach to treating the entire bluff; thereby, safeguarding the long-term integrity of the work. Restoring cliff and bluffland habitats will positively impact habitat for the state listed timber rattlesnake. Maintaining viable populations of the species in the wild allows in-situ scientific research and enhances our

knowledge of the contributions the animal makes to the bluff prairie– forest ecosystems. This project is of great regional significance and has the potential for replication throughout the blufflands region.

Site selection and measurement was done by DNR personnel, based on known timber rattlesnake denning sites, and adjacent turkey habitat. NWTF worked with the contractors on site during the project, and performed follow-up site inspections.

Project Results Use and Dissemination

Accomplishment Reports and press releases will be made available at http://www.mnhabitatcorridors.org, as well as through NWTF publications.

LCCMR Work Program Final Report

Restoring Minnesota's Fish and Wildlife Habitat Corridors Phase 5
Habitat Conservation Partnership

2P:Bluffland Restoration - National Wild Turkey Federation

Project Manager: Dave Neu

Affiliation: National Wild Turkey Federation

Address: 265 Lorrie Way
De Pere, WI 54115

Phone: (920)347-0312

Fax: (920)427-2335

E-mail: neunwtf@sbcglobal.net

Fund: Environment and Natural Resources Trust Fund

Legal Citation: ML 2008 First Special Section, Ch. 367, Sec. 2 Subd. 3(c).

Total Biennial Project Budget

Result	ENTF Allocation	ENTF Funds Spent	ENTF Balance	Other Funds Proposed	Other Funds Spent
Restoration	$70,000	$70,000	$0	$55,000	$0
Total	$70,000	$70,000	$0	$55,000	$0

Work Program Summary

Overall Project Outcome and Results

The Southeastern Minnesota bluffland is one of the 11 HCP project areas. The bluffland corridor runs along the Mississippi River across three counties, Wabasha, Winona, and Houston. Minnesota's Comprehensive Wildlife Conservation Strategy (Strategy for Tomorrow's Habitat for the Wild and Rare) identifies the Bluffland subsection of southeastern MN as having the highest percentage of species of greatest conservation need, particularly reptiles, with 11 of 15 species considered in great conservation need. This strategy further identifies bluff prairies and oak savannas as two of the most rare habitats remaining across Minnesota.

The Timber rattlesnake is a state threatened species occurring exclusively in the southeastern Minnesota counties of Goodhue, Fillmore, Houston, Olmsted, Wabasha, and Winona. Since rattlesnake dens are central to their lives, protecting dens and enhancing surrounding habitat is critical to conserving this species. This project implemented habitat restoration activities directed at reducing the amount of canopy cover to 30% or less around the den sites by controlling invasive plant species such as Eastern red cedar, buckthorn, honeysuckle, and prickly ash. A multiple treatment approach was utilized that included hand cutting of red cedars and invasive brush species, prescribed burns, and exotic species control. Three sites were treated, for a total of 43.5 acres restored.

This project complimented the existing Landowner Incentive Program (LIP) Blufflands Landscape project. Approximately 60 acres of habitat were restored utilizing LIP funding. LIP assists eligible, private landowners, who wish to voluntarily manage their land to benefit listed species, with the development of habitat management plans and financial assistance for habitat enhancement and restoration. Through this project one of the most critical habitats in Minnesota was conserved and enhanced. The project focused on the population sustainability of the timber rattlesnake (C. horridus), three other at-risk snake species (racer, bullsnake, and hognose snake) and other numerous at-risk plant species in the Bluffland subsection of southeastern MN.

This project helped to take a more holistic restoration management approach to treating the entire bluff; thereby, safeguarding the long-term integrity of the work. Restoring cliff and bluffland habitats will positively impact habitat for the state listed timber rattlesnake. Maintaining viable populations of the species in the wild allows in-situ scientific research and enhances our knowledge of the contributions the animal makes to the bluff prairie– forest ecosystems. This project is of great regional significance and has the potential for replication throughout the blufflands region.

Site selection and measurement was done by DNR personnel, based on known timber rattlesnake denning sites, and adjacent turkey habitat. NWTF worked with the contractors on site during the project, and performed follow-up site inspections.

Project Results Use and Dissemination

Accomplishment Reports and press releases will be made available at http://www.mnhabitatcorridors.org, as well as through NWTF publications.

LCCMR Work Program Final Report

Restoring Minnesota's Fish and Wildlife Habitat Corridors Phase 5
Habitat Conservation Partnership

2P:Bluffland Restoration - National Wild Turkey Federation

Restoration Activities

Project Area - 11 - Mississippi Bluff Lands

Project Name: Ken Visger property
Tract: 1
Township: 104, Range: 5, Section: 25

Activity: Grassland Enhancement
Landtype: Private - Land
Description: Two sites were restored on this property by removing red cedar and other invasive species. This improves the site for timber rattlesnakes, wild turkeys and other wildlife species by opening up the canopy over the "goat prairie" habitat, allowing it to rejuevnate.

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Restoration	$36,700.00	29.50	0.00

Project Name: Gray/Breitenbach property
Tract: 1
Township: 102, Range: 7, Section: 7

Activity: Grassland Enhancement
Landtype: Private - Land
Description: Work was completed in the winter of 2009-10 after being partially completed in early 2009.

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Restoration	$23,750.00	12.50	0.00

Project Name: Laschenski
Tract: 1
Township: 103, Range: 7, Section: 35

Activity: Grassland Enhancement
Landtype: Private - Land
Description: Restored 1.65 acres of bluff prairie by removing red cedar and other invasive species.

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Prorated Shoreline*
ENTF	Restoration	$2,550.00	1.50	0.00

Restoration Project Totals (By Funding Type)

Funding Type	Funding Amount	Acres	Shoreline Feet
ENTF:	$63,000.00	43.50	0.00
Total:	**$63,000.00**	**43.50**	**0.00**

LCCMR Work Program Final Report

Restoring Minnesota's Fish and Wildlife Habitat Corridors Phase 5
Habitat Conservation Partnership

2P:Bluffland Restoration - National Wild Turkey Federation

Work Program Expenditures - Not Attributable to Specific Projects

FundingType	*Category*	*Amount*	*Description*
ENTF	Personnel Expenditures	$7,000.00	Hours and expenses for NWTF Regional Wildlife Biologist
	Total:	**$7,000.00**	

Work Program Expenditures (Not Attributable to Specific Projects) By Funding Type

Funding Type	Amount
ENTF	$7,000.00
Total	**$7,000.00**

Work Program Expenditures Breakdown

Funding Type:	Restoration Projects	Not Attributable to Specific Projects	Total
ENTF	$63,000.00	$7,000.00	$70,000.00
State Funds	$0.00	$0.00	$0.00
Total	$63,000.00	$7,000.00	$70,000.00

Funding Type Definitions

ENTF:	Grant dollars provided through the Minnesota Environment and Natural Resources Trust Fund
Other Funds:	Non-state, non-state leveraged dollars (if partner funds are leveraging State Funds (e.g. RIM) they are not eligible to be considered Other Funds)
State Funds:	State Funds expended on HCP projects (not eligible for use as Other Funds commitment)
Partner's State Leveraged Funds:	Non State Funds that have leveraged State Funds as part of an HCP project (not eligible for use as Other Funds commitment)
Other:	Any other expenditures (e.g. grant income funds)

Attachment A: Budget Detail for 2008 Projects - **Summary and a Budget page for each partner**

Project Title: *Bluffland Restorartion*

Minnesota's Habitat Conservation Partnership (V)

Project Manager Name: *Dave Neu - NWTF Senior Regional Biologist*

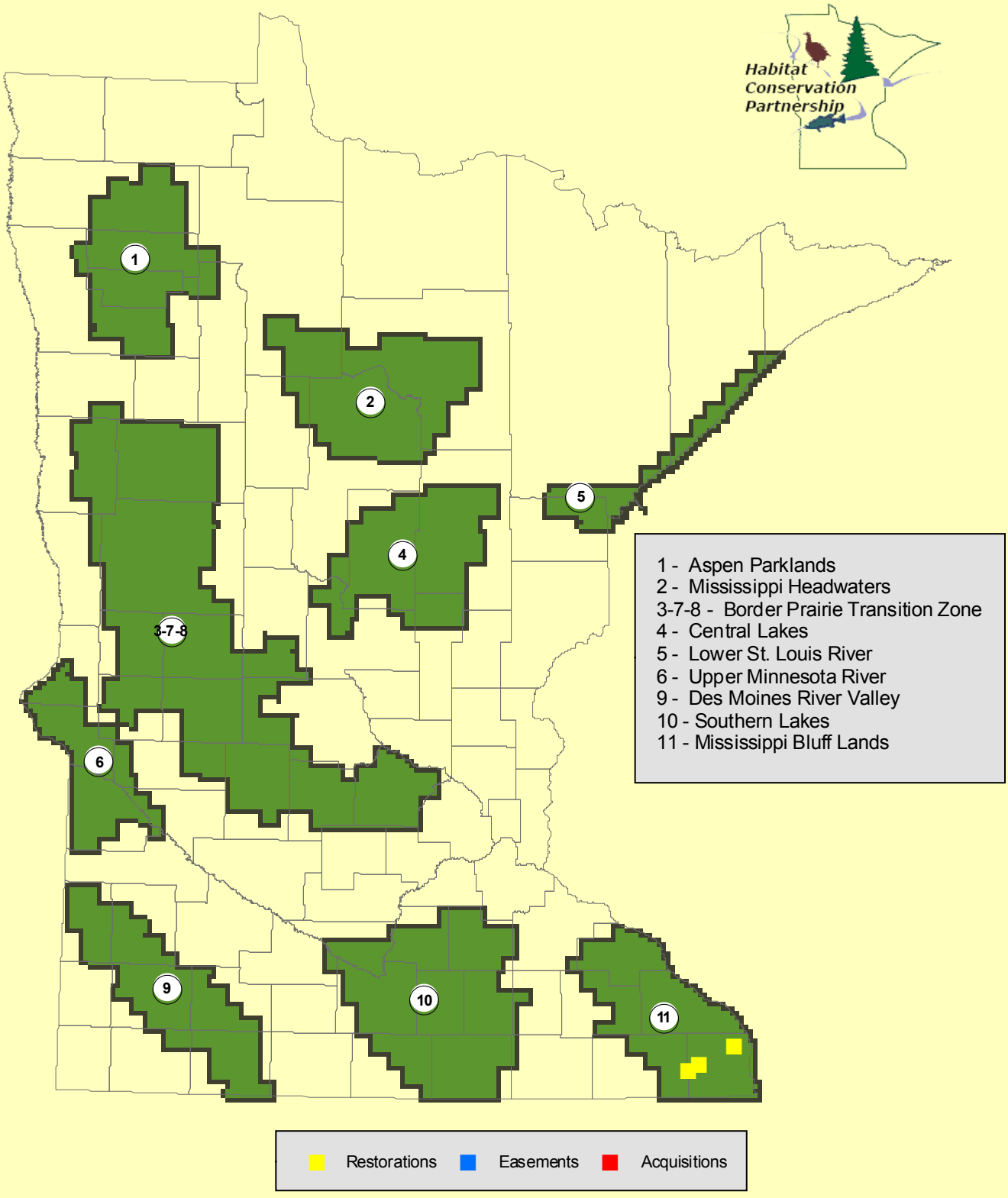
Trust Fund Appropriation: $ *70,000*

1) See list of non-eligible expenses, do not include any of these items in your budget sheet

2) Remove any budget item lines not applicable

2008 Trust Fund Budget	**Result 1 Budget:**	**Amount Spent** *(date)*	**Balance** *(date)*	**Result 2 Budget:**	**Amount Spent** *(date)*	**Balance** *(date)*	**Result 3 Budget:**	**Amount Spent** *(date)*	**Balance** *(date)*	**TOTAL BUDGET**	**TOTAL BALANCE**
	Restore 120 acres of Bluffland habitat			*Fill in your result title here.*			*Fill in your result title here.*				
BUDGET ITEM			0			0			0		0
PERSONNEL: wages and benefits	7,000	7,000	7,000			0			0	7,000	0
Contracts			0			0			0	0	0
Professional/technical *(with whom?, for what?)*	63,000	63,000	0			0			0	63,000	0
COLUMN TOTAL	**$70,000**	**$70,000**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$70,000**	**$0**

Habitat Conservation Partnership
Bluffland Restoration
2P



Attachment A: Budget Detail for 2008 Projects - Summary and a Budget page for each partner

Project Title: *Bluffland Restorartion*

Minnesota's Habitat Conservation Partnership (V)

Project Manager Name: *Dave Neu - NWTF Senior Regional Biologist*

Trust Fund Appropriation: $ *70,000*

1) See list of non-eligible expenses, do not include any of these items in your budget sheet

2) Remove any budget item lines not applicable

2008 Trust Fund Budget	**Result 1 Budget:**	**Amount Spent** *(date)*	**Balance** *(date)*	**Result 2 Budget:**	**Amount Spent** *(date)*	**Balance** *(date)*	**Result 3 Budget:**	**Amount Spent** *(date)*	**Balance** *(date)*	**TOTAL BUDGET**	**TOTAL BALANCE**
	Restore 120 acres of Bluffland habitat			*Fill in your result title here.*			*Fill in your result title here.*				
BUDGET ITEM			0			0			0		0
PERSONNEL: wages and benefits	7,000	7,000	7,000			0			0	7,000	0
Contracts			0			0			0	0	0
Chimney Rock Forestry, LLC, and Driftless Land Stewardship, LLC for removal of red cedar and other invasive species.	63,000	63,000	0			0			0	63,000	0
COLUMN TOTAL	**$70,000**	**$70,000**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$70,000**	**$0**

2008 Project Abstract
For the Period Ending June 30, 2010

TITLE:	Habitat Conservation Partnership (HCP) – Phase V Shorelands Protection Program – 3A
PROJECT MANAGER:	Sarah Strommen
ORGANIZATION:	Minnesota Land Trust
ADDRESS:	2356 University Avenue West, Suite 240 St. Paul, MN 55114
WEB SITE ADDRESS:	www.mnland.org
FUND:	Environmental and Natural Resources Trust Fund
LEGAL CITATION:	Minnesota Laws 2008, Chapter 367, Section 2, Subdivision 3(c)

APPROPRIATION AMOUNT: $210,000

OVERALL PROJECT OUTCOME AND RESULTS

In the fifth phase of our Shorelands Protection project, the Minnesota Land Trust continued to work with landowners to secure permanent conservation easements on quality habitat along or containing critical riparian lands. We initiated or continued contact with 61 landowners and completed seven conservation easements. Collectively, these easements preserve 833 acres of land—exceeding our original goal of 300 to 500 acres—and protect nearly 22,000 feet of fragile shoreline. Although we had originally planned for some bargain purchase of easements, we were able to acquire all seven conservation easements through donation.

All seven projects met the following selection criteria:

1. Habitat: quality and quantity of existing habitat on site; protects riparian areas and buffers water resources
2. Context: proximity and relationship to other protected lands
3. Opportunity: cost-benefit ratio: which landowners will participate now
4. Other Benefits: meeting multiple objectives, including visual and physical access, forestry goals, water quality, etc.

Additionally, the Land Trust prepared baseline property reports for each easement, detailing the condition of the property for future monitoring and enforcement. To fund this required perpetual obligation, the Land Trust dedicated funds to its segregated Stewardship and Enforcement Fund for several completed projects. For these projects, we estimated the anticipated annual expenses of each project and the investment needed to generate annual income sufficient to cover these expenses in perpetuity – all in accordance with our internal policies and procedures as approved by LCCMR. We will report to LCCMR annually on the status of the Stewardship and Enforcement Fund and the easements acquired with funds from this grant.

The value is known for only two of the easements. This value, all of which is donated value, is $399,000. The cost to the State of Minnesota to complete the seven projects completed under this phase of the grant was just over $250 per acre.

Cumulatively, across all phases of the HCP program, the Land Trust has protected 6,895 acres of critical habitat and more than 200,000 feet of shoreline, at a cost to the State of $276 per acre.

The Land Trust's work on this project demonstrates the continued cost effectiveness of working with conservation easements to protect natural and scenic resources along Minnesota's lakes, rivers, and streams, as the cost to the State was well below the cost to purchase land along our increasingly threatened shorelines. This grant continued to generate interest among landowners, and therefore, ongoing funding will be important to sustained success. Additionally, while we were successful in

securing donated easements during this phase, we continue to believe that funds to purchase easements will be necessary in the future.

PROJECT RESULTS USE AND DISSEMINATION

The Land Trust continued to gain more experience with conservation easements, easement management, and issues unique to protecting shoreland. This experience and information was shared with our partner organizations, other easement holders, local communities, as well as policy makers. The Land Trust also disseminated information about the specific land protection projects completed under this grant though our newsletter, annual report, web site, and press releases.

LCCMR Work Program Final Report

Restoring Minnesota's Fish and Wildlife Habitat Corridors Phase 5
Habitat Conservation Partnership

3A: Shorelands Protection Program - Minnesota Land Trust

Project Manager: Sarah Strommen

Affiliation: Minnesota Land Trust

Address: 2356 University Avenue West

St. Paul, MN 55114

Phone: 651-647-9590

Fax: 651-647-9769

E-mail: sstrommen@mnland.org

Fund: Environment and Natural Resources Trust Fund

Legal Citation: ML 2008 First Special Section, Ch. 367, Sec. 2 Subd. 3(c).

Total Biennial Project Budget

Result	ENTF Balance	ENTF Funds Spent	ENTF Balance	Other Funds Proposed	Other Funds Spent
Easement	$210,000	$210,000	$0	$300,000	$414,000
Total	$210,000	$210,000	$0	$300,000	$414,000

Work Program Summary

Overall Project Outcome and Results

In the fifth phase of our Shorelands Protection project, the Minnesota Land Trust continued to work with landowners to secure permanent conservation easements on quality habitat along or containing critical riparian lands. We initiated or continued contact with 61 landowners and completed seven conservation easements. Collectively, these easements preserve 833 acres of land—exceeding our original goal of 300 to 500 acres—and protect nearly 22,000 feet of fragile shoreline. Although we had originally planned for some bargain purchase of easements, we were able to acquire all seven conservation easements through donation.

All seven projects met the following selection criteria:
1. Habitat: quality and quantity of existing habitat on site; protects riparian areas and buffers water resources
2. Context: proximity and relationship to other protected lands
3. Opportunity: cost-benefit ratio: which landowners will participate now
4. Other Benefits: meeting multiple objectives, including visual and physical access, forestry goals, water quality, etc.

Additionally, the Land Trust prepared baseline property reports for each easement, detailing the condition of the property for future monitoring and enforcement. To fund this required perpetual obligation, the Land Trust dedicated funds to its segregated Stewardship and Enforcement Fund for several completed projects. For these projects, we estimated the anticipated annual expenses of each project and the investment needed to generate annual income sufficient to cover these expenses in perpetuity – all in accordance with our internal policies and procedures as approved by LCCMR. We will report to LCCMR annually on the status of the Stewardship and Enforcement Fund and the easements acquired with funds from this grant.

The value is known for only two of the easements. This value, all of which is donated value, is $399,000. The cost to the State of Minnesota to complete the seven projects completed under this phase of the grant was just over $250 per acre.

Cumulatively, across all phases of the HCP program, the Land Trust has protected 6,895 acres of critical habitat and more than 200,000 feet of shoreline, at a cost to the State of $276 per acre.

The Land Trust's work on this project demonstrates the continued cost effectiveness of working with conservation easements to protect natural and scenic resources along Minnesota's lakes, rivers, and streams, as the cost to the State was well below the cost to purchase land along our increasingly threatened shorelines. This grant continued to generate interest among landowners, and therefore, ongoing funding will be important to sustained success. Additionally, while we were successful in securing donated easements during this phase, we continue to believe that funds to purchase easements will be necessary in

3A: Shorelands Protection Program - Minnesota Land Trust

the future.

Project Results Use and Dissemination

The Land Trust continued to gain more experience with conservation easements, easement management, and issues unique to protecting shoreland. This experience and information was shared with our partner organizations, other easement holders, local communities, as well as policy makers. The Land Trust also disseminated information about the specific land protection projects completed under this grant though our newsletter, annual report, web site, and press releases.

3A: Shorelands Protection Program - Minnesota Land Trust

Easement Activities

Project Name: Koronis Hills
Tract: Liestman-Ellis 2
Project Area: 1 - Aspen Parklands
Township: 122, Range: 32, Section: 20

Description: The property is located southwest of Paynesville, MN along Highway 23 and lies in the immediate watershed of Lake Koronis, a general development lake. It is adjacent to the Koronis Hills Golf Club, a portion of which also is protected by a conservation easement held by the Minnesota Land Trust. The property also is an important component of a larger complex of wildlife habitat in this area and lies within a five mile radius of six state Wildlife Management Areas and three Wildlife Protection Areas. The 67 acres protected through this project also are adjacent to approximately 140 acres of land previously protected by the landowner.

The conservation easement will protect the conservation features of this property by limiting buildings and structures and prohibiting activities inconsistent with preserving conservation values.

The value of this easement is unknown.

Easement Recorded in LCCMR office: Yes

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Grassland Acres*	*Woodland Acres*	*Wetland Acres*	*Shoreline Feet*	*Riparian Feet*
ENTF	Stewardship	$12,000.00	67.00	1.00	42.00	23.00	2,847.00	0.00

LCCMR Work Program Final Report

Restoring Minnesota's Fish and Wildlife Habitat Corridors Phase 5
Habitat Conservation Partnership

3A: Shorelands Protection Program - Minnesota Land Trust

Project Name: Buzzle Lake
Tract: Kittel
Project Area: 2 - Mississippi Headwaters
Township: 148, Range: 35, Section: 20

Description: The property is located approximately 20 miles northwest of Bemidji, Minnesota, on the west side of Buzzle Lake, a deep lake of 189 acres, known for its water clarity and steep drop offs. The natural attributes of the property include its forests, grasslands, wetlands and shorelines, which help support diverse wildlife in the Clearwater River watershed. Wildlife includes great gray owls, yellow rails, common loons, red-shouldered hawks, black-backed woodpeckers, ospreys, bald eagles, gray wolves, and red-necked grebes, all of which are designated as species in greatest conservation need.

The conservation easement will protect these conservation features by prohibiting subdivision of the property and limiting expansion of existing buildings and structures.

The value of this easement is unknown.

This project was initiated during Phase 3 (2005) of the HCP grant. At that time it was located within the boundaries of project area 2. Due to family and title issues, we were not able to complete this project until Phase 5 (2008). The Phase 5 boundaries for Area 2 are smaller than they were in 2005, and this project now lies approximately 4 miles outside of the current corridor boundary. Buzzle Lake has been on our approved project list continuously since its initiation in Phase 3 through its completion in Phase 5. Therefore, this project was included in our Phase 5 accomplishments.

Easement Recorded in LCCMR office: Yes

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Grassland Acres*	*Woodland Acres*	*Wetland Acres*	*Shoreline Feet*	*Riparian Feet*
ENTF	Stewardship	$15,000.00	23.00	8.00	6.00	9.00	1,233.00	275.00

Project Name: Leaf Hills
Tract: Cullen 4
Project Area: 3 - Border Prairie
Township: 131, Range: 39, Section: 30

Description: This 149-acre project in Otter Tail County is adjacent to 67 acres of land already protected by a conservation easement held by the Land Trust. The property consists of large rolling hills with wooded ridges that overlook the surrounding area and are typical of the Leaf Hills area landscape. The protected property includes grassland, woodland, and wetlands that flow into Spitzer Lake, a 764-acre natural environment lake that lies just north of the property.

The conservation easement will protect these conservation features by limiting agricultural use and prohibiting residential use and development, as well as other activities inconsistent with preserving the property's conservation values.

Easement Recorded in LCCMR office: Yes

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Grassland Acres*	*Woodland Acres*	*Wetland Acres*	*Shoreline Feet*	*Riparian Feet*
Other Funds	Donated Easement Value	$154,000.00	145.23	33.14	36.06	14.62	1,264.16	0.00
Other Funds	Stewardship	$4,000.00	3.77	0.86	0.94	0.38	32.84	0.00
	Total:	**$158,000.00**	**149.00**	**34.00**	**74.00**	**15.00**	**1,297.00**	**0.00**

3A: Shorelands Protection Program - Minnesota Land Trust

Project Name: Center Shores Estates
Project Area: 4 - Central Lakes
Township: 135, Range: 27, Section: 21

Description: This 66-acre property in Crow Wing County includes approximately 16 acres of wetlands and approximately 50 acres of mixed hardwood forest in a clustered residential development known as Center Shores Estates to be developed by the landowner. The plat of Center Shores Estates includes up to 9 single family homes on approximately 48 acres of property adjacent to the protected property.

The protected property includes almost one mile of shoreline, including approximately 2,955 feet of shoreline directly along the Mississippi River and approximately 1,529 feet of shoreline along a stream that runs east through the property from its western border into the Mississippi River. The Half Moon Lake School Trust Land, owned and managed by the Minnesota Department of Natural Resources, is located approximately 1 mile to the north of the Protected Property. Forest land owned by Crow Wing County is located to the east across the Mississippi River.

The conservation easement will protect the conservation features of this property by prohibiting agricultural and residential uses, as well as division of the property and other activities inconsistent with preserving conservation values.

The value of this easement is unknown.

Easement Recorded in LCCMR office: Yes

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Grassland Acres*	*Woodland Acres*	*Wetland Acres*	*Shoreline Feet*	*Riparian Feet*
ENTF	Stewardship	$15,000.00	66.00	0.00	50.00	16.00	0.00	4,484.00

Project Name: Island Lake
Tract: Geist
Project Area: 4 - Central Lakes
Township: 137, Range: 26, Section: 13

Description: The property is located near Emily, Minnesota on Island Lake in Crow Wing County. Island Lake is a 240 acre natural lake with a state owned public access. The property is a component of a larger identified migratory waterfowl corridor, the Mississippi Flyway, providing critical habitat for migrating and nesting waterfowl. The relatively undisturbed and natural character of the property provides a variety of habitat for a number of species in greatest conservation need. The nearly 1,800 feet of undeveloped shoreline helps maintain the water quality and ecological integrity of the lake and watershed.

The conservation easement will protect these conservation features by prohibiting agricultural, residential, and other uses inconsistent with the preservation of the property's conservation values.

Additionally, the Land Trust received an unsolicited donation of $1,000 from the landowner for the Land Trust's operating fund. This donation will help cover costs not funded by the ENRTF.

Easement Recorded in LCCMR office: Yes

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Grassland Acres*	*Woodland Acres*	*Wetland Acres*	*Shoreline Feet*	*Riparian Feet*
ENTF	Stewardship	$9,000.00	1.87	0.00	1.83	0.03	61.37	34.62
Other Funds	Donated Easement Value	$245,000.00	50.88	0.00	49.94	0.94	1,670.71	942.31
Other Funds	Stewardship	$6,000.00	1.25	0.00	1.22	0.02	40.92	23.08
	Total:	**$260,000.00**	**54.00**	**0.00**	**159.00**	**1.00**	**1,773.00**	**1,000.00**

LCCMR Work Program Final Report

Restoring Minnesota's Fish and Wildlife Habitat Corridors Phase 5
Habitat Conservation Partnership

3A: Shorelands Protection Program - Minnesota Land Trust

Project Name: Lester River
Project Area: 5 - Lower St. Louis River
Township: 51, Range: 13, Section: 8

Description: The Minnesota Land Trust has accepted a donated conservation easement on almost 82 acres of undeveloped land in St. Louis County. The property is a mix of forested uplands and wooded swamps. Bottomland hardwoods are dominated by black ash with a few impressive stands of large cedar mixed in. The protected land includes 3,750 feet of undeveloped shoreline along Lester River, a designated trout stream. The property provides habitat for a variety of terrestrial and aquatic wildlife species including black bears, moose, timber wolves, martens and bobcats, all of which have been seen on the property.

The conservation easement will protect these conservation features by prohibiting all buildings and structures and any activities inconsistent with preserving the property's conservation features.

The value of this easement is unknown.

Easement Recorded in LCCMR office: Yes

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Grassland Acres*	*Woodland Acres*	*Wetland Acres*	*Shoreline Feet*	*Riparian Feet*
ENTF	Stewardship	$15,000.00	81.84	0.00	52.87	28.97	0.00	3,750.00

Project Name: Zumbro River
Tract: Yanish
Project Area: 10 - Southern Lakes
Township: 108, Range: 14, Section: 1

Description: The Zumbro River project is located in Olmsted County approximately 15 miles north of Rochester. The property includes more than 200 acres of hardwood forest, which provides critical habitat for Neotropical migratory birds during migration and nesting. The property also includes approximately 1,094 feet of shoreline along the Zumbro River, which provides important near shore aquatic habitat for native fish and aquatic invertebrates. There is additional riparian frontage along an intermittent stream.

The conservation easement will protect these conservation features by limiting agricultural use and prohibiting residential use or development of the property and any other activities inconsistent with preserving the property's conservation values.

The value of this easement is unknown.

Easement Recorded in LCCMR office: Yes

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Grassland Acres*	*Woodland Acres*	*Wetland Acres*	*Shoreline Feet*	*Riparian Feet*
ENTF	Professional Services	$7,757.00	0.00	0.00	0.00	0.00	0.00	0.00
Other Funds	Stewardship	$5,000.00	392.00	13.00	203.00	0.00	0.00	6,173.00
	Total:	**$12,757.00**	**392.00**	**13.00**	**406.00**	**0.00**	**0.00**	**6,173.00**

Easement Totals (By Funding Type)

Funding Type:	**Funding Amount**	**Prorated Acres**	**Grassland Acres**	**Woodland Acres**	**Wetland Acres**	**Shoreline Feet**	**Riparian Feet**
ENTF	$73,757.00	239.71	9.00	406.87	77.00	4,141.37	8,543.62
Other Funds	$414,000.00	593.13	47.00	291.17	15.97	3,008.63	7,138.38

3A: Shorelands Protection Program - Minnesota Land Trust

Total	**$487,757.00**	**832.84**	**56.00**	**443.87**	**92.97**	**7,150.00**	**15,682.00**

Work Program Expenditures (Not Attributable to Specific Projects)

FundingType	*Category*	*Amount*	*Description*
ENTF	Personnel Expenditures	$106,857.00	Salaries and related benefits for staff working on contacting landowners, negotiating conservation easements and completing all aspect of easement projects. Because of the large number of potential conservation projects involved in this grant and because many projects initiated or worked on under the grant are not actually completed in this phase of the project,the Land Trust does not allocate salaries to specific conservation easement projects.
ENTF	Professional Services	$25,065.00	Title work, project specific mapping for prospective and completed projects, film, recording fees and other miscellaneous acquisition expenses related to projects pursued under this grant. This also includes land protection project professional services, including negotiating and drafting conservation easements and/or completing easement baseline documentation. Because of the large number of conservation projects involved, the Land Trust does not allocate these expenses to specific easement projects.
ENTF	Travel	$4,321.00	Travel to evaluate sites, visit with landowners, complete project requirements.
	Total:	**$136,243.00**	

Work Program Expenditures (Not Attributable to Specific Projects) By Funding Type

Funding Type	Amount
ENTF:	$136,243.00
Total:	**$136,243.00**

Work Program Expenditures Breakdown

Funding Type:	Easement Projects	Not Attributable to Specific Projects	Total
ENTF	$73,757.00	$136,243.00	$210,000.00
Other Funds	$414,000.00	$0.00	$414,000.00
Total	**$487,757.00**	**$136,243.00**	**$624,000.00**

Funding Type Definitions

ENTF:	Grant dollars provided through the Minnesota Environment and Natural Resources Trust Fund
Other Funds:	Non-state, non-state leveraged dollars (if partner funds are leveraging State Funds (e.g. RIM) they are not eligible to be considered Other Funds)
State Funds:	State Funds expended on HCP projects (not eligible for use as Other Funds commitment)
Partner's State Leveraged Funds:	Non State Funds that have leveraged State Funds as part of an HCP project (not eligible for use as Other Funds commitment)
Other:	Any other expenditures (e.g. grant income funds)

Attachment A: Budget Detail

Project Title:

Habitat Corridors Partnership--Phase 5

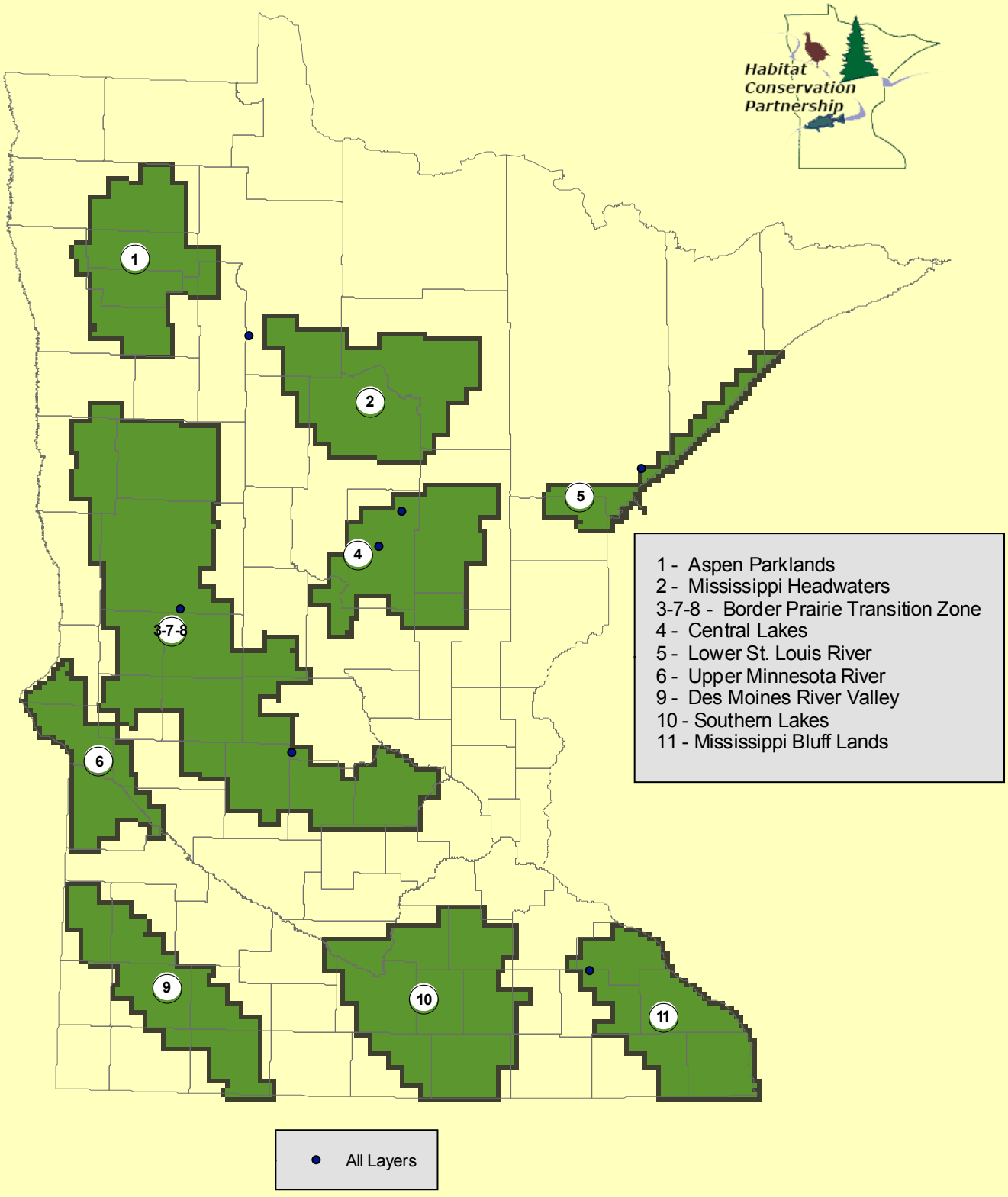
Minnesota Land Trust - Shoreland Protection Program -3(a)

Project Manager: Sarah Strommen

ETF Funds: $210,000

	Result 1 -- Acquiring CEs - Shoreland Protection Program : BUDGET	Adjusted BUDGET January 27, 2010	AMOUNT SPENT AS OF March 31, 2010	BALANCE AS OF March 31, 2010
BUDGET ITEM				
Personnel: Staff expenses including salaries, benefits (FICA,FUTA. SUI, worker's comp health insurance, 401 (k), etc.) and related costs	**$80,000.00**	**$100,000.00**	**$100,000.00**	**$0.00**
Contracts: land protection project professional services, including negotiating and drafting conservation easements and/or completing easement baseline documentation		**$10,000.00**	**$7,757.00**	**$2,243.00**
Easement acquisition costs	**$75,000.00**	**$45,000.00**	**$19,978.00**	**$25,022.00**
Purchase price of conservtion easement(s)				
Title work, title insurance, closing costs, recording fees				
Maps, GIS (sprecific project mapping by Community GIS for Minnesota Land Trust individual projects.)				
Film				
Appraisals, surveys				
Other				
Travel in Minnesota	**$5,000.00**	**$5,000.00**	**$4,107.00**	**$893.00**
Easement stewardship	**$50,000.00**	**$50,000.00**	**$39,000.00**	**$11,000.00**
TOTAL	**$210,000.00**	**$210,000.00**	**$170,842.00**	**$39,158.00**

Habitat Conservation Partnership
Shorelands Protection Program
3A



Attachment A: Budget Detail

Project Title:
Habitat Corridors Partnership--Phase 5
Minnesota Land Trust - Shoreland Protection Program -3(a)

Project Manager: Sarah Strommen

ETF Funds: $210,000

BUDGET ITEM	Result 1 -- Shoreland Protection Program : BUDGET (adjusted - approved Jan 2010)	Final BUDGET June 30, 2010	AMOUNT SPENT AS OF June 30, 2010	BALANCE AS OF June 30, 2010
Personnel: Staff expenses including salaries, benefits (FICA,FUTA. SUI, worker's comp health insurance, 401 (k), etc.) and related costs	$100,000.00	$106,857.00	$106,857.00	$0.00
Contracts: land protection project professional services, including negotiating and drafting conservation easements and/or completing easement baseline documentation	$10,000.00	$7,757.00	$7,757.00	$0.00
Easement acquisition costs	$45,000.00	$25,065.00	$25,065.00	$0.00
Purchase price of conservtion easement(s)				
Title work, title insurance, closing costs, recording fees				
Maps, GIS (sprecific project mapping by Community GIS for Minnesota Land Trust individual projects.)				
Film				
Appraisals, surveys				
Other				
Travel in Minnesota	$5,000.00	$4,321.00	$4,321.00	$0.00
Easement stewardship	$50,000.00	$66,000.00	$66,000.00	$0.00
TOTAL	$210,000.00	$210,000.00	$210,000.00	$0.00

2008 Project Abstract
For the Period Ending June 30, 2010

PROJECT TITLE: Wetlands Reserve Program
Minnesota's Habitat Conservation Partnership (Part 3d)

PROJECT MANAGER: Jon Schneider, Manager – Minn. Conservation Programs
AFFILIATION: Ducks Unlimited, Inc.
MAILING ADDRESS: 311 East Lake Geneva Road NE
CITY/STATE/ZIP: Alexandria, Minnesota 56308
PHONE: 320-762-9916
E-MAIL: jschneider@ducks.org
FAX: 320-759-1567
WEB SITE: www.ducks.org

PROJECT CO-MANAGER: Tim Koehler – Assistant State Conservationist
AFFILIATION: USDA Natural Resources Conservation Service (NRCS)
MAILING ADDRESS: USDA-NRCS Jackson Street, Suite 600, St. Paul, MN 55101
PHONE: (651) 602-7857
E-MAIL: Tim.Koehler@mn.usda.gov
FAX: (651) 602-7914

FUNDING SOURCE: Environment and Natural Resources Trust Fund
LEGAL CITATION: Minnesota Law 2008, Chapter 367, Section 2, Subd. 3(c)

APPROPRIATION AMOUNT: **$ 267,500**

Overall Project Outcome and Results

In partnership with the USDA's Natural Resources Conservation Service (NRCS), Ducks Unlimited (DU) hired contracted Wetlands Reserve Program (WRP) technicians that began HCP Phase 5 work on November 11, 2008 with combined funding support from Environment and Natural Resources Trust Fund and NRCS grants. The delivery goal for these technicians was to provide technical assistance to help NRCS to secure permanent WRP conservation easements on 1,300 acres. Upon completion of this grant on September 9, 2009, DU WRP contract technicians had:

- Contacted 309 landowners while promoting WRP;
- Completed 119 signed WRP applications;
- Developed 21 new conservation plans;
- Modified 30 conservation plans to adjust for actual restoration practices, costs, and acres; and
- Oversaw the restoration of 12 wetland basins on WRP easements within HCP Project Areas.

This technical assistance helped NRCS secure 6 new easements for a combined total of 5,438 new WRP acres. These included:

- 4 new WRP easements in HCP Project Area 3-7-8 totaling 485 acres
- 1 new WRP easement in HCP Project Area 10 totaling 77 acres
- 1 new easement in HCP Project Area 1 totaling 4,876 acres.

In addition to spending $267,500 from this Environment & Natural Resources Trust Fund grant, DU and NRCS also spent $4,014,810 in Other Funds comprised of federal NRCS and non-state DU expense to complete this project.

Project Results Use and Dissemination

Information on the WRP signups has been publicized through news releases from the USDA's NRCS and local Soil and Water Conservation Districts, and through hundreds of individual landowner contacts made by DU wetland restoration specialists. Additional announcements and landowner contacts continue to be made and publicized by DU and USDA's NRCS. Additionally, the WRP partnership received a 2009 Minnesota Environmental Institute (MEI) award, and this news was widely distributed and covered.

LCCMR Work Program Update Report

Restoring Minnesota's Fish and Wildlife Habitat Corridors Phase 5

Habitat Conservation Partnership

3D: Wetlands Reserve Program - Ducks Unlimited (DU) & Natural Resources Conservation Services (NRCS)

Project Manager: Jon Schneider

Affiliation: Ducks Unlimited

Address: 311 East Lake Geneva Road
Alexandria, MN 56308

Phone: (320)762-9916

Fax: (320)759-1567

E-mail: jschneider@ducks.org

Project Manager: Tim Koehler

Affiliation: USDA - Natural Resources Conservation Service

Address: 375 Jackson Street, Suite 600
St. Paul, MN 55101

Phone: (651) 602-7857

Fax: (651) 602-7926

E-mail: tim.koehler@mn.usda.gov

Fund: Environment and Natural Resources Trust Fund

Legal Citation: ML 2008 First Special Section, Ch. 367, Sec. 2 Subd. 3(c).

Total Biennial Project Budget

Result	ENTF Balance	ENTF Funds Spent	ENTF Balance	Other Funds * Proposed	Other Funds * Spent
Easement	$267,500	$267,500	$0	$1,225,000	$4,014,810
Total	$267,500	$267,500	$0	$1,225,000	$4,014,810

* Please note that most other funds reported here are federal in origin but do include some Ducks Unlimited costs.

Potential Project List

Project Name	*Type of Work*	*County*	*Project Area*	*Status*
66632270033	Easement	Douglas	3	pending
66632270037	Easement	Becker	3	pending
66632270052	Easement	Douglas	3	pending
66632270064	Easement	Polk	3	pending
66632270075	Easement	Clay	3	pending
66632270077	Easement	Becker	3	pending
66632270015	Easement	Pope	7	pending
66632270016	Easement	Pope	7	pending
66632270042	Easement	Douglas	7	pending
66632270011	Easement	Freeborn	10	pending
66632270050	Easement	Steele	10	pending
66632270055	Easement	Freeborn	10	pending
66632270076	Easement	Rice	10	pending
66632270078	Easement	Waseca	10	pending
6608006	Easement	Pope	3-7-8	Complete

Work Program Summary

Project Summary and Results

DU will use ETF funding to contract with approximately eight (6-10) wetland restoration technicians in Crookston, Detroit Lakes,

3D: Wetlands Reserve Program - Ducks Unlimited (DU) & Natural Resources Conservation Services (NRCS)

Fergus Falls, Morris, Glenwood, St. Peter, and Albert Lea to provide technical assistance (TA) to the Natural Resources Conservation Service (NRCS) and private landowners to help NRCS secure 1,300 acres of Wetlands Reserve Program (WRP) easements in HCP habitat corridor areas. WRP promotion will target restorable wetlands and drained shallow lakes, especially those within priority shallow lake watersheds comprising emphasis areas of DU's Living Lakes Initiative. The contract technicians will help landowners apply for the WRP, and help guide the planning and restoration of lands accepted into the WRP. TA activities will include landowner contacts, WRP applications submitted, restoration plans submitted, wetland restoration designs, and restoration project oversight, all of which are critical steps to securing easements. The USDA's NRCS will fund the associated easement and restoration costs. The contract technicians will implement all aspects of the WRP program that will result in lands being enrolled and wetlands and uplands restored under the federal WRP in HCP Project Areas #1 (Aspen Parklands), 3/6/7 (Prairie Forest Transition), 9 (Des Moines River Valley), 10 (Southern Lakes), and 11 (Prairie Coteau). DU will coordinate the partnership and administer wetland restoration tech contracts, including payments of salary, travel, and field expenses with grant funds and grant administration and coordination. NRCS will pay for all WRP easements with federal funds.

Summary of Progress as of November 2008

Work on this 2008 grant for HCP Phase 5 part 3d is set to being in early November 2008 and be completed in late spring or summer 2009. As of this update, work has yet to start.

Summary of Progress as of May 1st, 2009

Work to help the USDA's Natural Resources Conservation Service (NRCS) promote and deliver the Wetlands Reserve Program (WRP) under DU's 2008 LCCMR grant for HCP Phase 5 part 3d began on November 11, 2008. DU continued the contracted employment of wetland restoration specialists previously hired by DU under HCP Phase 4 part 3d to help NRCS promote and deliver the WRP and assist landowners and NRCS with restoring wetlands and native prairie grasslands enrolled into this conservation easement program within HCP Project Areas. Since November 2008, these contractors have made 338 landowner contacts, processed 72 WRP applications, helped sign 71 WRP contracts, drafted 2 restoration designs, and conducted 0 construction management projects (construction work will start later in spring). This effort helped NRCS closed one new WRP easement on 151 acres in Pope County using USDA federal funds, and several more WRP easements are scheduled to close before October. Work will continue through summer 2009 via this 2008 grant and more WRP deliverables and easement accomplishments will be reported in the final report later this year.

3D: Wetlands Reserve Program - Ducks Unlimited (DU) & Natural Resources Conservation Services (NRCS)

Easement Activities

Project Name: 660900NBK
Project Area: 1 - Aspen Parklands
Township: 150, Range: 44, Section: 36

Description: WRP Easement in Polk county.
Easement Recorded in LCCMR office: No

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Grassland Acres*	*Woodland Acres*	*Wetland Acres*	*Shoreline Feet*	*Riparian Feet*
Other Funds	Easement Acquisition Costs	$2,910,770.52	4,876.00	2,613.50	0.00	2,262.50	0.00	0.00

Project Name: 66080121
Project Area: 7 - Alexandria Moraine
Township: 128, Range: 37, Section: 25

Description: WRP-RIM easement in Douglas County.
Easement Recorded in LCCMR office: No

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Grassland Acres*	*Woodland Acres*	*Wetland Acres*	*Shoreline Feet*	*Riparian Feet*
Other Funds	Easement Acquisition Costs	$180,157.28	96.50	76.50	0.00	20.00	0.00	0.00

Project Name: 66080130
Project Area: 7 - Alexandria Moraine
Township: 125, Range: 44, Section: 5

Description: WRP-RIM Easement in Stevens County.
Easement Recorded in LCCMR office: No

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Grassland Acres*	*Woodland Acres*	*Wetland Acres*	*Shoreline Feet*	*Riparian Feet*
Other Funds	Easement Acquisition Costs	$166,512.15	100.60	81.70	0.00	18.90	0.00	0.00

Project Name: 66080131
Project Area: 7 - Alexandria Moraine
Township: 125, Range: 44, Section: 5

Description: WRP-RIM easement in Stevens county.
Easement Recorded in LCCMR office: No

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Grassland Acres*	*Woodland Acres*	*Wetland Acres*	*Shoreline Feet*	*Riparian Feet*
Other Funds	Easement Acquisition Costs	$225,402.63	136.90	106.90	0.00	30.00	0.00	0.00

LCCMR Work Program Update Report

Restoring Minnesota's Fish and Wildlife Habitat Corridors Phase 5

Habitat Conservation Partnership

3D: Wetlands Reserve Program - Ducks Unlimited (DU) & Natural Resources Conservation Services (NRCS)

Project Name: 66080047
Project Area: 10 - Southern Lakes
Township: 106, Range: 22, Section: 1

Description: WRP-RIM easement in Waseca County.

Easement Recorded in LCCMR office: No

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Grassland Acres*	*Woodland Acres*	*Wetland Acres*	*Shoreline Feet*	*Riparian Feet*
Other Funds	Easement Acquisition Costs	$165,315.04	77.00	59.00	0.00	18.00	0.00	0.00

Project Name: 6608006
Project Area: 3-7-8 - Border Prairie Transition Zone
Township: 124, Range: 38, Section: 27

Description: NRCS secured a 151-acre WRP easement in Pope County protecting 102 acres of upland and 49 acres wetlands.

Easement Recorded in LCCMR office: No

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Grassland Acres*	*Woodland Acres*	*Wetland Acres*	*Shoreline Feet*	*Riparian Feet*
Other Funds	Easement Acquisition Costs	$203,670.00	150.20	101.60	0.00	48.60	0.00	0.00

Easement Totals (By Funding Type)

Funding Type:	Funding Amount	Prorated Acres	Grassland Acres	Woodland Acres	Wetland Acres	Shoreline Feet	Riparian Feet
Other Funds	$3,851,827.62	5,437.20	3,039.20	0.00	2,398.00	0.00	0.00
Total	**$3,851,827.62**	**5,437.20**	**3,039.20**	**0.00**	**2,398.00**	**0.00**	**0.00**

Work Program Expenditures (Not Attributable to Specific Projects)

FundingType	*Category*	*Amount*	*Description*
ENTF	Professional Services	$253,067.00	Contract expense for wetland restoration specialists that DU contracted to help NRCS promote and deliver the USDA's Wetlands Reserve Program (WRP) and assist landowners and NRCS with restoring wetlands and native prairie grasslands enrolled into this conservation easement program within HCP Project Areas.
ENTF	Personnel Expenditures	$14,433.00	DU staff expense to manage the WRP partnership program with NRCS, hire and manage the activities of contracted wetland management specialists to meet the goals of this grant, report their accomplishments within HCP Project Areas, and administer this LCCMR grant.

3D: Wetlands Reserve Program - Ducks Unlimited (DU) & Natural Resources Conservation Services (NRCS)

Other Funds	Professional Services	$114,768.25	Contract expense for wetland restoration specialists that DU contracted to help NRCS promote and deliver the USDA's Wetlands Reserve Program (WRP) and assist landowners and NRCS with restoring wetlands and native prairie grasslands enrolled into this conservation easement program within HCP Project Areas. This expense was a combination of USDA NRCS funds granted to DU via contribution agreement and DU in-kind expense.
Other Funds	Personnel Expenditures	$48,214.41	DU staff expense to manage the WRP partnership program with NRCS, hire and manage the activities of contracted wetland management specialists to meet the goals of this grant, report their accomplishments within HCP Project Areas, and administer this LCCMR grant.
	Total:	**$430,482.66**	

Work Program Expenditures (Not Attributable to Specific Projects) By Funding Type

Funding Type	Amount
ENTF:	$267,500.00
Other Funds:	$162,982.66
Total:	**$430,482.66**

Work Program Expenditures Breakdown

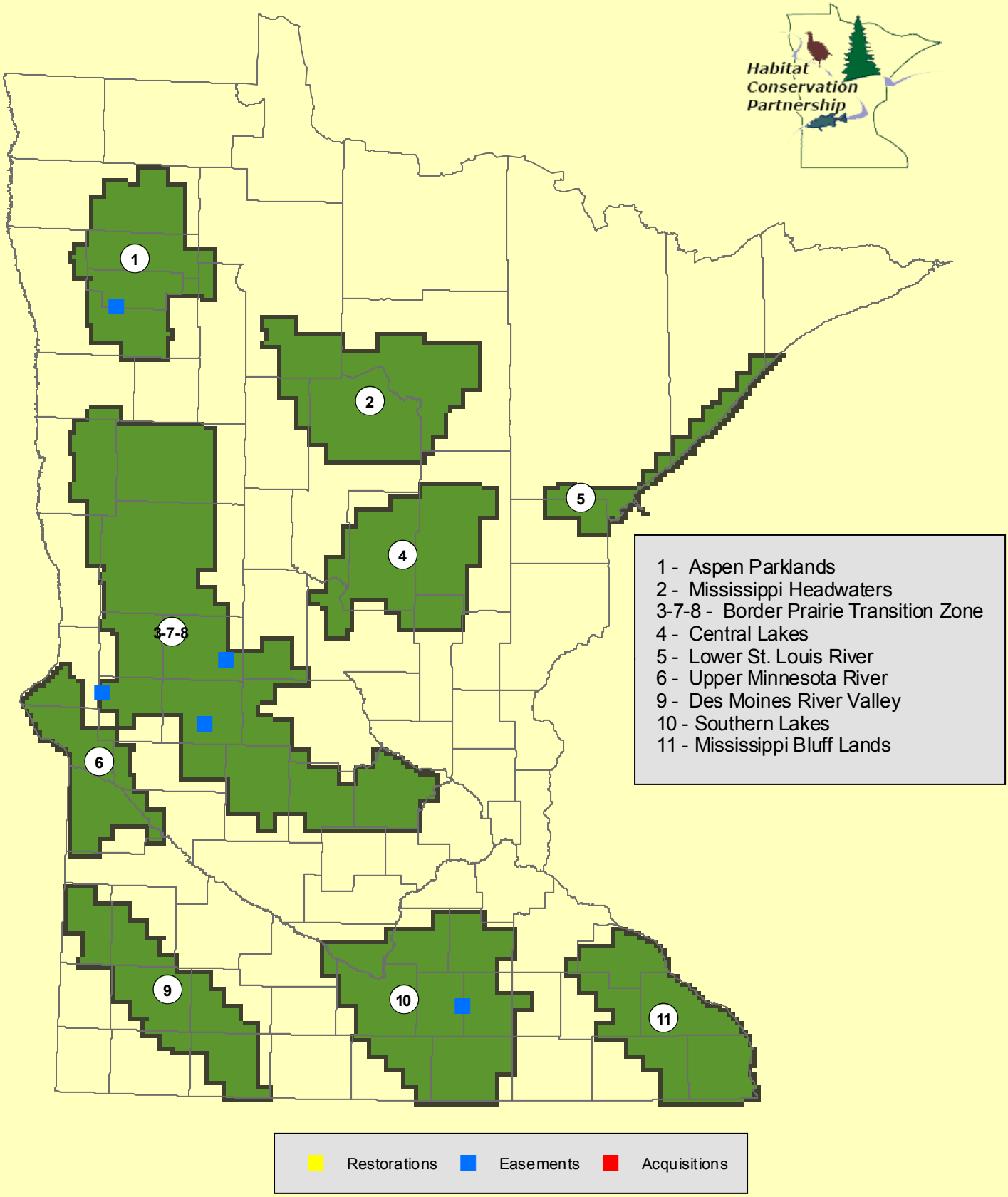
Funding Type:	Easement Projects	Not Attributable to Specific Projects	Total
ENTF	$0.00	$267,500.00	$267,500.00
Other Funds	$3,851,827.62	$162,982.66	$4,014,810.28
Total	**$3,851,827.62**	**$430,482.66**	**$4,282,310.28**

Funding Type Definitions

ENTF:	Grant dollars provided through the Minnesota Environment and Natural Resources Trust Fund
Other Funds:	Non-state, non-state leveraged dollars (if partner funds are leveraging State Funds (e.g. RIM) they are not eligible to be considered Other Funds)
State Funds:	State Funds expended on HCP projects (not eligible for use as Other Funds commitment)
Partner's State Leveraged Funds:	Non State Funds that have leveraged State Funds as part of an HCP project (not eligible for use as Other Funds commitment)
Other:	Any other expenditures (e.g. grant income funds)

Attachment A: Budget Detail for 2008 Projects						
ML 2008, Chapter [367], Section [2], Subdivision 3[c]3d. Minnesota's Habitat Conservation Partnership - Phase IV						
Wetlands Reserve Program -- Minnesota's Habitat Conservation Partnership - Phase V						
Project Manager Name: Jon Schneider, DU						
Project Co-Manager: Tim Koehler, NRCS						
Trust Fund Appropriation: $267,500						
November 11, 2008 thru September 9, 2009						
FINAL REPORT						
2008 Trust Fund Budget	**Result 1 Budget:**	**Amount Spent**	**Balance**	**TOTAL BUDGET**	**TOTAL SPENT**	**TOTAL BALANCE**
	TA for WRP Easements					
BUDGET ITEM						
PERSONNEL: wages and benefits (DU staff for project administration)	22,500	14,193	8,307	22,500	14,193	8,307
Contracts						
Professional/technical (contract biotechnicians to deliver WRP)	242,500	253,067	-10,567	242,500	253,067	-10,567
Other contracts.						
Travel expenses in Minnesota	2,500	240	2,260	2,500	240	2,260
COLUMN TOTAL	**$267,500**	**$267,500**	**$0**	**$ 267,500**	**$ 267,500**	**$ -**

Habitat Conservation Partnership
Phase 5 Accomplishments
3D - Wetlands Reserve Program



2008 Project Abstract
For the Period Ending June 30, 2010

PROJECT TITLE: Restoring Minnesota's Fish and Wildlife Habitat Corridors Phase V
Habitat Conservation Partnership

PROJECT MANAGER: Kevin J. Lines
AFFILIATION: Board of Water and Soil Resources
MAILING ADDRESS: 520 Lafayette Road
CITY/STATE/ZIP: St. Paul, MN 55155
PHONE: 651-297-1894
E-MAIL: kevin.lines@state.mn.us
WEBSITE: www.bwsr.state.mn.us
FUNDING SOURCE: Minnesota Environment and Natural Resources Trust Fund
LEGAL CITATION: M.L. 2008, Chp. 367, Sec. 2, Subd. 3(c)

APPROPRIATION AMOUNT: $250,000

Overall Project Outcome and Results

The BWSR used $250,000 in LCCMR awarded MN Environment and Natural Resources Trust Fund to acquire voluntary conservation easements on private lands, and implement conservation practices on these easement lands through its stand-alone RIM Reserve program and the RIM-WRP Partnership with NRCS. These easements are located in Habitat Corridors Parternship (HCP) project areas, and two are within five miles of a Working Lands Initiative (WLI) area. By targeting lands in or near the WLI focus areas, we leveraged numerous federal, state and private partners' activities in areas where the state has already acquired significant public and private investments in habitat for wildlife, fish, and native plant communities.

The BWSR has completed acquisition of three perpetual easements, resulting in 289 acres of land protected for perpetuity, and allowing restoration of previously drained wetlands and adjacent native upland. Two of these easements were acquired via the RIM-WRP Partnership and are in the Boarder Prairie Transition Zone, and within five miles of a WLI target area. These acquisitions were selected and prioritized using the Minnesota Wetlands Evaluation Worksheet and focus on frequently flooded cropland, including land within the 100-year flood plain, marginal and highly erodible cropland along rivers, streams, and ditches. The third is a perpetual riparian RIM Reserve easement in the HCP Bluff Lands Project Area.

All of the easements acquired afford protection of soil, enhance water quality, and support fish and wildlife habitat. Stewardship provisions are included, to monitor and enforce the conditions of the conservation easement by the BWSR through our local SWCDs. All restorations utilize native seeds and plants of local ecotypes unless not available. LCCMR Notice of Funding Restrictions documents have been recorded in conjunction with each of these perpetual easements.

Project Results Use and Dissemination

BWSR has captured these three perpetual conservation easements in our online Geographic Information System (GIS) layer. An online easement application has been developed that utilizes the conservation practice data, easement boundary and tabular data containing specific attributes about each easement. This application serves to provide specific easement information to the public via an online web mapping interface.

LCCMR Work Program Final Report

Restoring Minnesota's Fish and Wildlife Habitat Corridors Phase 5

Habitat Conservation Partnership

3E:RIM Reserve - MN Board of Water & Soil Resources

Project Manager: Kevin Lines

Affiliation: MN Board of Water & Soil Resources

Address: 520 Lafayette Road
St. Paul, MN 55155

Phone: (651) 297-1894

Fax: (651) 297-5615

E-mail: Kevin.lines@state.mn.us

Fund: Environment and Natural Resources Trust Fund

Legal Citation: ML 2008 First Special Section, Ch. 367, Sec. 2 Subd. 3(c).

Total Biennial Project Budget

Result	Environmental Trust Allocation	Environmental Trust Funds Spent	Environmental Trust Balance	Other Funds Proposed	Other Funds Spent
Restoration	-	$0.00	-	-	$125,723.00
Easement	-	$250,000	-	-	$435,812
Work Program Expenditures (Not Attributable to Specific Projects)	-	$0	-	-	$0
Total	$250,000	$250,000	$0	$560,000	$561,535

Work Program Summary

Overall Project Outcome and Results

The BWSR used $250,000 in LCCMR awarded MN Environment and Natural Resources Trust Fund to acquire voluntary conservation easements on private lands through its stand-alone RIM Reserve program and the RIM-WRP Partnership with NRCS. The BWSR leveraged federal RIM-WRP dollars and used bonding dollars to fund the remaining easement acquisition costs and to implement conservation practices on these easements. These easements are located in Habitat Corridors Parternship (HCP) project areas, and two are within five miles of a Working Lands Initiative (WLI) area. By targeting lands in or near the WLI focus areas, we leveraged numerous federal, state and private partners' activities in areas where the state has already acquired significant public and private investments in habitat for wildlife, fish, and native plant communities.

The BWSR has completed acquisition of three perpetual easements, resulting in 289 acres of land protected for perpetuity, and allowing restoration of previously drained wetlands and adjacent native upland. Two of these easements were acquired via the RIM-WRP Partnership and are in the Boarder Prairie Transition Zone, and within five miles of a WLI target area. These acquisitions were selected and prioritized using the Minnesota Wetlands Evaluation Worksheet and focus on frequently flooded cropland, including land within the 100-year flood plain, marginal and highly erodible cropland along rivers, streams, and ditches. The third is a perpetual riparian RIM Reserve easement in the HCP Bluff Lands Project Area.

All of the easements acquired afford protection of soil, enhance water quality, and support fish and wildlife habitat. Stewardship provisions are included, to monitor and enforce the conditions of the conservation easement by the BWSR through our local SWCDs. All restorations utilize native seeds and plants of local ecotypes unless not available. LCCMR Notice of Funding Restrictions documents have been recorded in conjunction with each of these perpetual easements.

3E:RIM Reserve - MN Board of Water & Soil Resources

Project Results Use and Dissemination

BWSR has captured these three perpetual conservation easements in our online Geographic Information System (GIS) layer. An online easement application has been developed that utilizes the conservation practice data, easement boundary and tabular data containing specific attributes about each easement. This application serves to provide specific easement information to the public via an online web mapping interface.

LCCMR Work Program Final Report

Restoring Minnesota's Fish and Wildlife Habitat Corridors Phase 5

Habitat Conservation Partnership

3E:RIM Reserve - MN Board of Water & Soil Resources

Restoration Activities

Project Name: 75-01-08-02
Project Area: 3-7-8 - Border Prairie Transition Zone
Township: 126, Range: 44, Section: 27

Activity: Grassland Restoration
Landtype: Private - Land
Description: This entire easement is being restored to native vegetation. In addition, there is a wetland restoration component over approximately half of the easement area. Water quality is being protected, and wildlife habitat is enhanced.

			Acres	Shoreline
		Non Prorated Totals	149.30	0.00
Funding Type	**Funds Use**	**Funding Amount**	**Prorated Acres**	**Prorated Shoreline Feet**
Other Funds	Restoration	$33,593.00	111.97	0.00
State Funds	Restoration	$11,198.00	37.33	0.00

Activity: Wetland Restoration
Landtype: Private - Land
Description: This is a multi-basin restoration. These basins will serve to protect water quality and enhance wildlife habitat.

			Acres	Shoreline
		Non Prorated Totals	40.30	0.00
Funding Type	**Funds Use**	**Funding Amount**	**Prorated Acres**	**Prorated Shoreline Feet**
Other Funds	Restoration	$24,180.00	20.15	0.00
State Funds	Restoration	$24,180.00	20.15	0.00
	75-01-08-02 Total	**$93,151.00**	**189.60**	**0.00**

Project Name: 75-10-08-02
Project Area: 3-7-8 - Border Prairie Transition Zone
Township: 126, Range: 44, Section: 18

LCCMR Work Program Final Report

Restoring Minnesota's Fish and Wildlife Habitat Corridors Phase 5

Habitat Conservation Partnership

3E:RIM Reserve - MN Board of Water & Soil Resources

Activity: Grassland Restoration
Landtype: Private - Land
Description: This entire easement is being restored to native vegetation. In addition, there is a wetland restoration component over approximately half of the easement area. Water quality is being protected, and wildlife habitat is enhanced.

			Acres	Shoreline
		Non Prorated Totals	122.80	0.00
Funding Type	**Funds Use**	**Funding Amount**	**Prorated Acres**	**Prorated Shoreline Feet**
Other Funds	Restoration	$27,630.00	92.10	0.00
State Funds	Restoration	$9,210.00	30.70	0.00

Activity: Wetland Restoration
Landtype: Private - Land
Description: Two basins are being restored on this easement. Both will serve to protect water quality and enhance wildlife habitat.

			Acres	Shoreline
		Non Prorated Totals	67.20	0.00
Funding Type	**Funds Use**	**Funding Amount**	**Prorated Acres**	**Prorated Shoreline Feet**
Other Funds	Restoration	$40,320.00	33.60	0.00
State Funds	Restoration	$40,320.00	33.60	0.00
	75-10-08-02 Total	**$117,480.00**	**190.00**	**0.00**

Restoration Project Totals (By Funding Type)

Funding Type	Funding Amount	Prorated Acres	Shoreline Feet
Other Funds:	$125,723.00	257.82	0.00
State Funds:	$84,908.00	121.78	0.00
Total:	**$210,631.00**	**379.60**	**0.00**

Easement Activities

Project Name: 28-02-07-06
Project Area: 11 - Mississippi Bluff Lands
Township: 104, Range: 4, Section: 35

3E:RIM Reserve - MN Board of Water & Soil Resources

Description: This ia a perpetual riparian buffer easement along the Root River in Houston County. This easement will help to improve water quality and enhance wildlife habitat in the area. A portion of this easement was funded using LCCMR dollars, with the remainder of funding coming from RIM bonding dollars.

	Acres	Grassland Acres	Woodland Acres	Wetland Acres	Shoreline Feet	Riparian Feet
Non Prorated Totals:	190.10	80.00	80.10	0.00	0.00	4,850.00

Funding Type	Funds Use	Funding Amount	Prorated Acres	Grassland Acres	Woodland Acres	Wetland Acres	Shoreline Feet	Riparian Feet
ENTF	Easement Acquisition Costs	$25,227.00	5.71	2.40	2.41	0.00	0.00	145.63
State Funds	Easement Acquisition Costs	$394,836.97	89.34	37.60	37.64	0.00	0.00	2,279.37
	28-02-07-06 Total	**$420,063.97**	**95.05**	**40.00**	**160.20**	**0.00**	**0.00**	**2,425.00**

Project Name: 75-01-08-02
Project Area: 3-7-8 - Border Prairie Transition Zone
Township: 126, Range: 44, Section: 27
Description: This is a perpetual RIM-WRP partnership easement in the Prairie Forest Transition Zone HCP project area, and within five miles of the WLI target area. This easement was partially funded using LCCMR dollars. An LCCMR Notice of Funding Restriction is in the process of being recorded.

	Acres	Grassland Acres	Woodland Acres	Wetland Acres	Shoreline Feet	Riparian Feet
Non Prorated Totals:	155.80	149.30	0.00	40.30	0.00	0.00

Funding Type	Funds Use	Funding Amount	Prorated Acres	Grassland Acres	Woodland Acres	Wetland Acres	Shoreline Feet	Riparian Feet
ENTF	Easement Acquisition Costs	$56,297.00	19.48	18.66	0.00	5.04	0.00	0.00
Other Funds	Easement Acquisition Costs	$241,263.15	83.47	79.98	0.00	21.59	0.00	0.00
State Funds	Easement Acquisition Costs	$152,789.10	52.86	50.65	0.00	13.67	0.00	0.00
	75-01-08-02 Total	**$450,349.25**	**155.80**	**149.30**	**0.00**	**40.30**	**0.00**	**0.00**

LCCMR Work Program Final Report

Restoring Minnesota's Fish and Wildlife Habitat Corridors Phase 5

Habitat Conservation Partnership

3E:RIM Reserve - MN Board of Water & Soil Resources

Project Name: 75-10-08-02
Project Area: 3-7-8 - Border Prairie Transition Zone
Township: 126, Range: 44, Section: 18
Description: This is a perpetual RIM-WRP partnership easement in the Prairie Forest Transition Zone HCP project area, and within five miles of the WLI target area.

	Acres	Grassland Acres	Woodland Acres	Wetland Acres	Shoreline Feet	Riparian Feet
Non Prorated Totals:	122.80	0.00	0.00	67.20	55.60	0.00

Funding Type	Funds Use	Funding Amount	Prorated Acres	Grassland Acres	Woodland Acres	Wetland Acres	Shoreline Feet	Riparian Feet
ENTF	Easement Acquisition Costs	$168,476.00	56.99	0.00	0.00	31.19	25.80	0.00
Other Funds	Easement Acquisition Costs	$194,549.00	65.81	0.00	0.00	36.01	29.80	0.00
75-10-08-02 Total		**$363,025.00**	**122.80**	**0.00**	**0.00**	**67.20**	**55.60**	**0.00**

Easement Totals (By Funding Type)

Funding Type:	Funding Amount	Prorated Acres	Grassland Acres	Woodland Acres	Wetland Acres	Shoreline Feet	Riparian Feet
Other Funds	$435,812.15	149.28	79.98	0.00	57.60	29.80	0.00
State Funds	$547,626.07	142.20	88.25	37.64	13.67	0.00	2,279.37
Total	**$1,233,438.22**	**373.65**	**189.30**	**40.05**	**107.50**	**55.60**	**2,425.00**

Work Program Expenditures (Not Attributable to Specific Projects)

FundingType	Category	Amount	Description
Total:			

Work Program Expenditures (Not Attributable to Specific Projects) By Funding Type

Funding Type	Amount
ETF	$0.00
Other Funds	$0.00
Partner's State Leveraged Funds	$0.00
State Funds	$0.00
Other	$0.00
Total	**$0.00**

LCCMR Work Program Final Report

Restoring Minnesota's Fish and Wildlife Habitat Corridors Phase 5

Habitat Conservation Partnership

3E:RIM Reserve - MN Board of Water & Soil Resources

Work Program Expenditures Breakdown

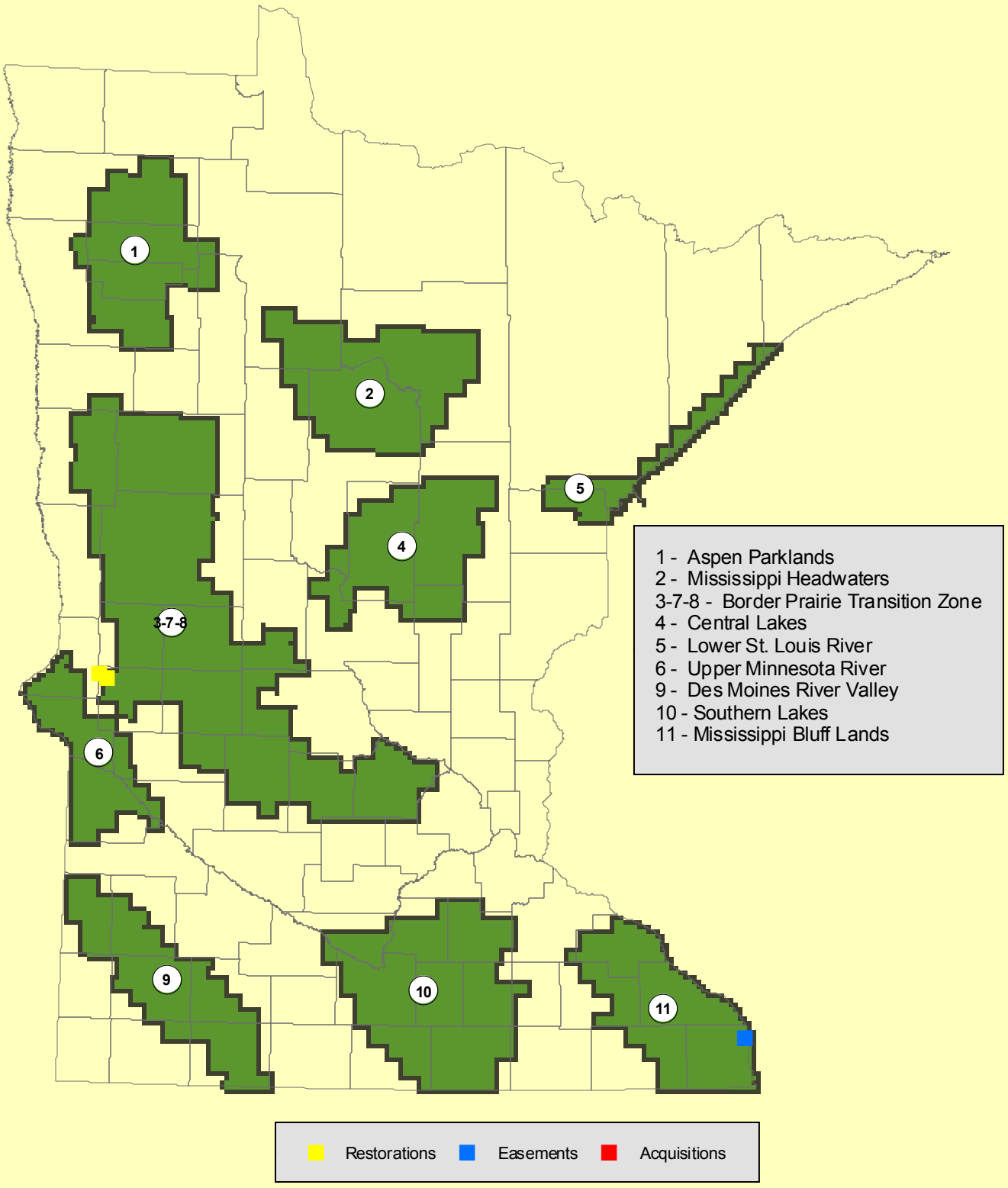
Funding Type	Restoration Projects	Easement Projects	Not Attributable To Specific Projects	Total
ETF	$ 0.00	$250,000.00	$0.00	$250,000.00
Other Funds	$125,723.00	$435,812.15	$0.00	$561,535.15
State Funds	$84,908.00	$547,626.07	$0.00	$632,534.07
Total	**$210,631.00**	**$1,233,438.22**	**$0.00**	**$1,444,069.22**

Funding Type Definitions

ETF:	Grant dollars provided through the Minnesota Environment and Natural Resources Trust Fund
Other Funds:	Non-state, non-state leveraged dollars (if partner funds are leveraging State Funds (e.g. RIM) they are not eligible to be considered Other Funds)
State Funds:	State Funds expended on HCP projects (not eligible for use as Other Funds commitment)
Partner's State Leveraged Funds:	Non State Funds that have leveraged State Funds as part of an HCP project (not eligible for use as Other Funds commitment)
Other:	Any other expenditures (e.g. grant income funds)

Attachment A: Budget Detail for 2008 Projects											
Project Title: Minnesota Habitat Conservation Partnership - BWSR											
	Minnesota's Habitat Conservation Partnership (V)										
Project Manager Name: Kevin Lines											
Trust Fund Appropriation: $250,000											
1) See list of non-eligible expenses, do not include any of these items in your budget sheet											
2) Remove any budget item lines not applicable											
2008 Trust Fund Budget	**Result 1 Budget:**	**Amount Spent**	**Balance**	**Result 2 Budget:**	**Amount Spent**	**Balance**	**Result 3 Budget:**	**Amount Spent**	**Balance**	**TOTAL BUDGET**	**TOTAL BALANCE**
Land rights acquisition *(less than fee)*	250,000	250,000	0			0			0	250,000	0
COLUMN TOTAL	**$250,000**	**$250,000**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$250,000**	**$0**

Habitat Conservation Partnership
RIM Reserve
3E



2008 Project Abstract
For the Period Ending June 30, 2010

PROJECT TITLE: Critical Lands Conservation Initiative - 4a - Habitat Conservation Partnership
PROJECT MANAGER: Joe Pavelko
AFFILIATION: Pheasants Forever, Inc.
MAILING ADDRESS: 7975 Acorn Circle
CITY/STATE/ZIP: Victoria, MN 55386
PHONE: 612-532-3800
E-MAIL: jpavelko@pheasantsforever.org
WEBSITE: www.pheasantsforever.org www.minnesotapf.org
FUNDING SOURCE: Environment and Natural Resources Trust Fund
LEGAL CITATION: ML 2008 First Special Section, Ch.367, Sec. 2 Subd. 3(c).

APPROPRIATION AMOUNT: $350,000

Overall Project Outcome and Results
To help slow the loss of habitat and declining wildlife populations, Pheasants Forever purchased in fee-title 8 parcels totaling 289.27 acres to permanently protect quality wildlife habitat lands within Big Stone, Blue Earth, Chippewa, Faribault, Grant, Lincoln, Ottertail, and Pope Counties, MN. All lands have been or will be enrolled into the state Wildlife Management Area System and will be protected and managed in perpetuity by the Minnesota Department of Natural Resources. In addition, these newly acquired WMAs will provide access and recreational opportunities for ALL Minnesotans, so fundamentally important to our outdoor heritage.

More specifically, a total of 130.15 acres were acquired using $349,985 of Environment and Natural Resources Trust Funds that were matched with $428,446 of non-state funds to acquire an additional 159.11 acres totaling 289.27 acres. Of those total acres, 190.5 acres are grassland (31 acres of native prairie), 50 acres of woodland, and 48.64 acres of wetlands. Striving to build landscape level habitat complexes that will protect and sustain wildlife populations, seven of the projects are additions to existing WMAs and build upon past investments in wildlife habitat conservation. A project by project accounting and supporting context can be found in the final work program report and all accomplishment reports are available at www.mnhabitatcorridors.org.

Accomplishments were achieved by working with many local, state, and federal partners. Effective partnerships are the backbone of conservation in Minnesota. Through this project we have continued the effort to build and enhance effective conservation partnerships that provide wildlife and recreation benefits to all Minnesotans.

Project Results Use and Dissemination
All projects acquired through the Habitat Conservation Partnership acknowledge the funding from the Minnesota Environment & Natural Resources Trust Fund. These new public land additions will be incorporated into the DNR Wildlife Management Area System and will be added to appropriate maps, websites, and other WMA information dissemination outlets. Detailed accomplishment report information is available at www.mnhabitatcorridors.org.

LCCMR Work Program Final Report

Restoring Minnesota's Fish and Wildlife Habitat Corridors Phase 5
Habitat Conservation Partnership

4A: Critical Lands Conservation Initiative - Pheasants Forever

Project Manager: Joe Pavelko

Affiliation: Pheasants Forever

Address: 7975 Acorn Circle
Victoria, MN 55386

Phone: 612-532-3800

Fax:

E-mail: jpavelko@pheasantsforever.org

Fund: Environment and Natural Resources Trust Fund

Legal Citation: ML 2008 First Special Section, Ch. 367, Sec. 2 Subd. 3(c).

Total Biennial Project Budget

Result	ENTF Allocation	ENTF Funds Spent	ENTF Balance	Other Funds Proposed	Other Funds Spent
Acquisition	$350,000	$349,985	$15	$350,000	$428,446
Total	$350,000	$349,985	$15	$350,000	$428,446

.

Work Program Summary

Overall Project Outcome and Results

To help slow the loss of habitat and declining wildlife populations, Pheasants Forever purchased in fee-title 8 parcels totaling 289.27 acres to permanently protect quality wildlife habitat lands within Big Stone, Blue Earth, Chippewa, Faribault, Grant, Lincoln, Ottertail, and Pope Counties, MN. All lands have been or will be enrolled into the state Wildlife Management Area System and will be protected and managed in perpetuity by the Minnesota Department of Natural Resources. In addition, these newly acquired WMAs will provide access and recreational opportunities for ALL Minnesotans, so fundamentally important to our outdoor heritage.

More specifically, a total of 130.15 acres were acquired using $349,985 of Environment and Natural Resources Trust Funds that were matched with $428,446 of non-state funds to acquire an additional 159.11 acres totaling 289.27 acres. Of those total acres, 190.5 acres are grassland (31 acres of native prairie), 50 acres of woodland, and 48.64 acres of wetlands. Striving to build landscape level habitat complexes that will protect and sustain wildlife populations, seven of the projects are additions to existing WMAs and build upon past investments in wildlife habitat conservation. A project by project accounting and supporting context can be found in the final work program report and all accomplishment reports are available at www.mnhabitatcorridors.org.

Accomplishments were achieved by working with many local, state, and federal partners. Effective partnerships are the backbone of conservation in Minnesota. Through this project we have continued the effort to build and enhance effective conservation partnerships that provide wildlife and recreation benefits to all Minnesotans.

Land Acquisiton Report Date of Submission:
Alvstad WMA - 05/24/2010
Benderberg WMA - 08/18/2010
Cambria WMA - 05/24/2010
Clare Johnson WMA - 08/18/2010
Copeland WMA - 05/24/2010
Milan WMA - 08/18/2010
Rich Lake II WMA - 05/24/2010
White Bear WMA - 05/24/2010

LCCMR Work Program Final Report

Restoring Minnesota's Fish and Wildlife Habitat Corridors Phase 5
Habitat Conservation Partnership

4A: Critical Lands Conservation Initiative - Pheasants Forever

Project Results Use and Dissemination
All projects acquired through the Habitat Conservation Partnership acknowledge the funding from the Minnesota Environment & Natural Resources Trust Fund. These new public land additions will be incorporated into the DNR Wildlife Management Area System and will be added to appropriate maps, websites, and other WMA information dissemination outlets. Detailed accomplishment report information is available at www.mnhabitatcorridors.org.

Acquisition Activities

Project Name: White Bear WMA
Project Area: 3 - Border Prairie
Township: 125, Range: 39, Section: 4
Acquisition Holder: DNR-WMA
Description: This 50.3-acre addition includes wetland and grass with approximatley 10 acres of farmland adjacent to the White Bear WMA in White Bear Lake Township, Pope County. This parcel helps
to square up the existing unit and includes several wetlands that straddle the WMA boundary onto this property. Acquisition also will protect the creek drainage that flows from the WMA until the road. Acquisiton will enable better WMA grassland and wetland management. Since this project straddles phases IV and V, prorated acre totals do not equal total project acres in this report.
Acquisition reported via LCCMR website: Yes

	Acres	Grassland Acres	Woodland Acres	Wetland Acres	Shoreline Feet	Riparian Feet
Non Prorated Totals:	50.30	33.00	0.00	17.00	0.00	0.00

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Grassland Acres*	*Woodland Acres*	*Wetland Acres*	*Shoreline Feet*	*Riparian Feet*
ENTF	Fee-Title Acquisition Costs	$21,408.01	7.91	5.19	0.00	2.67	0.00	0.00
Other Funds	Donated Fee Value	$22,918.00	8.47	5.56	0.00	2.86	0.00	0.00
Other Funds	Fee-Title Acquisition Costs	$12,556.00	4.64	3.04	0.00	1.57	0.00	0.00
White Bear WMA Total		**$56,882.01**	**21.02**	**13.79**	**0.00**	**7.11**	**0.00**	**0.00**

LCCMR Work Program Final Report

Restoring Minnesota's Fish and Wildlife Habitat Corridors Phase 5
Habitat Conservation Partnership

4A: Critical Lands Conservation Initiative - Pheasants Forever

Project Name: Benderberg WMA
Tract: 18
Project Area: 6 - Upper Minnesota River
Township: 119, Range: 42, Section: 13
Acquisition Holder: DNR-WMA
Description: This tract consists of 20 acres of wetland and 62 acres of upland and croplands. The croplands will be permanently retired and restored with a high diversity priaire mix. This tract is 2 miles from the 9,000 acre Lac Qui Parle WMA, 1.5 miles away from the Milan WMA, and adjoins another WMA. The acquisition of this tract builds upon previous wildlife habitat investments, will provide quality wildlife habitat, and will provide outdoor recreation opportunities to all Minnesotans. This project was completed using both 2008 and 2009 ENTF appropriations.
Acquisition reported via LCCMR website: Yes

	Acres	Grassland Acres	Woodland Acres	Wetland Acres	Shoreline Feet	Riparian Feet
Non Prorated Totals:	82.00	62.00	0.00	20.00	0.00	0.00

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Grassland Acres*	*Woodland Acres*	*Wetland Acres*	*Shoreline Feet*	*Riparian Feet*
ENTF	Fee-Title Acquisition Costs	$36,067.00	17.16	12.98	0.00	4.19	0.00	0.00
ENTF	Professional Services	$978.00	0.00	0.00	0.00	0.00	0.00	0.00
ENTF	Professional Services	$76.00	0.00	0.00	0.00	0.00	0.00	0.00
ENTF	Professional Services	$1,060.00	0.00	0.00	0.00	0.00	0.00	0.00
Other Funds	Fee-Title Acquisition Costs	$62,563.00	29.77	22.51	0.00	7.26	0.00	0.00
Other Funds	Fee-Title Acquisition Costs	$9,300.00	4.43	3.35	0.00	1.08	0.00	0.00
Benderberg WMA Total		**$110,044.00**	**51.37**	**38.84**	**0.00**	**12.53**	**0.00**	**0.00**

LCCMR Work Program Final Report

Restoring Minnesota's Fish and Wildlife Habitat Corridors Phase 5
Habitat Conservation Partnership

4A: Critical Lands Conservation Initiative - Pheasants Forever

Project Name: Milan WMA
Tract: 14
Project Area: 6 - Upper Minnesota River
Township: 119, Range: 42, Section: 4
Acquisition Holder: DNR-WMA
Description: This 65 acre tract consists of 20 acres of wetland and 45 acres of upland prairie habitat. There is approximatley 20 acres of remnant native prairie on this tract and directly adjoins an established permanently protected habitat complex consisting of WMAs and WPAs. The acquisition of this tract will permanently protect remnant native prairie, will provide quality wildlife habitat, and will provide outdoor recreation opportunities to all Minnesotans.
Acquisition reported via LCCMR website: Yes

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Grassland Acres*	*Woodland Acres*	*Wetland Acres*	*Shoreline Feet*	*Riparian Feet*
ENTF	Fee-Title Acquisition Costs	$55,200.00	30.64	21.21	0.00	9.43	0.00	0.00
ENTF	Professional Services	$92.00	0.00	0.00	0.00	0.00	0.00	0.00
ENTF	Professional Services	$999.50	0.00	0.00	0.00	0.00	0.00	0.00
Other Funds	Fee-Title Acquisition Costs	$55,200.00	30.64	21.21	0.00	9.43	0.00	0.00
Other Funds	Fee-Title Acquisition Costs	$6,700.00	3.72	2.57	0.00	1.14	0.00	0.00
Other Funds	Professional Services	$2,500.00	0.00	0.00	0.00	0.00	0.00	0.00
	Milan WMA Total	**$120,691.50**	**65.00**	**45.00**	**0.00**	**20.00**	**0.00**	**0.00**

Project Name: Clare Johnson WMA
Project Area: 9 - Des Moines River Valley
Township: 113, Range: 45, Section: 7
Acquisition Holder: DNR-WMA
Description: PF purchased (fee title) 36.6 acre adjacent to the excellent wetland on the Clare Johnson WMA. This acquisition will provide quality wildlife habitat and also provide recreational opportunities. PF is in the process of transferring the property to the MNDNR to be managed as a WMA. Matching costs were $2,500 for an appraisal. Total purchase price was $85,000 with $33,000 coming the ENRTF and the remaining from NAWCA and PF.
Acquisition reported via LCCMR website: Yes

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Grassland Acres*	*Woodland Acres*	*Wetland Acres*	*Shoreline Feet*	*Riparian Feet*
ENTF	Fee-Title Acquisition Costs	$33,000.00	14.99	13.43	0.00	1.55	0.00	0.00
ENTF	Professional Services	$1,279.00	0.00	0.00	0.00	0.00	0.00	0.00
Other Funds	Fee-Title Acquisition Costs	$33,000.00	14.99	13.43	0.00	1.55	0.00	0.00
Other Funds	Fee-Title Acquisition Costs	$19,000.00	8.63	7.73	0.00	0.89	0.00	0.00
Other Funds	Professional Services	$2,500.00	0.00	0.00	0.00	0.00	0.00	0.00
	Clare Johnson WMA Total	**$88,779.00**	**38.60**	**34.60**	**0.00**	**4.00**	**0.00**	**0.00**

LCCMR Work Program Final Report

Restoring Minnesota's Fish and Wildlife Habitat Corridors Phase 5
Habitat Conservation Partnership

4A: Critical Lands Conservation Initiative - Pheasants Forever

Project Name: Cambria WMA
Tract: 1
Project Area: 10 - Southern Lakes
Township: 109, Range: 29, Section: 22
Acquisition Holder: DNR-WMA
Description: This parcel lies in NW Blue Earth County and contains 11-acres of remnant native prairie, 50 acres of mixed hardwoods, and shoreline of an oxbow of the Minnesota River. DNR area staff have catalogued more than 60 species of native prairie plants on this site. Funding partners include the seller who donated $2,934 in land value, Nicollet/Blue Earth PF ($50,000), MN Deer Hunter's Association ($4,000), Alliance Pipeline ($20,000), and the PF Minnesota Habitat Fund ($20,000).
Acquisition reported via LCCMR website: Yes

	Acres	Grassland Acres	Woodland Acres	Wetland Acres	Shoreline Feet	Riparian Feet
Non Prorated Totals:	81.00	31.00	50.00	0.00	0.00	0.00

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Grassland Acres*	*Woodland Acres*	*Wetland Acres*	*Shoreline Feet*	*Riparian Feet*
ENTF	Fee-Title Acquisition Costs	$134,200.00	47.03	18.00	29.03	0.00	0.00	0.00
Other Funds	Donated Fee Value	$2,934.00	1.03	0.39	0.63	0.00	0.00	0.00
Other Funds	Fee-Title Acquisition Costs	$94,000.00	32.94	12.61	20.33	0.00	0.00	0.00
Cambria WMA Total		**$231,134.00**	**81.00**	**31.00**	**50.00**	**0.00**	**0.00**	**0.00**

Project Name: Rice Lake - Faribault County
Project Area: 10 - Southern Lakes
Township: 104, Range: 27, Section: 21
Acquisition Holder: DNR-WMA
Description: PF acquired in fee 27 acres on the outlet of Rice Lake. This acquisition will allow water level management on the lake by installing a water control structure and fish barrier. Total acquistion cost was $130,000 with $59,750 coming from ENRTF. The remaining $70,250 were other non-state funds. In addition, $2,750 was match for the appraisal and 697.79 of ENRTF funds paid for closing costs.
Acquisition reported via LCCMR website: Yes

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Grassland Acres*	*Woodland Acres*	*Wetland Acres*	*Shoreline Feet*	*Riparian Feet*
ENTF	Fee-Title Acquisition Costs	$59,750.00	12.41	10.11	0.00	2.30	0.00	0.00
ENTF	Professional Services	$697.79	0.00	0.00	0.00	0.00	0.00	0.00
Other Funds	Fee-Title Acquisition Costs	$70,250.00	14.59	11.89	0.00	2.70	0.00	0.00
Other Funds	Professional Services	$2,750.00	0.00	0.00	0.00	0.00	0.00	0.00
Rice Lake - Faribault County Total		**$133,447.79**	**27.00**	**22.00**	**0.00**	**5.00**	**0.00**	**0.00**

LCCMR Work Program Final Report

Restoring Minnesota's Fish and Wildlife Habitat Corridors Phase 5
Habitat Conservation Partnership

4A: Critical Lands Conservation Initiative - Pheasants Forever

Project Name: Alvstad WMA
Project Area: 3-7-8 - Border Prairie Transition Zone
Township: 128, Range: 41, Section: 1
Acquisition Holder: DNR-WMA
Description: This acquisition squares off the existing Alvstad WMA unit. It improves nesting cover for grassland birds along with providing improved parking and access to the exisitng Alvstad Wildlife
Management Area. Since this project straddles phase IV and V, the prorated acres totals do not
equal the total project totals in this report. Professional services included under Phase V are legal fees.
Acquisition reported via LCCMR website: Yes

		Acres	Grassland Acres	Woodland Acres	Wetland Acres	Shoreline Feet	Riparian Feet
	Non Prorated Totals:	10.00	10.00	0.00	0.00	0.00	0.00

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Grassland Acres*	*Woodland Acres*	*Wetland Acres*	*Shoreline Feet*	*Riparian Feet*
ENTF	Professional Services	$159.50	0.00	0.00	0.00	0.00	0.00	0.00
Other Funds	Donated Fee Value	$32,275.00	5.27	5.27	0.00	0.00	0.00	0.00
Alvstad WMA Total		**$32,434.50**	**5.27**	**5.27**	**0.00**	**0.00**	**0.00**	**0.00**

Project Name: Copeland WMA
Tract: 3
Project Area: 3-7-8 - Border Prairie Transition Zone
Township: 131, Range: 44, Section: 32
Acquisition Holder: DNR-WMA
Description: Marsh and upland habitat adjacent to Copeland WMA located in the Southwest Otter Tail County beach ridge habitat corridor. In addition to adding and preserving habitat in this important corridor, acquisition of this tract will enable additional public use and access to the unit from the south. Professional services included appraisal, appraisal addenda, closing costs and survey.
Acquisition reported via LCCMR website: Yes

		Acres	Grassland Acres	Woodland Acres	Wetland Acres	Shoreline Feet	Riparian Feet
	Non Prorated Totals:	32.00	7.00	0.00	25.00	0.00	0.00

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Grassland Acres*	*Woodland Acres*	*Wetland Acres*	*Shoreline Feet*	*Riparian Feet*
ENTF	Fees	$17.93	0.01	0.00	0.00	0.01	0.00	0.00
Copeland WMA Total		**$17.93**	**0.01**	**0.00**	**0.00**	**0.01**	**0.00**	**0.00**

Acquisition Totals (By Funding Type)

Funding Type:	*Funding Amount*	*Prorated Acres*	*Grassland Acres*	*Woodland Acres*	*Wetland Acres*	*Shoreline Feet*	*Riparian Feet*
ENTF:	$344,984.73	130.15	80.93	29.03	20.15	0.00	0.00

4A: Critical Lands Conservation Initiative - Pheasants Forever

Other Funds:	$428,446.00	159.11	109.57	20.97	28.49	0.00	0.00
Total:	**$773,430.73**	**289.27**	**190.50**	**50.00**	**48.64**	**0.00**	**0.00**

LCCMR Work Program Final Report

Restoring Minnesota's Fish and Wildlife Habitat Corridors Phase 5
Habitat Conservation Partnership

4A: Critical Lands Conservation Initiative - Pheasants Forever

Work Program Expenditures (Not Attributable to Specific Projects)

FundingType	Category	Amount	Description
ENTF	Personnel Expenditures	$5,000.00	Personnel cost
	Total:	**$5,000.00**	

Work Program Expenditures (Not Attributable to Specific Projects) By Funding Type

Funding Type	Amount
ENTF:	$5,000.00
Total:	**$5,000.00**

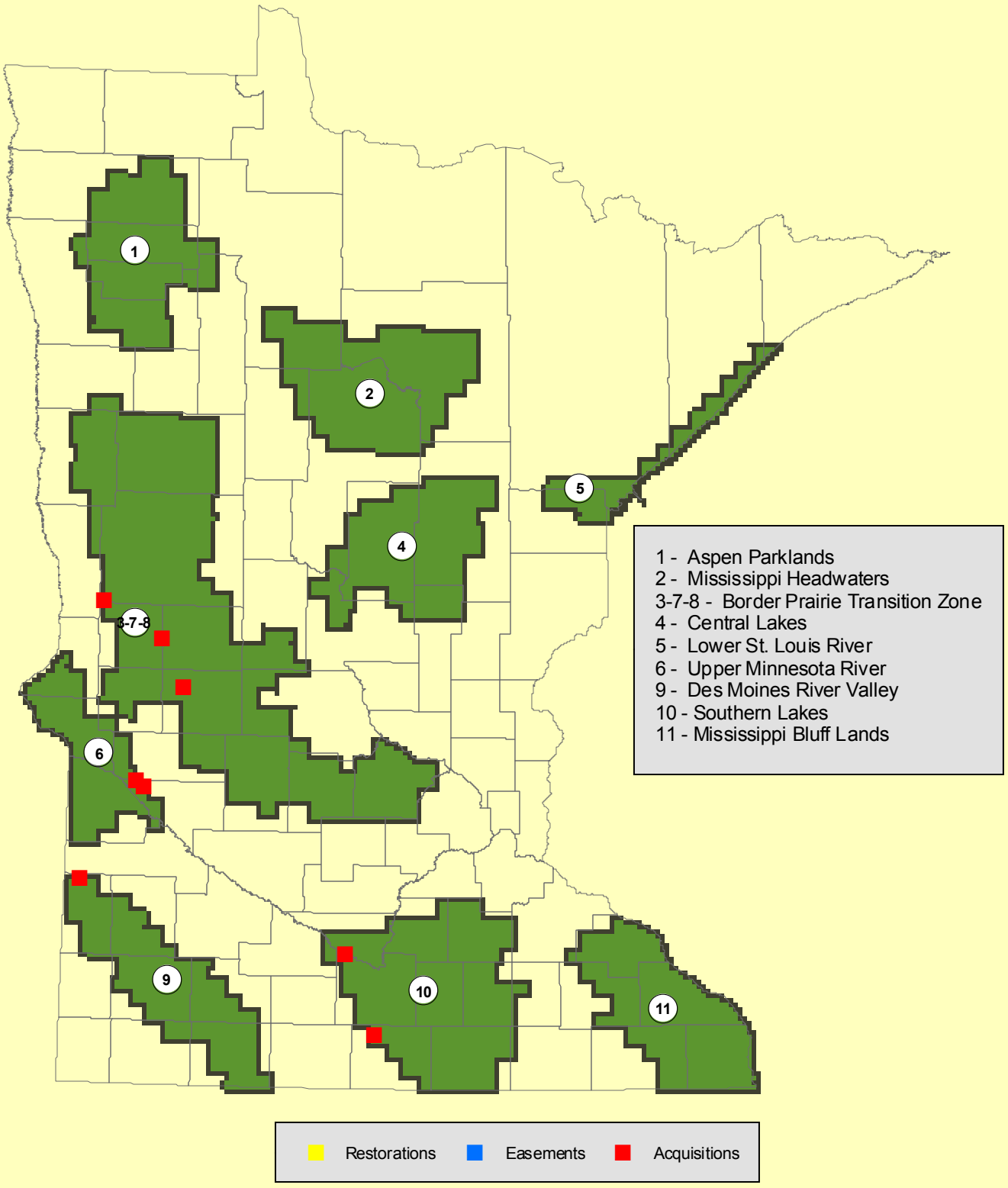
Work Program Expenditures Breakdown

Funding Type:	Acquistion Projects	Not Attributable to Specific Projects	Total
ENTF:	$344,984.73	$5,000.00	$349,984.73
Other Funds:	$428,446.00	$0.00	$428,446.00
Total:	**$773,430.73**	**$5,000.00**	**$778,430.73**

Funding Type Definitions

ENTF:	Grant dollars provided through the Minnesota Environment and Natural Resources Trust Fund
Other Funds:	Non-state, non-state leveraged dollars (if partner funds are leveraging State Funds (e.g. RIM) they are not eligible to be considered Other Funds)
State Funds:	State Funds expended on HCP projects (not eligible for use as Other Funds commitment)
Partner's State Leveraged Funds:	Non State Funds that have leveraged State Funds as part of an HCP project (not eligible for use as Other Funds commitment)
Other:	Any other expenditures (e.g. grant income funds)

Habitat Conservation Partnership
Critical Lands Conservation Initiative
4A



Attachment A: Budget Detail for 2008 Projects - Summary and a Budget page for each partner								
Project Title: Critical Lands Conservation Initiative (CLCI), Pheasants Forever, HCP V - 2008								
	Minnesota's Habitat Conservation Partnership (V)							
Project Manager Name: Eran Sandquist, Regional Wildlife Biologist								
Trust Fund Appropriation: $	**$350,000**							
2008 Trust Fund Budget	**Result 1 Budget:**	**Amount Spent** *(date)*	**Balance** *6/30/10*	**Result 2 Budget:**	**Amount Spent** *(date)*	**Balance** *6/30/10*	**TOTAL BUDGET**	**TOTAL BALANCE**
	Acquisition			*Personnel*				
BUDGET ITEM								
PERSONNEL: wages and benefits			0	5,000	5,000	0	5,000	0
Land acquisition	345,000	344,985	15			0	345,000	15
COLUMN TOTAL	**$345,000**	**$344,985**	**$15**	**$5,000**	**$5,000**	**$0**	**$350,000**	**$15**

2008 Project Abstract
For the Period Ending June 30, 2010

PROJECT TITLE: 4B: Fisheries Acquisition – MN DNR – Division of Fish and Wildlife
PROJECT MANAGER: Mike Halverson
AFFILIATION: MN DNR – Division of Fish & Wildlife
MAILING ADDRESS: 500 Lafayette Rd.
CITY/STATE/ZIP: St. Paul, MN 55155
PHONE: (651) 259- 5209
FAX: (651) 297-4916
E-MAIL: mike.halverson@state.mn.us
WEBSITE: [
FUNDING SOURCE: Environment and Natural Resources Trust Fund
LEGAL CITATION: ML 2008, CH 367, Sec. 2. Sub 3(c)

APPROPRIATION AMOUNT: $250,000

Overall Project Outcome and Results

This project focused on the acquisition of habitat linkages that provided environmental protection of the shoreline and riparian zone, exhibited a high risk of development, supplied angler access, and afforded management access necessary for implementing habitat improvement projects.

Project goals were to protect 60 acres (1.2 miles of lake and stream shoreline) with the help of partner and other state funding. Partner funding includes donations of land value and cash.

Environment and Natural Resources Trust Fund dollars for this project enabled the acquisition of approximately 57.3 acres, including 0.5 miles of lake and stream shoreline. Additionally, leveraged dollars of donations of land value and cash ("other funds" $1,117,828) enabled acquisition of another 103.8 acres and 1.0 shoreline miles, and other state monies ($180,000) enabled acquisition of another 49.5 acres and 0.3 shoreline miles – a total of $1,297,828 of other funds used in this project.

As a result of all funds used in this project, 210.6 acres, including 1.8 miles of critical shoreline fish and wildlife habitat, are now permanently protected and open to public angling and/or hunting - as well as other light use recreational activities. Acquired parcels are now designated and managed as Aquatic Management Areas (AMAs).

Project Results Use and Dissemination

Accomplishment Reports and press releases will be made available at http://www.mnhabitatcorridors.org, and all AMAs will be added to DNR's Public Recreational Information Maps (PRIM).

LCCMR Work Program Final Report

Restoring Minnesota's Fish and Wildlife Habitat Corridors Phase 5
Habitat Conservation Partnership

4B: Fisheries Land Acquisition - MN DNR - Division of Fisheries

Project Manager: Linda Erickson-Eastwood

Affiliation: MN DNR - Division of Fisheries

Address: 500 Lafayette Rd.

St. Paul, MN 55155

Phone: (651) 259-5206

Fax: (651) 297-4916

E-mail: linda.erickson-eastwood@dnr.state.mn.us

Fund: Environment and Natural Resources Trust Fund

Legal Citation: ML 2008 First Special Section, Ch. 367, Sec. 2 Subd. 3(c).

Total Biennial Project Budget

Result	ENTF Allocation	ENTF Funds Spent	ENTF Balance	Other Funds * Proposed	Other Funds * Spent
Acquisition	$250,000	$250,000	$0	$250,000	$299,000
Total	$250,000	$250,000	$0	$250,000	$299,000

*Other Funds are classified as non-state, non-state leveraged dollars (if partner funds are leveraging State Funds (e.g. RIM) they are not eligible to be considered Other Funds). Please note, however, that this work program has spent the following amounts not shown in the above table:

State Funds: $180,000.00

Other: $653,828.00

See the tables and funding type definitions at the end of this report for further explanation.

Work Program Summary

Overall Project Outcome and Results

This project resulted in a grand total of approximately 180.4 acres and 1.8 miles of lake and stream shoreline being acquired as either easement or fee title. Environmental and Natural Resources Trust dollars directly acquired approximately 41.5 acres of the total, including 0.5 miles of lake and stream shoreline. Donations of land value and cash ("other funds" $1,117,828) and other state monies ($180,000) leveraged with trust dollars totaled $1,297,828. These contributions helped acquire the remaining acres of the grand total, including 35.1 acres and 0.3 shoreline miles using state dollars and 103.8 acres and 1.0 shoreline miles from donations of land value and cash.

Project Results Use and Dissemination

This project complemented parcel acquisitions funded in the past with capital bonding, Trout Stamp, and Environmental Trust Fund dollars. The acquisition of aquatic management areas adjacent to lakes and streams ensured the protection of critical riparian habitat areas within sensitive watersheds and headwater areas, as well as, angler and management access. Acquisition under this segment concentrated in the following project areas: 2) Mississippi Headwaters, 3) Border Prairie, 4) Central Lakes, and 6) Upper Minnesota River. AMA parcels will be added to PRIM maps.

LCCMR Work Program Final Report

Restoring Minnesota's Fish and Wildlife Habitat Corridors Phase 5
Habitat Conservation Partnership

4B: Fisheries Land Acquisition - MN DNR - Division of Fisheries

Acquisition Activities

Project Name: Buetow AMA
Tract: 1
Project Area: 2 - Mississippi Headwaters
Township: 142, Range: 28, Section: 16
Acquisition Holder: DNR-AMA
Description: Property includes 238 acres of land, with over 2 miles of shoreline on Headquarters Bay of Leech Lake in Cass County. The project will both protect the natural integrity of the shoreline habitat, and provide non-motorized public acces, including fishing, hunting, trapping, and other light use activities. This is a partnership project with TPL.

Of the $1,200,000 needed to purchase this property, DNR used $370,000(30.83%) and TPL used $830,000(69.17%). Therefore, of the 238 acres and 11,000 feet of shoreline protected with this project, DNR and TPL's prorated accomplishments are 73.4(acres)\3,480(shoreline feet) and 164.6(acres)\7,520(shoreline feet). See below. Please note that Professional Services are not used in determining the prorated accomplishment credits.

	DNR	TPL	Total
Expenditures	$370,000	$830,000	$1,2000,000
Prorated %	30.83%	69.7%	100%
Acres	73.4	164.6	238
Shoreline(feet)	3,480	7,520	11,000

TPL used $480,000 of 2007 Environment and Natural Resources Trust Fund (ENRTF) (HCP Phase 4) money and DNR Fisheries used $190,000 of 2008 ENRTF (HCP Phase 5) money towards this purchase. TPL negotiated the purchase of the property for $175,000 less than its appraised fair market value of $1,200,000, and thus $175,000 of RIM funding could also be used. DNR Fisheries used $180,000 of bonding money to fund the balance of the acquisition.

Acquisition reported via LCCMR website: Yes

	Acres	Grassland Acres	Woodland Acres	Wetland Acres	Shoreline Feet	Riparian Feet
Non Prorated Totals:	238.00	0.00	115.00	123.00	3,480.00	0.00

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Grassland Acres*	*Woodland Acres*	*Wetland Acres*	*Shoreline Feet*	*Riparian Feet*
ENTF	Fee-Title Acquisition Costs	$190,000.00	37.68	0.00	18.21	19.48	551.00	0.00
ENTF	Professional Services	$6,852.90	0.00	0.00	0.00	0.00	0.00	0.00
State Funds	Fee-Title Acquisition Costs	$180,000.00	35.70	0.00	17.25	18.45	522.00	0.00
Buetow AMA Total		**$376,852.90**	**73.38**	**0.00**	**35.46**	**37.93**	**1,073.00**	**0.00**

LCCMR Work Program Final Report

Restoring Minnesota's Fish and Wildlife Habitat Corridors Phase 5
Habitat Conservation Partnership

4B: Fisheries Land Acquisition - MN DNR - Division of Fisheries

Project Name: Preece Point
Tract: 1
Project Area: 2 - Mississippi Headwaters
Township: 146, Range: 33, Section: 30
Acquisition Holder: DNR-AMA
Description: Property includes 15 acres of land, with 1,700 feet of shoreline on Marquette Lake in Beltrami County. This parcel will provide light use public access, including shorefishing.
Acquisition reported via LCCMR website: No

	Acres	Grassland Acres	Woodland Acres	Wetland Acres	Shoreline Feet	Riparian Feet
Non Prorated Totals:	15.00	0.00	8.00	7.00	0.00	0.00

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Grassland Acres*	*Woodland Acres*	*Wetland Acres*	*Shoreline Feet*	*Riparian Feet*
ENTF	Professional Services	$1,089.00	0.00	0.00	0.00	0.00	0.00	0.00
Preece Point Total		**$1,089.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

Project Name: Steamboat Lake AMA
Tract: 2
Project Area: 2 - Mississippi Headwaters
Township: 144, Range: 31, Section: 29
Acquisition Holder: DNR-AMA
Description: Property includes 36 acres of land, with 1,170 feet of shoreline on Steamboat Lake in Cass County. This parcel doubles the shoreline protected as AMA on Steamboat Lake. Acquisition of this site permanently protects habitat important to a variety of fish and wildlife species, as well as protect vital surface and groundwater resources.
Acquisition reported via LCCMR website: No

	Acres	Grassland Acres	Woodland Acres	Wetland Acres	Shoreline Feet	Riparian Feet
Non Prorated Totals:	38.70	0.00	6.00	32.70	1,100.00	0.00

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Grassland Acres*	*Woodland Acres*	*Wetland Acres*	*Shoreline Feet*	*Riparian Feet*
ENTF	Professional Services	$7,234.00	0.00	0.00	0.00	0.00	0.00	0.00
Steamboat Lake AMA Total		**$7,234.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

LCCMR Work Program Final Report

Restoring Minnesota's Fish and Wildlife Habitat Corridors Phase 5
Habitat Conservation Partnership

4B: Fisheries Land Acquisition - MN DNR - Division of Fisheries

Project Name: Bennewitz Pond AMA
Tract: 1
Project Area: 3 - Border Prairie
Township: 128, Range: 39, Section: 24
Acquisition Holder: DNR-AMA
Description: This parcel is a donation from the Vikings Sportsmens Club in Douglas County. They acquired this property to provide permanent access to the DNR for the purposes of rearing walleye for stocking in area lakes. The property includes 27.5 acres with 1.13 miles of shoreline on Bennewitz Pond in Douglas County . The project provides permanent state access to rear walleye, public access to fish during years when walleye survive the winter, and permanently protects the natural integrity of the shoreline habitat.
Acquisition reported via LCCMR website: No

	Acres	Grassland Acres	Woodland Acres	Wetland Acres	Shoreline Feet	Riparian Feet
Non Prorated Totals:	27.50	0.00	2.50	25.00	5,950.00	0.00

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Grassland Acres*	*Woodland Acres*	*Wetland Acres*	*Shoreline Feet*	*Riparian Feet*
ENTF	Professional Services	$80.00	0.00	0.00	0.00	0.00	0.00	0.00
Bennewitz Pond AMA Total		**$80.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

Project Name: Greenleaf AMA
Tract: 1
Project Area: 3 - Border Prairie
Township: 118, Range: 30, Section: 21
Acquisition Holder: DNR-AMA
Description: Property includes 28 acres of land, with 0.5 miles of shoreline on Souix Lake in Meeker County. This is part of a larger project called the Greenleaf Recreation Area. This AMA parcel will both protect the natural integrity of the shoreline habitat, and provide light use public access, including shorefishing. This project is being carried forward into Phase V.
Acquisition reported via LCCMR website: No

	Acres	Grassland Acres	Woodland Acres	Wetland Acres	Shoreline Feet	Riparian Feet
Non Prorated Totals:	28.00	8.00	10.00	10.00	1,700.00	0.00

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Grassland Acres*	*Woodland Acres*	*Wetland Acres*	*Shoreline Feet*	*Riparian Feet*
ENTF	Professional Services	$1,800.00	0.00	0.00	0.00	0.00	0.00	0.00
Greenleaf AMA Total		**$1,800.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

LCCMR Work Program Final Report

Restoring Minnesota's Fish and Wildlife Habitat Corridors Phase 5
Habitat Conservation Partnership

4B: Fisheries Land Acquisition - MN DNR - Division of Fisheries

Project Name: Ida Lake AMA
Tract: 7
Project Area: 3 - Border Prairie
Township: 129, Range: 38, Section: 2
Acquisition Holder: DNR-AMA
Description: This parcel is a donation from the Vikings Sportsmens Club in Douglas County. They acquired this property to permanently protect important spawning habitat. The property includes 21.8 acres with 0.66 miles of shoreline on Ida Lake in Douglas County. The project provides permanent protection to an important gamefish spawning area, protects the natural integrity of the shoreline habitat and provides walk-in public access. This acquisition will be carried forward into phase V.
Acquisition reported via LCCMR website: No

	Acres	Grassland Acres	Woodland Acres	Wetland Acres	Shoreline Feet	Riparian Feet
Non Prorated Totals:	21.80	0.00	5.00	16.80	1,350.00	0.00

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Grassland Acres*	*Woodland Acres*	*Wetland Acres*	*Shoreline Feet*	*Riparian Feet*
Other Funds	Donated Fee Value	$130,000.00	21.80	0.00	5.00	16.80	1,350.00	0.00
Ida Lake AMA Total		**$130,000.00**	**21.80**	**0.00**	**5.00**	**16.80**	**1,350.00**	**0.00**

Project Name: Lizzie Lake AMA
Tract: 1
Project Area: 3 - Border Prairie
Township: 136, Range: 42, Section: 7
Acquisition Holder: DNR-AMA
Description: This is a joint project with the Division of Trails and Waterways. Property includes 3 acres of land, with 900 feet of shoreline where the Pelican River enters Lizzie Lake in Becker County. The project will both protect the natural integrity of the shoreline habitat, and provide public access.
Acquisition reported via LCCMR website: No

	Acres	Grassland Acres	Woodland Acres	Wetland Acres	Shoreline Feet	Riparian Feet
Non Prorated Totals:	3.00	2.00	0.00	1.00	900.00	0.00

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Grassland Acres*	*Woodland Acres*	*Wetland Acres*	*Shoreline Feet*	*Riparian Feet*
ENTF	Fee-Title Acquisition Costs	$34,452.00	2.70	1.80	0.00	0.90	810.00	0.00
ENTF	Professional Services	$1,255.15	0.00	0.00	0.00	0.00	0.00	0.00
Other	Donated Fee Value	$3,828.00	0.30	0.20	0.00	0.10	90.00	0.00
Lizzie Lake AMA Total		**$39,535.15**	**3.00**	**2.00**	**0.00**	**1.00**	**900.00**	**0.00**

4B: Fisheries Land Acquisition - MN DNR - Division of Fisheries

Project Name: Mary Lake AMA
Tract: 1
Project Area: 3 - Border Prairie
Township: 127, Range: 38, Section: 4
Acquisition Holder: DNR-AMA
Description: This parcel is a donation from the Vikings Sportsmens Club in Douglas County. They acquired this property in 1964 to provide access to an inlet area that served as state carp trap. The property includes 1.4 acres with 715 feet of shoreline on Mary Lake in Douglas County. The project provides permanent protection to an important wetland connection to Mary Lake, protects the natural integrity of the shoreline habitat and provides walk-in public access. This project is being carried forward into Phase V.
Acquisition reported via LCCMR website: No

	Acres	Grassland Acres	Woodland Acres	Wetland Acres	Shoreline Feet	Riparian Feet
Non Prorated Totals:	1.40	0.00	1.00	0.40	715.00	0.00

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Grassland Acres*	*Woodland Acres*	*Wetland Acres*	*Shoreline Feet*	*Riparian Feet*
ENTF	Fees	$200.00	1.40	0.00	1.00	0.40	715.00	0.00
Mary Lake AMA Total		**$200.00**	**1.40**	**0.00**	**1.00**	**0.40**	**715.00**	**0.00**

Project Name: Mason Lake Pass
Tract: 1
Project Area: 3 - Border Prairie
Township: 133, Range: 39, Section: 22
Acquisition Holder: DNR-AMA
Description: This parcel is a donation by the last survivors of an old shooting club. They acquired this property in 1965 to use as a duck hunting property for pass shooting ducks between East And West Mason Lakes. The property includes 3.4 acres with 1,070 feet of shoreline. The project provides permanent protection to an important wetland, and public access to both lakes. This project will carry forward into Phase V.
Acquisition reported via LCCMR website: No

	Acres	Grassland Acres	Woodland Acres	Wetland Acres	Shoreline Feet	Riparian Feet
Non Prorated Totals:	3.40	0.00	2.00	3.40	1,070.00	0.00

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Grassland Acres*	*Woodland Acres*	*Wetland Acres*	*Shoreline Feet*	*Riparian Feet*
ENTF	Professional Services	$281.00	0.00	0.00	0.00	0.00	0.00	0.00
Mason Lake Pass Total		**$281.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

4B: Fisheries Land Acquisition - MN DNR - Division of Fisheries

Project Name: Middle Lake AMA
Tract: 1
Project Area: 3 - Border Prairie
Township: 121, Range: 35, Section: 9
Acquisition Holder: DNR-AMA
Description: Property includes 14 acres of land, with 3,010 feet of shoreline on Middle Lake in Kandiyohi County. This is a cooperative project with MN DNR Trails and Waterways, who will develop a public boat access on their portion. The Fisheries administered portion will both protect the natural integrity of the shoreline habitat, and provide light use public access, including shorefishing.
Acquisition reported via LCCMR website: No

	Acres	Grassland Acres	Woodland Acres	Wetland Acres	Shoreline Feet	Riparian Feet
Non Prorated Totals:	8.80	0.00	8.00	0.80	1,715.00	0.00

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Grassland Acres*	*Woodland Acres*	*Wetland Acres*	*Shoreline Feet*	*Riparian Feet*
ENTF	Professional Services	$829.00	0.00	0.00	0.00	0.00	0.00	0.00
Middle Lake AMA Total		**$829.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

Project Name: Pelican Lake AMA
Tract: 1
Project Area: 4 - Central Lakes
Township: 136, Range: 28, Section: 25
Acquisition Holder: DNR-AMA
Description: Property includes 54 acres of land, with 2,200 feet of shoreline on Pelican Lake in Crow Wing County. The land is already encumbered with a Conservation Easement held by the Minnesota Land Trust. The fee title portion is being donated to the DNR and will provide light use public access, including shorefishing.
Acquisition reported via LCCMR website: No

	Acres	Grassland Acres	Woodland Acres	Wetland Acres	Shoreline Feet	Riparian Feet
Non Prorated Totals:	78.30	0.00	38.30	40.00	2,815.00	0.00

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Grassland Acres*	*Woodland Acres*	*Wetland Acres*	*Shoreline Feet*	*Riparian Feet*
ENTF	Professional Services	$3,965.95	0.00	0.00	0.00	0.00	0.00	0.00
Other	Donated Fee Value	$650,000.00	78.30	0.00	38.30	40.00	2,815.00	0.00
Pelican Lake AMA Total		**$653,965.95**	**78.30**	**0.00**	**38.30**	**40.00**	**2,815.00**	**0.00**

LCCMR Work Program Final Report

Restoring Minnesota's Fish and Wildlife Habitat Corridors Phase 5
Habitat Conservation Partnership

4B: Fisheries Land Acquisition - MN DNR - Division of Fisheries

Project Name: Knife River
Tract: 27
Project Area: 5 - Lower St. Louis River
Township: 52, Range: 11, Section: 19
Acquisition Holder: DNR-AMA
Description: This is a permanent AMA angling and management easement that provides angler access on 860 feet of the Knife River, a designated trout stream. The easement is immediately adjacent to another permanent easement. The easement also provides protection to the shoreline habitat.
Acquisition reported via LCCMR website: No

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Grassland Acres*	*Woodland Acres*	*Wetland Acres*	*Shoreline Feet*	*Riparian Feet*
ENTF	Professional Services	$1,042.00	0.00	0.00	0.00	0.00	0.00	0.00
Knife River Total		**$1,042.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

Project Name: Big Stone Lake AMA
Tract: 1
Project Area: 6 - Upper Minnesota River
Township: 122, Range: 47, Section: 10
Acquisition Holder: DNR-AMA
Description: Property includes 2.5 acres of land, with 300 feet of shoreline on Big Stone Lake in Big Stone County. This parcel permanently protects habitat important to a variety of fish and wildlife species, as well as provide light use access, including shore angling.
Acquisition reported via LCCMR website: No

	Acres	**Grassland Acres**	**Woodland Acres**	**Wetland Acres**	**Shoreline Feet**	**Riparian Feet**
Non Prorated Totals:	2.50	0.00	2.00	0.50	300.00	0.00

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Grassland Acres*	*Woodland Acres*	*Wetland Acres*	*Shoreline Feet*	*Riparian Feet*
ENTF	Professional Services	$719.00	0.00	0.00	0.00	0.00	0.00	0.00
Other Funds	Donated Fee Value	$169,000.00	2.50	0.00	2.00	0.50	300.00	0.00
Big Stone Lake AMA Total		**$169,719.00**	**2.50**	**0.00**	**2.00**	**0.50**	**300.00**	**0.00**

LCCMR Work Program Final Report

Restoring Minnesota's Fish and Wildlife Habitat Corridors Phase 5
Habitat Conservation Partnership

4B: Fisheries Land Acquisition - MN DNR - Division of Fisheries

Project Name: Whitewater Way AMA
Tract: 1
Project Area: 11 - Mississippi Bluff Lands
Township: 108, Range: 12, Section: 27
Acquisition Holder: DNR-AMA
Description: This is a fee title donation from the Multi-County Hosing and Redevelopment Authority and is located on the North Branch of the Whitewater River in Elgin. It will permanently protect 1,950 feet of natural shoreline and provide trout angling for the public, as well as management access for the DNR.
Acquisition reported via LCCMR website: No

	Acres	Grassland Acres	Woodland Acres	Wetland Acres	Shoreline Feet	Riparian Feet
Non Prorated Totals:	8.00	2.00	5.00	1.00	0.00	1,950.00

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Grassland Acres*	*Woodland Acres*	*Wetland Acres*	*Shoreline Feet*	*Riparian Feet*
ENTF	Professional Services	$200.00	0.00	0.00	0.00	0.00	0.00	0.00
Whitewater Way AMA Total		**$200.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

Acquisition Totals (By Funding Type)

Funding Type:	*Funding Amount*	*Prorated Acres*	*Grassland Acres*	*Woodland Acres*	*Wetland Acres*	*Shoreline Feet*	*Riparian Feet*
ENTF:	$250,000.00	41.78	1.80	19.21	20.78	2,076.00	0.00
Other Funds:	$299,000.00	24.30	0.00	7.00	17.30	1,650.00	0.00
State Funds:	$180,000.00	35.70	0.00	17.25	18.45	522.00	0.00
Other:	$653,828.00	78.60	0.20	38.30	40.10	2,905.00	0.00
Total:	**$1,382,828.00**	**180.38**	**2.00**	**81.76**	**96.63**	**7,153.00**	**0.00**

Funding Type Definitions

ENTF:	Grant dollars provided through the Minnesota Environment and Natural Resources Trust Fund
Other Funds:	Non-state, non-state leveraged dollars (if partner funds are leveraging State Funds (e.g. RIM) they are not eligible to be considered Other Funds)
State Funds:	State Funds expended on HCP projects (not eligible for use as Other Funds commitment)
Partner's State Leveraged Funds:	Non State Funds that have leveraged State Funds as part of an HCP project (not eligible for use as Other Funds commitment)
Other:	Any other expenditures (e.g. grant income funds)

2008 Project Abstract
For the Period Ending June 30, 2010

PROJECT TITLE: 4C: Critical Lands Protection Program – The Trust for Public Land
PROJECT MANAGER: Robert McGillivray
AFFILIATION: The Trust for Public Land
MAILING ADDRESS: 2610 University Ave, #300
CITY/STATE/ZIP: St. Paul, MN 55114
PHONE: 651-999-5307
E-MAIL: rjm@tpl.org
WEBSITE: www.tpl.org
FUNDING SOURCE: Environment and Natural Resources Trust Fund
LEGAL CITATION: ML 2008 First Special Session, Ch. 376, Sec. 2, Subd. 3(c)

APPROPRIATION AMOUNT: $350,000

Overall Project Outcome and Results
On March 30, 2010, The Trust for Public Land (TPL) acquired 440 acres on Lester Lake in Hubbard County, Minnesota from Bieloh Brothers Investments, LLC for $1,450,000 (its appraised fair market value) and conveyed it to the Minnesota Department of Natural Resources (DNR). The $350,000 appropriation of Environment and Natural Resources Trust Fund (ENRTF) money that TPL used on this acquisition purchased 106 of those acres acres. Other funding for this acquisition included a $350,000 Conservation Partners Legacy Grant, $100,000 in ENRTF money appropriated to DNR SNA, $390,000 in State Bonding money appropriated to DNR SNA, $183,800 in Outdoor Heritage Fund money appropriated to DNR Fisheries, $16,200 in RIM Critical Habitat Match, and $60,000 in private funds.

The Lester Lake acquisition creates a new DNR SNA/AMA protecting a sensitive natural resource and providing outstanding opportunities for public fishing, hunting, and nature observation. The 440-acre parcel contains all of the shoreline of a 75 acre undeveloped lake and half a mile of a small creek that previously had no public access. The site hosts a full spectrum of plant communities and several species of special concern. The Minnesota County Biological Survey recognized it as a site of high biodiversity significance meriting consideration for “the highest level of protection available." This diverse habitat also links a number of parcels of land already in public ownership ensuring a large landscape for wildlife to roam. Water quality of Lester Lake, the creek running through the property, and surrounding water bodies has also been protected by conservation of this resource.

The land is close to Walker and Park Rapids in an area under great development pressure and the owners had decided to sell. The threat of development to this important natural resource made this acquisition a priority for the DNR, the Kabekona Lake Association, the Leech Lake Area Watershed Foundation, and other stakeholders. The DNR had previously attempted to acquire the property but was unsuccessful. Although the property was listed for sale, TPL was able to quickly secure the property for its appraised fair market value, complete the due diligence process, and work together with its partners to assemble a funding package to protect this important resource for fish, wildlife, and future generations. There was strong public support for this conservation effort that ultimately received unanimous approval from the Hubbard County Board.

Project Results Use and Dissemination
The Leech Lake Area Watershed encompasses nearly 800,000 acres of land and water critical to the water quality of Minnesota's lakes and rivers. It is under intense development pressure as more and more people seek to have second homes in the heart of Minnesota's Northwoods. TPL is working with the Minnesota DNR and interested stakeholders, such as the Leech Lake Area Watershed Foundation, the U.S. Forest Service and the Leech Lake Band of Ojibwe to protect the most sensitive lands in this area. TPL will use the Lester Lake project as an example of how various organizations can work together to conserve more resources than they could working separately. TPL will disseminate information about this

project on its website. There have also been several news articles about this project that have been separately submitted.

LCCMR Work Program Final Report

Restoring Minnesota's Fish and Wildlife Habitat Corridors Phase 5

Habitat Conservation Partnership

4C: Critical Lands Protection Program - The Trust for Public Land

Project Manager: Robert McGillivray

Affiliation: The Trust for Public Land

Address: 2610 University Ave

St. Paul, MN 55114

Phone: 651-999-5307

Fax: 651-917-2248

E-mail: Bob.McGillivray@tpl.org

Fund: Environment and Natural Resources Trust Fund

Legal Citation: ML 2008 First Special Section, Ch. 367, Sec. 2 Subd. 3(c).

Total Biennial Project Budget

Result	ENTF Allocation	ENTF Funds Spent	ENTF Balance	Other Funds * Proposed	Other Funds * Spent
Acquisition	$350,000	$350,000	$0	$350,000	$60,000
Total	$350,000	$350,000	$0	$350,000	$60,000

*Other Funds are classified as non-state, non-state leveraged dollars (if partner funds are leveraging State Funds (e.g. RIM) they are not eligible to be considered Other Funds). Please note, however, that this work program has spent the following amounts not shown in the above table:

State Funds: $1,040,000.00

See the tables and funding type definitions at the end of this report for further explanation.

Work Program Summary

Overall Project Outcome and Results

On March 30, 2010, The Trust for Public Land (TPL) acquired 440 acres on Lester Lake in Hubbard County, Minnesota from Bieloh Brothers Investments, LLC for $1,450,000 (its appraised fair market value) and conveyed it to the Minnesota Department of Natural Resources (DNR). The $350,000 appropriation of Environment and Natural Resources Trust Fund (ENRTF) money that TPL used on this acquisition purchased 106 allocated acres. Other funding for this acquisition included a $350,000 Conservation Partners Legacy Grant, $100,000 in ENRTF money appropriated to DNR SNA, $390,000 in State Bonding money appropriated to DNR SNA, $183,800 in Outdoor Heritage Fund money appropriated to DNR Fisheries, $16,200 in RIM Critical Habitat Match, and $60,000 in private funds.

The Lester Lake acquisition creates a new Department of Natural Resources SNA/AMA protecting a sensitive natural resource and providing outstanding opportunities for public fishing, hunting and nature observation. The 440-acre parcel contains all of the shoreline of a 75 acre undeveloped lake and half a mile of a small creek that previously had no public assess. The site hosts a full spectrum of plant communities and several species of special concern. The Minnesota County Biological Survey recognized it as a site of high biodiversity significance meriting consideration for “the highest level of protection available." This diverse habitat also links a number of parcels of land already in public ownership ensuring a large landscape for wildlife to roam. Water quality of Lester Lake, the creek running through the property, and surrounding water bodies has also been protected by conservation of this resource.

The land is close to Walker and Park Rapids in an area under great development pressure and the owners had decided to sell. The threat of development to this important natural resource made this acquisition a priority for the DNR, the Kabekona Lake Association, the Leech Lake Area Watershed Foundation and other stakeholders. The DNR had previously attempted to acquire the property but was unsuccessful. Although the property was listed for sale, TPL was able to quickly secure the property for its appraised fair market value, complete the due diligence process and work together with its partners to assemble a funding

package to protect this important resource for fish, wildlife and future generations. There was strong public support for this conservation effort that ultimately received unanimous approval from the Hubbard County Board.

Project Results Use and Dissemination

The Leech Lake Area Watershed encompasses nearly 800,000 acres of land and water critical to the water quality of Minnesota's lakes and rivers. It is under intense development pressure as more and more people seek to have second homes in the heart of Minnesota's Northwoods. TPL is working with the Minnesota DNR and interested stakeholders, such as the Leech Lake Area Watershed Foundation, the U. S. Forest Service and the Leech Lake Band of Ojibwe, to protect the most sensitive lands in this area. TPL will use the Lester Lake project as an example of how various organizations can work together to conserve more resources than they could working separately. TPL will diseminate information about this project on its website . There have also been several news articles about this project that have been separately submitted.

Acquisition Activities

Project Name: Lester Lake SNA/AMA
Tract: 1
Project Area: 1 - Aspen Parklands
Township: 142, Range: 32, Section: 5
Acquisition Holder: DNR-SNA
Description: Acquistion of 440 acre Lester Lake SNA/AMA. Note that State Funds listed below includes $100,000 of 2008 ENRTF funds appropriated to DNR SNA.
Acquisition reported via LCCMR website: Yes

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Grassland Acres*	*Woodland Acres*	*Wetland Acres*	*Shoreline Feet*	*Riparian Feet*
ENTF	Fee-Title Acquisition Costs	$350,000.00	106.21	0.00	57.93	48.28	1,448.28	482.76
Other Funds	Fee-Title Acquisition Costs	$60,000.00	18.21	0.00	9.93	8.28	248.28	82.76
State Funds	Fee-Title Acquisition Costs	$1,040,000.00	315.59	0.00	172.14	143.45	4,303.45	1,434.48
Lester Lake SNA/AMA Total		**$1,450,000.00**	**440.00**	**0.00**	**240.00**	**200.00**	**6,000.00**	**2,000.00**

Acquisition Totals (By Funding Type)

Funding Type:	*Funding Amount*	*Prorated Acres*	*Grassland Acres*	*Woodland Acres*	*Wetland Acres*	*Shoreline Feet*	*Riparian Feet*
ENTF:	$350,000.00	106.21	0.00	57.93	48.28	1,448.28	482.76
Other Funds:	$60,000.00	18.21	0.00	9.93	8.28	248.28	82.76
State Funds:	$1,040,000.00	315.59	0.00	172.14	143.45	4,303.45	1,434.48
Total:	**$1,450,000.00**	**440.00**	**0.00**	**240.00**	**200.00**	**6,000.00**	**2,000.00**

LCCMR Work Program Final Report

Restoring Minnesota's Fish and Wildlife Habitat Corridors Phase 5

Habitat Conservation Partnership

4C: Critical Lands Protection Program - The Trust for Public Land

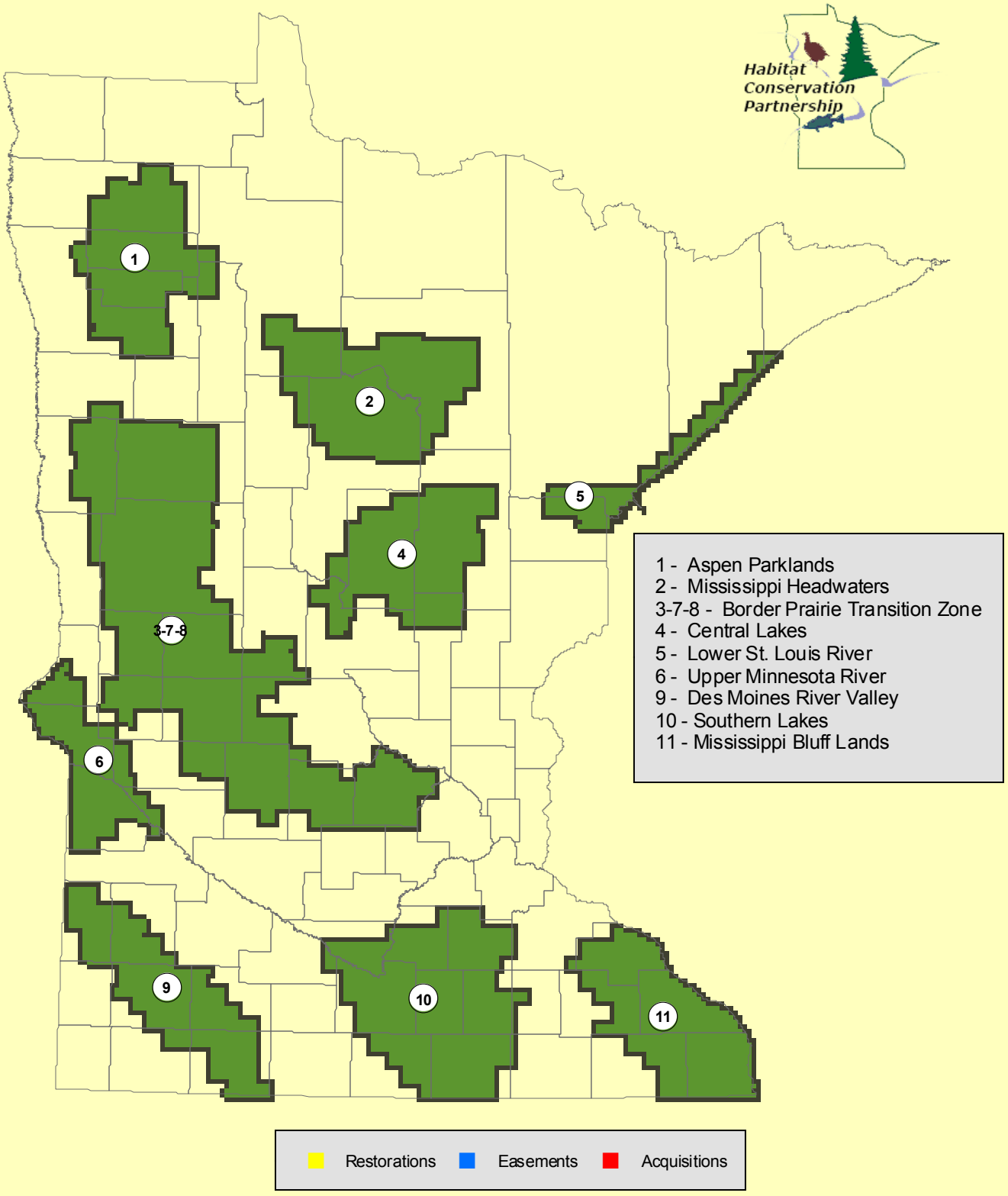
Funding Type Definitions

ENTF:	Grant dollars provided through the Minnesota Environment and Natural Resources Trust Fund
Other Funds:	Non-state, non-state leveraged dollars (if partner funds are leveraging State Funds (e.g. RIM) they are not eligible to be considered Other Funds)
State Funds:	State Funds expended on HCP projects (not eligible for use as Other Funds commitment)
Partner's State Leveraged Funds:	Non State Funds that have leveraged State Funds as part of an HCP project (not eligible for use as Other Funds commitment)
Other:	Any other expenditures (e.g. grant income funds)

Attachment A: Budget Detail for 2008 Projects				
Project Title: TPL's Critical Lands Protection Program				
	Minnesota's Habitat Conservation Partnership (V)			
Project Manager Name: Robert McGillivray				
Trust Fund Appropriation: $ *350,000*				
2008 Trust Fund Budget	**Result 1 Budget:**	**Amount Spent 5-1-10**	**Balance 5-1-10**	
	Acquisition			
BUDGET ITEM			0	
Land acquisition	350,000	350,000	0	
COLUMN TOTAL	**$350,000**	**$350,000**	**$0**	

Habitat Conservation Partnership
Critical Lands Protection Program

4C



Attachment A: Budget Detail for 2008 Projects			
Project Title: TPL's Critical Lands Protection Program			
	Minnesota's Habitat Conservation Partnership (V)		
Project Manager Name: Robert McGillivray			
Trust Fund Appropriation: $ *350,000*			
2008 Trust Fund Budget	**Result 1 Budget:**	**Amount Spent 5-1-10**	**Balance 5-1-10**
	Acquisition		
BUDGET ITEM			0
Land acquisition	350,000	350,000	0
COLUMN TOTAL	**$350,000**	**$350,000**	**$0**

2008 Project Abstract
For the Period Ending June 30, 2010

TITLE: Habitat Acquisition for Minnesota Valley Wetland Management District, USFWS- 4(h)
PROJECT MANAGER: Deborah Loon
ORGANIZATION: Minnesota Valley National Wildlife Refuge Trust, Inc.
ADDRESS: 2312 Seabury Avenue, Minneapolis, MN 55406
WEB SITE ADDRESS: NA
FUND: Environment and Natural Resources Trust Fund
LEGAL CITATION: ML 2008, Chap. 367, Sec. 2, Subd. 3(c).
APPROPRIATION AMOUNT: $50,000

Overall Project Outcome and Results

The Minnesota Valley National Wildlife Refuge Trust, Inc. acquired 80 acres of significant wetland and grassland habitat in Lincoln Township of Blue Earth County (HCP Project Area 10) on December 2, 2008. Of the 80 acres, 30.49 acres were purchased with Environment and Natural Resources Trust grant funds and the balance of 49.51 acres were purchased with Minnesota Valley Trust funds.

This tract was specifically identified by the USFWS as a priority acquisition, as it is immediately north of the 320 acres previously acquired by the Trust for the Lincoln WPA. This expansion, along with another 120 acres acquired by the Trust simultaneously and 120 adjacent acres enrolled in WRP, brings the Lincoln WPA complex to 640 acres.

This strategic acquisition will enable a complete restoration of all wetlands and grasslands in this large complex, including more than 100 acres of wetlands. As this complex sits at the head of the judicial ditch, we will be able to remove substantial currently drained agricultural land from the judicial ditch. This project will provide excellent waterfowl and wildlife habitat, while improving water quality in the Watonwan River Watershed.

The Trust is working with the USFWS and BWSR on the restoration plans for the full 520 acre WPA and 120 acre WRP. Work will commence in the summer of 2010. After restoration, the land will be donated to the USFWS.

Project Results Use and Dissemination

The Minnesota Valley Trust will publicize the completion of this acquisition and all restoration through its website and news releases to the local media. After restoration is completed, the land will be donated to the Minnesota Valley National Wildlife Refuge and Wetland Management District. All funding partners will be acknowledged on Refuge kiosks, including the Environment and Natural Resources Trust Fund, as recommended by the Legislative Commission on Minnesota Resources.

LCCMR Work Program Final Report

Restoring Minnesota's Fish and Wildlife Habitat Corridors Phase 5
Habitat Conservation Partnership

4H: Habitat Acquisition for Minnesota Valley Wetland Managment District of UWFWS - MN Valley Trust

Project Manager: Deborah Loon

Affiliation: MN Valley Trust

Address: 2312 Seabury Avenue
Minneapolis, MN 55406

Phone: (612)728-3772

Fax: (612)728-0700

E-mail: DebLoon@comcast.net

Fund: Environment and Natural Resources Trust Fund

Legal Citation: ML 2008 First Special Section, Ch. 367, Sec. 2 Subd. 3(c).

Total Biennial Project Budget

Result	ENTF Allocation	ENTF Funds Spent	ENTF Balance	Other Funds Proposed	Other Funds Spent
Acquisition	$50,000	$50,000	$0	$50,000	$85,681
Total	$50,000	$50,000	$0	$50,000	$85,681

.

Work Program Summary

Overall Project Outcome and Results

The Minnesota Valley National Wildlife Refuge Trust, Inc. acquired 80 acres of significant wetland and grassland habitat in Lincoln Township of Blue Earth County (HCP Project Area 10) on December 2, 2008. Of the 80 acres, 30.49 acres were purchased with Environment and Natural Resources Trust grant funds and the balance of 49.51 acres were purchased with Minnesota Valley Trust funds.

This tract was specifically identified by the USFWS as a priority acquisition, as it is immediately north of the 320 acres previously acquired by the Trust for the Lincoln WPA. This expansion, along with another 120 acres acquired by the Trust simultaneously and 120 adjacent acres enrolled in WRP, brings the Lincoln WPA complex to 640 acres.

This strategic acquisition will enable a complete restoration of all wetlands and grasslands in this large complex, including more than 100 acres of wetlands. As this complex sits at the head of the judicial ditch, we will be able to remove substantial currently drained agricultural land from the judicial ditch. This project will provide excellent waterfowl and wildlife habitat, while improving water quality in the Watonwan River Watershed.

The Trust is working with the USFWS and BWSR on the restoration plans for the full 520 acre WPA and 120 acre WRP. Work will commence in the summer of 2010. After restoration, the land will be donated to the USFWS.

The Trust paid the appraised value for this 80 acre parcel of $131,200.

Transaction costs for this 80 acres and the adjacent 40 acre parcel acquired simultaneously from the seller were as follows:
- Appraisal – $1,200
- Legal – $1,590
- Title insurance, closing, recording fees -- $1,487.80

Project Results Use and Dissemination

The Minnesota Valley Trust will publicize the completion of this acquisition and all restoration through its website and news releases to the local media. After restoration is completed, the land will be donated to the Minnesota Valley National Wildlife Refuge and Wetland Management District. All funding partners will be acknowledged on Refuge kiosks, including the Environment and Natural Resources Trust Fund, as recommended by the Legislative Commission on Minnesota Resources.

LCCMR Work Program Final Report

Restoring Minnesota's Fish and Wildlife Habitat Corridors Phase 5
Habitat Conservation Partnership

4H: Habitat Acquisition for Minnesota Valley Wetland Managment District of UWFWS - MN Valley Trust

Acquisition Activities

Project Name: Lincoln WPA Addition
Tract: 2
Project Area: 10 - Southern Lakes
Township: 107, Range: 29, Section: 26
Acquisition Holder: USFWS-WPA
Description: The MN Valley Trust has acquired 80 acres as an important addition to the Lincoln WPA. This parcel includes the head of the judicial ditch that runs through the WPA, allowing a full restoration of all wetlands on the WPA.
Acquisition reported via LCCMR website: No

Funding Type	*Funds Use*	*Funding Amount*	*Prorated Acres*	*Grassland Acres*	*Woodland Acres*	*Wetland Acres*	*Shoreline Feet*	*Riparian Feet*
ENTF	Fees	$50,000.00	30.49	22.87	0.00	7.62	0.00	0.00
Other Funds	Fees	$81,190.55	49.51	37.13	0.00	12.38	0.00	0.00
Other Funds	Professional Services	$4,490.00	0.00	0.00	0.00	0.00	0.00	0.00
Lincoln WPA Addition Total		**$135,680.55**	**80.00**	**60.00**	**0.00**	**20.00**	**0.00**	**0.00**

Acquisition Totals (By Funding Type)

Funding Type:	*Funding Amount*	*Prorated Acres*	*Grassland Acres*	*Woodland Acres*	*Wetland Acres*	*Shoreline Feet*	*Riparian Feet*
ENTF:	$50,000.00	30.49	22.87	0.00	7.62	0.00	0.00
Other Funds:	$85,680.55	49.51	37.13	0.00	12.38	0.00	0.00
Total:	**$135,680.55**	**80.00**	**60.00**	**0.00**	**20.00**	**0.00**	**0.00**

Funding Type Definitions

ENTF:	Grant dollars provided through the Minnesota Environment and Natural Resources Trust Fund
Other Funds:	Non-state, non-state leveraged dollars (if partner funds are leveraging State Funds (e.g. RIM) they are not eligible to be considered Other Funds)
State Funds:	State Funds expended on HCP projects (not eligible for use as Other Funds commitment)
Partner's State Leveraged Funds:	Non State Funds that have leveraged State Funds as part of an HCP project (not eligible for use as Other Funds commitment)
Other:	Any other expenditures (e.g. grant income funds)

Attachment A: Budget Detail for 2008 Projects -

Project Title: Habitat Acquisition for Minnesota Valley Wetland Management District, USFWS- 4(h)

Project Manager Name: Deborah Loon, Minnesota Valley National Wildlife Refuge Trust, Inc.

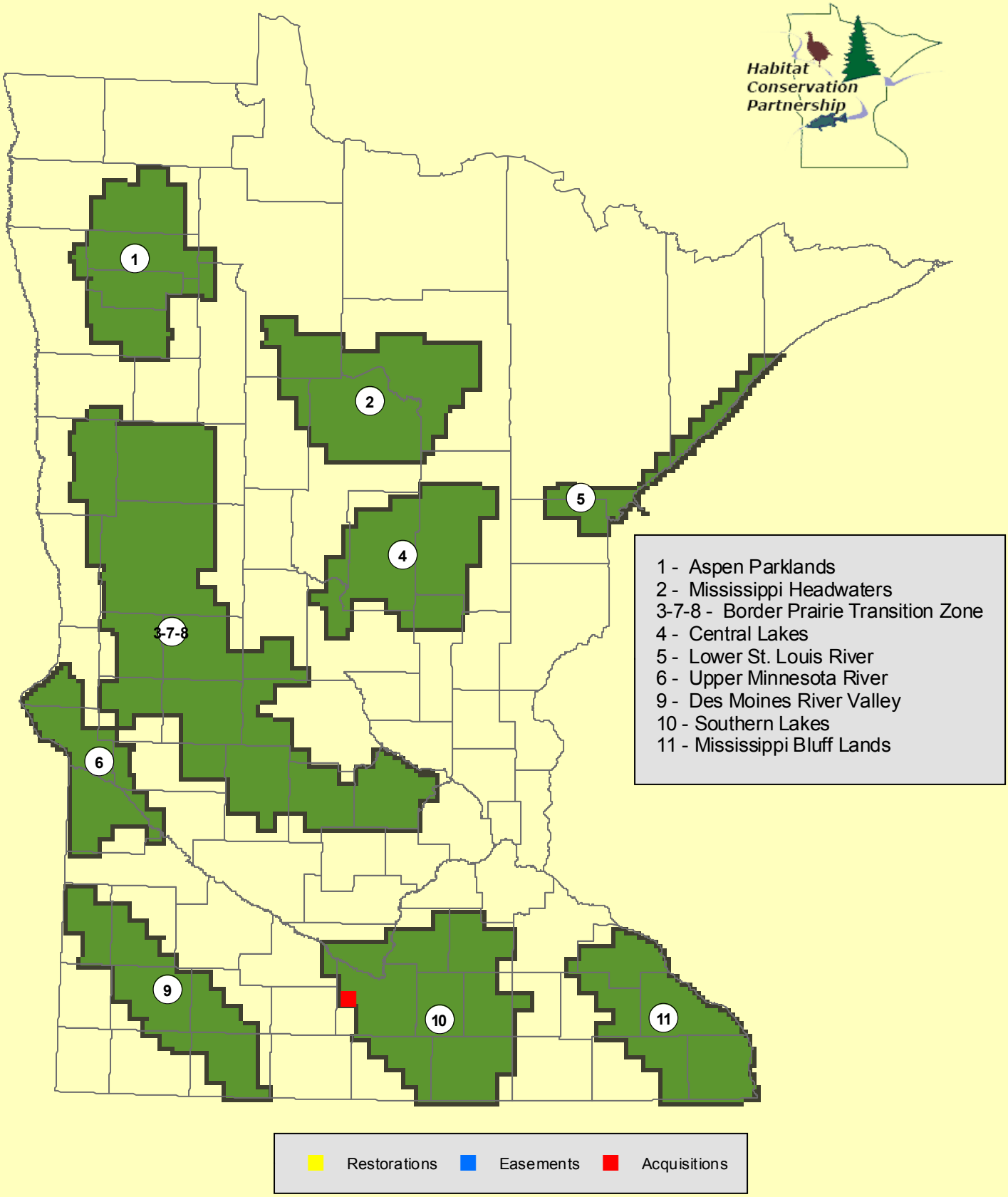
Trust Fund Appropriation: $ *5*0,000

1) See list of non-eligible expenses, do not include any of these items in your budget sheet

2) Remove any budget item lines not applicable

2008 Trust Fund Budget	**Result 1 Budget:**	**Amount Spent**	**Balance as of Feb. 23, 2009**	**TOTAL BUDGET**	**TOTAL BALANCE**
	Acquire 10 acres of priority habitat in focus area 10 for Minnesota Valley Wetland Management District, USFWS				
BUDGET ITEM			0	0	0
Land acquisition	50,000	50,000	0	0	0
COLUMN TOTAL	**$50,000**	**$50,000**	**$0**	**0**	**$0**

Habitat Conservation Partnership
Phase 5 Accomplishments
4H - Habitat Aquisition



2008 Project Abstract
For the Period Ending June 30, 2010

PROJECT TITLE:	4I: Habitat Acquisition – Professional Services – MN DNR – Division of Fish and Wildlife
PROJECT MANAGER:	Mike Halverson
AFFILIATION:	MN DNR – Division of Fish & Wildlife
MAILING ADDRESS:	500 Lafayette Rd.
CITY/STATE/ZIP:	St. Paul, MN 55155
PHONE:	(651) 259- 5209
FAX:	(651) 297-4916
E-MAIL:	mike.halverson@state.mn.us
WEBSITE:	
FUNDING SOURCE:	Environment and Natural Resources Trust Fund
LEGAL CITATION:	ML 2008, CH 367, Sec. 2. Sub 3(c)

APPROPRIATION AMOUNT: $30,000

Overall Project Outcome and Results
This project focused on paying professional services related to the conveyance of habitat corridor lands to the DNR by HCP partners. Parcels acquired from HCP partners will be placed in public ownership and administered as State Wildlife Management Areas.

Project goals were to pay professional services as parcels are conveyed to DNR by nonprofit HCP partners. During this appropriation – only Pheasants Forever (PF) projects were conveyed to DNR.

This project resulted in professional services being paid on 12 different parcels as they were processed for conveyance to DNR by HCP Partners. Project funding by PF changed as time went by, with some projects not being acquired with Environment and Natural Resources Trust Fund (ENRTF) dollars at closing, and other unanticipated parcels changing to ENRTF dollars at closing. Some of these PF projects were closed last year, but continued to have residual professional services for closing the project out. Some projects have just started the acquisition process and will continue into the next phase of 4I: Habitat Acquisition – Professional Services. Consequently the range of dollars spent on projects varied greatly, but ranged from $200 to $4,500.

As a result of this project, DNR was able to pay for professional services and processing costs related to land acquisition transfers to the DNR from HCP partners. Costs include the following: staff time for Division of Lands and Minerals ($80/hour) and the Attorney General's Office ($101/hour), survey costs, recording and abstracting fees, and deed tax.

Project Results Use and Dissemination
Accomplishment Reports and press releases will be made available at http://www.mnhabitatcorridors.org.

LCCMR Work Program Final Report

Restoring Minnesota's Fish and Wildlife Habitat Corridors Phase 5
Habitat Conservation Partnership

4I: Professional Services - MN DNR - Division of Fish & Wildlife

Project Manager: Kim Hennings

Affiliation: MN DNR - Division of Fish & Wildlife

Address: 500 Lafayette Rd.
St. Paul, MN 55,155

Phone: (651) 259-5210

Fax: (651) 297-4961

E-mail: kim.hennings@dnr.state.mn.us

Fund: Environment and Natural Resources Trust Fund

Legal Citation: ML 2008 First Special Section, Ch. 367, Sec. 2 Subd. 3(c).

Total Work Program Budget

Result	ENTF Allocation	ENTF Funds Spent	ENTF Balance	Other Funds Proposed	Other Funds Spent
Acquisition	$30,000	$ 30,000	$0	$0	$0
Total	$30,000	$ 30,000	$0	$0	$0

Work Program Summary

Overall Project Outcome and Results

This project focused on paying professional services related to the conveyance of habitat corridor lands to the DNR by HCP partners. Parcels acquired from HCP partners will be placed in public ownership and administered as State Wildlife Management Areas.

Project goals were to pay professional services as parcels are conveyed to DNR by nonprofit HCP partners. During this appropriation – only Pheasants Forever (PF) projects were conveyed to DNR.

This project resulted in professional services being paid on 12 different parcels as they were processed for conveyance to DNR by HCP Partners. Project funding by PF changed as time went by, with some projects not being acquired with ETF dollars at closing, and other unanticipated parcels changing to ETF dollars at closing. Some of these PF projects were closed last year, but continued to have residual professional services for closing the project out. Some projects have just started the acquisition process and will continue into the next phase of 4I: Habitat Acquisition – Professional Services. Consequently the range of dollars spent on projects varied greatly, but ranged from $200 to $4,500.

As a result of this project, DNR was able to pay for professional services and processing costs related to land acquisition transfers to the DNR from HCP partners. Costs include the following: staff time for Division of Lands and Minerals ($80/hour) and the Attorney General's Office ($101/hour), survey costs, recording and abstracting fees, and deed tax.

Project Results Use and Dissemination

Accomplishment Reports and press releases will be made available at http://www.mnhabitatcorridors.org

LCCMR Work Program Final Report

Restoring Minnesota's Fish and Wildlife Habitat Corridors Phase 5
Habitat Conservation Partnership

4I: Professional Services - MN DNR - Division of Fish & Wildlife

Work Program Expenditures

FundingType	*Funding Category*	*Amount*	*Description*
ENTF	Professional Services	$29,176.00	Real estate/Attorney General's fees
ENTF	Professional Services	$824.00	Abstracting & Recording
ENTF	Professional Services	$0.00	Property taxes
	Total:	**$30,000.00**	

Funding Type Definitions

ENTF:	Grant dollars provided through the Minnesota Environment and Natural Resources Trust Fund
Other Funds:	Non-state, non-state leveraged dollars (if partner funds are leveraging State Funds (e.g. RIM) they are not eligible to be considered Other Funds)
State Funds:	State Funds expended on HCP projects (not eligible for use as Other Funds commitment)
Partner's State Leveraged Funds:	Non State Funds that have leveraged State Funds as part of an HCP project (not eligible for use as Other Funds commitment)
Other:	Any other expenditures (e.g. grant income funds)

Attachment A: Budget Detail for 2008 Projects - Final

Proposal Title: Habitat Corridors Partnership Phase V - 4I Habitat Acquisition - Professional Services

Project Manager Name: Mike Halverson
LCMR Requested Dollars: $ 30,000

2008 LCMR Proposal Budget	**Result 1 Budget:**	**Amount Spent 06/30/10**	**Balance 06/30/10**	
	Conveyance of corridor lands to DNR			
BUDGET ITEM				**TOTAL FOR BUDGET ITEM**
Contracts				
Professional/technical *(professional service costs - appraisals, abstracting, recording/deed tax, property tax, Attorney General and Division of Lands and Minerals costs)*	**$30,000**	**$30,000**	**$0**	**$30,000**
COLUMN TOTAL	**$30,000**	**$30,000**	**$0**	**$30,000**