

Long-Term Protection of the State's Surface Water and Groundwater Resources



Legislative Charge

The statutory requirement for this report is found in Minnesota Session Laws 2009 Chapter 37 Section 4 Subd. 3, which reads in part:

By January 15, 2010, the commissioner shall submit a report evaluating and recommending options to provide for the long-term protection of the state's surface water and groundwater resources and the funding of programs to provide this protection.

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Background

The purpose of this report is to meet the requirements of Minnesota Session Laws 2009 Chapter 37 Section 4 Subd. 3:

By January 15, 2010, the commissioner shall submit a report evaluating and recommending options to provide for the long-term protection of the state's surface water and groundwater resources and the funding of programs to provide this protection.

The long-term protection of the state's surface water and groundwater resources involves every activity where we alter the land or the flow pathway of water moving across it or through it. It therefore involves the land use activities of everyone from individual landowners or managers, to local units of government, state agencies and the federal government. While we have engaged many people and professionals, particularly staff in other state agencies having environmental protection programs, such as the Departments of Agriculture, Pollution Control Agency, and Health, plus the Board of Soil and Water Resources, the Environmental Quality Board, Metropolitan Council, U.S. Geological Survey, Minnesota Geological Survey, University of Minnesota and other professionals, this report is not an exhaustive evaluation on all protection measures or funding required to provide long-term protection of all surface and groundwater resources.

The report delineates the areas that need continued or increased funding to move Minnesota forward toward this goal, and provides detailed recommendations for funding of programs and efforts within our area of expertise. Adoption of the approach outlined here will lead to a greater understanding of hydrology (how water moves across the landscape and in and out of aquifers) that is critically important for the Department of Natural Resources (DNR) and other agencies, governments and land managers in doing their jobs and making informed decisions.

Over the last decade, the DNR has been heavily engaged in the development of our own reports, and reports of other agencies and institutions on water sustainability, water availability, groundwater protection and management, and surface water protection and management. In preparing for this report, we reviewed past reports. The most recent reports: DNR, Plan to Develop a Groundwater Level Monitoring Network for the 11-County Metropolitan Area; EQB, Managing for Water Sustainability; Freshwater Society Report, Water is Life: Protecting a Critical Resource for Future Generations; the work of the Clean Water Council toward the development of surface and groundwater protection strategies; and finally, the work of the University of Minnesota and Freshwater Society, Groundwater Sustainability: Towards a Common Understanding; all contain important content relevant to the charge of this report.

Active engagement and increasing coordination continues between the partners listed above as the DNR works to provide sound guidance to decision-makers on how to manage our lands and waters more sustainably.

In summary the Department recommends the following strategies:

- Encourage and influence local engagement in management, prevention and demonstration efforts.
- Deliver up-to-date protection tools and recommended best management practices.
- Adopt a long-term focus for monitoring and prevention activities.
- Enhance data collection and sharing and simplify public access to data.
- Answer key questions and meet key information needs.
- Approach groundwater and surface water management and protection in a watershed context as a comprehensive hydrologic-ecologic system.
- Provide adequate financial and technical resources at appropriate levels to maximize the effective management and protection of water resources. Well-conceived and competently administered programs will not provide long-term protection if inadequately funded.

Protection of groundwater and surface water resources will require substantial investments from a diversity of funding sources over all levels of government during the next decade. As a part of this effort, a program of mapping, monitoring and managing is necessary to deliver the basic understanding of the hydrologic system for both surface and groundwater.

A summary of the state's water resource management funding needs are as follows:

Table 1: Water Resource Management Investments¹			
<i>Activity</i>	<i>Funding Amounts (10-Year)</i>	<i>Funding Amounts (25-Year)</i>	<i>Outcomes</i>
Mapping Needs	\$81,000,000	\$203,500,000	County Groundwater Atlas completion with technological updates; aquifer characterization studies; watershed hydrology; mining hydrology; County Biological Survey completion and Natural Resource Heritage Database; LiDAR completion
Monitoring Needs	\$70,500,000	\$176,250,000	Surface water - streamflow and lake level/outflows; groundwater water levels; springs and seeps (groundwater/surface water interactions); County Biological Survey and Natural Resource Heritage Database monitoring of status and trends
Managing needs	\$16,500,000	\$32,500,000	Water supply plans; resource protection plans; drainage reform; data management systems; water appropriation permits

Land occupiers have the responsibility to implement practices that conserve soil and water resources of the state (M.S. 103A.206)

DNR is focused on supporting healthy watersheds, which includes sustainable quantities/qualities of water (surface and groundwater, sustainable levels of desired biodiversity, and well functioning ecosystem services.

¹ Details are provided in Attachment A – Sustainability of Surface and Groundwater Resources

In order to better support the ability of landowners and managers to meet the state mandates and to achieve the state's vision for healthy watersheds, investments should be made in the following areas:

Table 2: Partner Funding Needs				
<i>Strategies-Actions</i>	<i>LGU Funding Needs</i>	<i>Land Occupier Incentives</i>	<i>Other State Agencies Funding Needs</i>	<i>Other Partners *</i>
1. Local management and prevention efforts	Ordinance development & administration Education & outreach	Technical assistance and implementation support	Continued community assistance and regulatory efforts	Education, cost-share, grants
2. Protection tools and recommended BMP's	Plan implementation & technical support of land occupiers	BMP's installation	Continued BMP development	Research and education
3. Long- term monitoring	Status and trends, inspection and compliance monitoring		Technical monitoring QA/QC standard development	
4. Data collection and sharing	Collection and reporting		Oversight of technical data collection and analysis	
5. Key research studies			Interagency research steering committee Develop & design practices for field application	Field scale research and modeling
6. Comprehensive hydrologic- ecological framework	Education, outreach and private land coordination	Technical assistance	Resource protection and management strategies	

Scope of the Challenge

Long-term protection of Minnesota's surface and groundwaters is possible only if the stewardship potential of land occupiers is fully developed and appropriately supported. This will require the state and all its forms of government and individuals to refocus priorities for land and water management. Natural ecosystem functions and flow pathways have been disrupted to such a degree in some parts of this state that only significant philosophical change in the way we manage our lands and waters can allow short or long term protection of water resources. Every citizen must understand how individual actions contribute negatively or positively to the cause or cure. Otherwise our legacy to our children and grandchildren will be an economic, social and environmental burden that they will be unable to afford.

Ecosystem Services

Ecosystems, whose functioning depends on biodiversity², provide the basic necessities of life, offer protection from natural disasters and disease, and shape human cultures and spiritual beliefs. **Ecosystem services are the benefits that people obtain from ecosystems.** They include provisioning services, regulating services, supporting services, and cultural services.

Provisioning services (goods) are the products obtained from ecosystems: food, fiber, fuel, genetic resources, biochemicals, and fresh water.

Regulating services are the benefits obtained from the regulation of ecosystem processes: invasion resistance, herbivory³, pollination, seed dispersal, climate regulation, pest regulation, disease regulation, natural hazard protection, erosion regulation, and water purification.

Supporting services are ecosystem services that are necessary for the production of all other ecosystem services. Examples include biomass production, provision of habitat, production of atmospheric oxygen, soil formation and retention, nutrient cycling, water cycling, and provisioning of habitat.

Cultural services are the non-material benefits people obtain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation, and aesthetic experience, including, knowledge systems, social relations, and aesthetic values.

² Biodiversity is a contraction of 'biological diversity' meant to include not only living organisms and their complex interactions, but also interactions with the abiotic (non-living) aspects of their environment.

³ Herbivory is a form of predation in which an organism, known as an herbivore, consumes mostly autotrophs such as plants, algae and photosynthesizing bacteria.

Table 3: Examples of Ecosystem Services

Purification of the air and water
Clean water for recreation
Generation and preservation of soils and renewal of soil fertility
Cycling and movement of nutrients
Habitat for fisheries
Moderation of weather extremes and their impacts
Protection of stream and river channels and coastal shores from erosion
Drought and flood mitigation
Climate stabilization
Detoxification and decomposition of wastes
Control of agricultural pests
Maintenance of biodiversity
Seed dispersal
Pollination of native and agricultural plants
Timber, pulpwood, and other forest products
Protection from the sun's harmful ultraviolet rays
Regulation of disease-carrying organisms

Minnesota's Historic Background and Ecosystem Services

Minnesota was rich in natural resources and endowed with functioning ecosystems when European settlement began. Minnesotans have been working diligently ever since to convert the landscape to suit human needs and desires. The clean, abundant water nature provided became an enemy of progress and growth. Government promoted conversion of swamps and “wastelands” to cropland. Government encouraged and continues to support drainage of the landscape incidental to almost every agricultural, construction, development or transportation project; such projects depend on ridding the landscape of water at optimal rates. Natural vegetation had formerly slowed water movement, lessened erosion, and improved water quality. In large part, this protective benefit – a service provided by the ecosystem – has been impaired if not lost. Additionally, the speed at which we now move water off the landscape over-taxes the ability of the remaining vegetative buffers and natural systems to improve water quality before it gathers in tributary streams or infiltrates into groundwater. Contaminated groundwater is often unusable for many purposes and is typically very expensive to treat and virtually impossible to clean up in situ. Loss of ecosystem services comes at a cost to human society. Most people understand this concept best when the loss is expressed as the cost of replacing otherwise “free” services with human-made systems, for example water purification plants instead of natural filtering.

In addition, groundwater use in some areas is unsustainable (see Figure 3 in the body of the report for an idea of where such areas might be). In purely economic terms, we are depleting the very capital we depend on (natural resources and ecosystem functions that protect and purify) and we are failing to reinvest in the source of our wealth. If we continue to pursue the cheapest, fastest, shortest-term solutions for growth and development, we will ultimately pay in the form of bankruptcy of the ecosystem, and for that there is no bailout.

Minnesota's Regulatory Background

Most of our laws and rules have been written to manage the actions of individuals. Individuals have had relatively unrestricted freedom to do what they want on their lands, with limited responsibility toward the greater good of society. Limits are only contemplated when exercise of individual freedoms threatens or impairs rights of others. Society has operated under an assumption that the natural system would always recover from imposed changes and may even harbor a pervasive belief that science or technology could fix whatever problems would occur. Raw wastes from cities and towns were dumped into rivers and streams as an accepted practice. Indeed, universities even taught that the solution to pollution was dilution. The resulting cumulative impact of everyone's actions threatened the health of the people.

In response, the federal Clean Water Act was passed in 1972. Subsequent laws were passed to regulate the actions of those causing pollution of water at identifiable locations or points. This strategy depended on clean waters flowing from largely undeveloped watersheds to dilute the pollution. In the intervening years, state agencies and other governments have developed monitoring networks, permitting systems, reporting requirements and performance improvement measures to track our progress on managing the point sources of our problems. As a result, we have made commendable improvements in human health and disease reduction, yet our water resources are still burdened with waste and pollutants from diffuse sources.

In example, emerging contaminants (those for which the knowledge base is only now being built – for example pharmaceuticals) and contaminants from diffuse sources are presenting new challenges as we learn more about them and about how they might be prevented from entering the waters of the state. The cumulative impact of most everyone doing many unsustainable practices on their parcels of land is difficult to quantify and even more difficult to direct toward sustainability. Individual land occupiers hold the key to long-term protection of the state's surface water and groundwater. Society's philosophy of personal freedom to do as one pleases on one's own land, needs to change more toward a philosophy of land stewardship and management for personal and societal benefit.

Monitoring and regulatory programs are in place to influence some specific land use practices and to provide some guidance and assistance to land occupiers, but these seminal programs suffer from chronic underfunding. The new and emerging problems in land and water management will require a much greater understanding of our hydrology than what we have typically learned so far. Long-term monitoring and evaluation of management practices must be expanded to ensure that government is funding the most effective actions. Sustainably managing our surface and groundwater resources remains difficult and results will not come easily or soon.

Evaluation of Areas of Concern

In consideration of future economic and human health, Minnesota must take on the challenge to restore highly altered landscapes to regain adequate natural functions and biotic communities and thus sustain quality of life. Areas currently supporting natural ecosystems in hydrologically-sensitive areas should be managed to preserve existing ecosystem function. An evaluation of existing conditions will allow prioritization of efforts.

Altered Areas with Impaired Function

Analysis of Minnesota's land cover – the patterns of land use mapped at settlement compared to more recent maps – quickly gives sense of some of the critical areas that will require integrated attention to make meaningful progress in managing our land and water resources more sustainably. The following maps (Figure 1) show the natural ecosystem land cover that we inherited and have subsequently altered for purposes of progress and growth of Minnesota's economies.

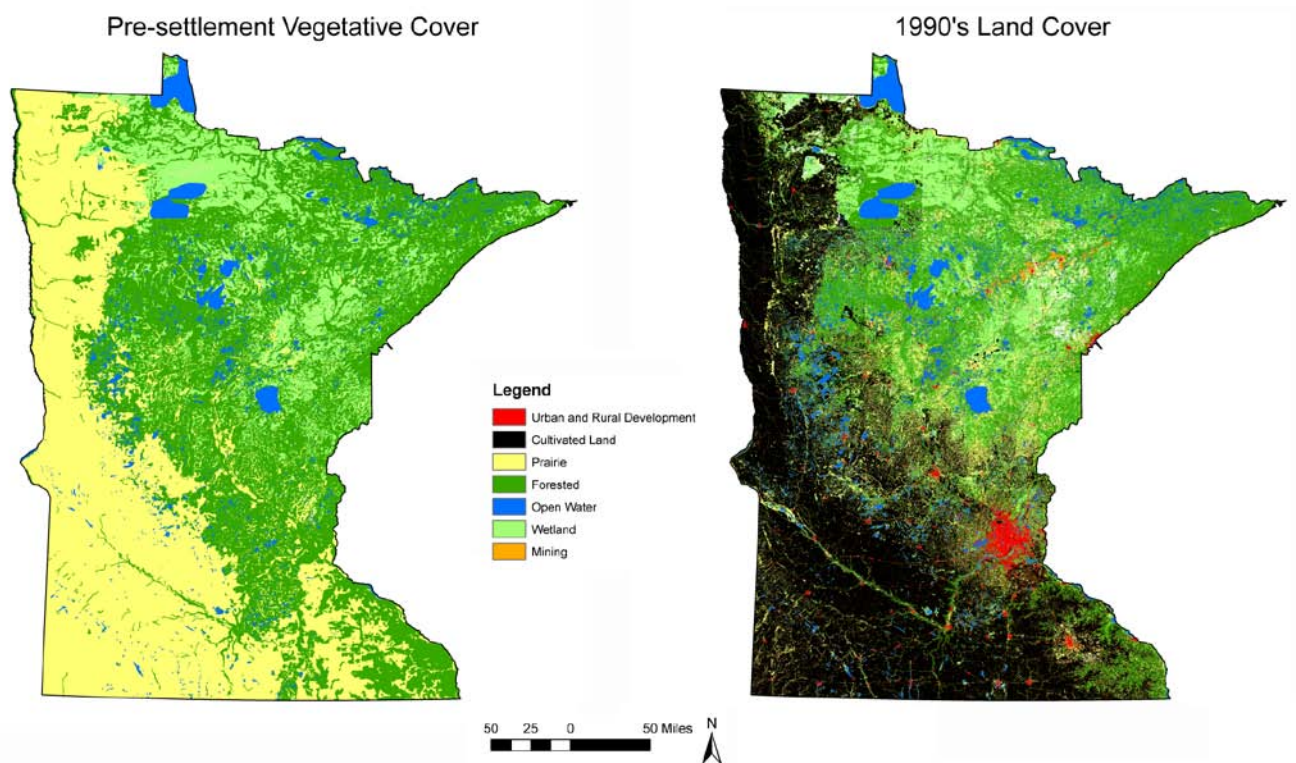


Figure 1: Pre-settlement and 1990 land use comparison

Hydrologically Sensitive Areas with Intact Function

A quick and coarse analysis of remaining natural ecosystems was conducted to determine where there would be strong surface or groundwater relationships with native plant communities. Areas defined by the Minnesota County Biological Survey (MCBS) of medium, high, and outstanding biodiversity significance and selected native plant communities with a strong dependence on surface and groundwater are depicted in Figure 2. Areas defined as having steep slopes were also highlighted because these are areas where terrestrial ecosystems are heavily dependent on groundwater discharge. These areas warrant more careful planning, analysis and protection measures if there are interests wishing to alter surface or groundwater flow pathways or volumes. It is much more cost-effective to prevent damage to functional systems than to attempt to restore them after damage or neglect.

Ecosystem Protection Areas

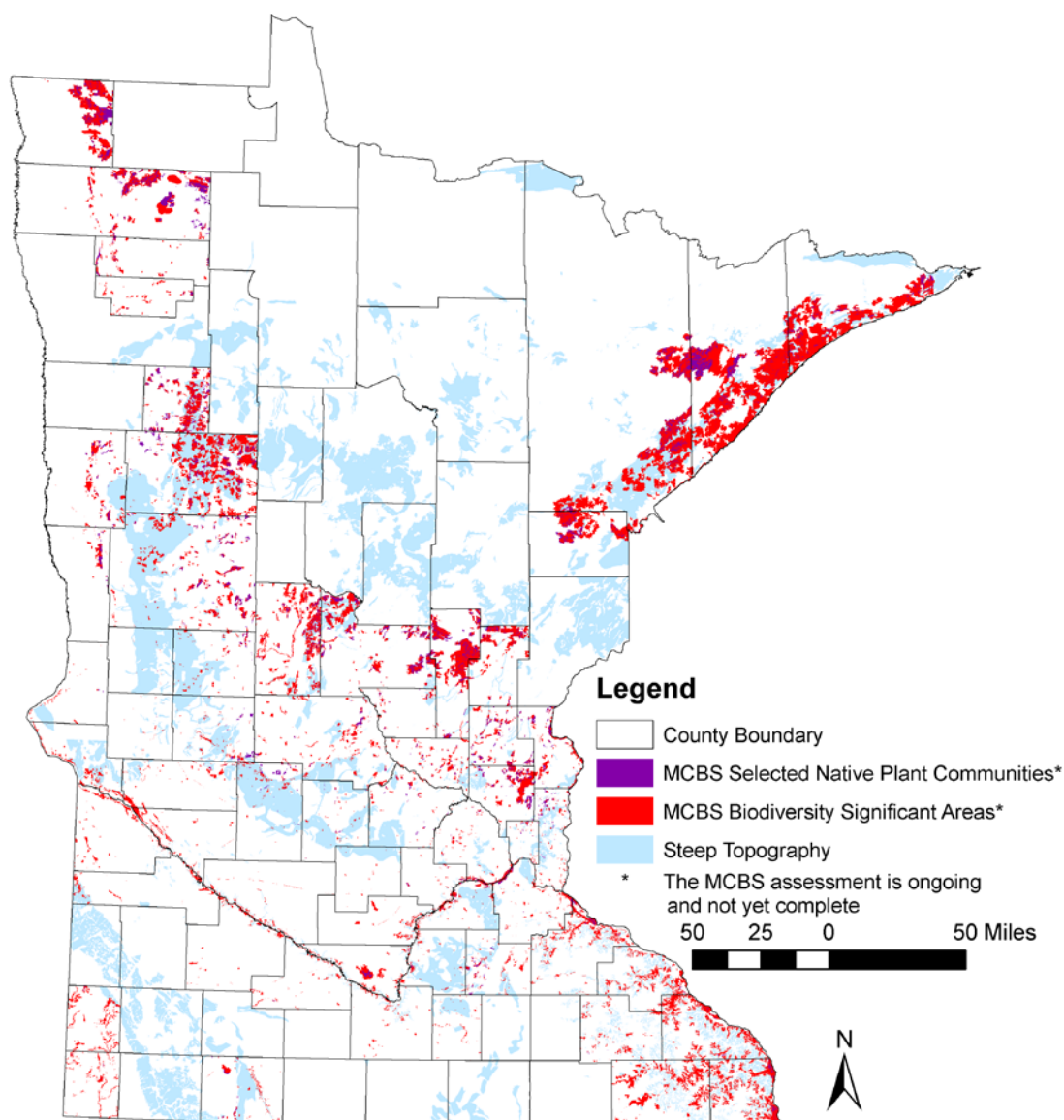


Figure 2: Ecosystem protection areas

Water Supply Areas of Concern

A coarse analysis of water supply concerns identified areas having inadequate water quantity, quality or both. We are in the process of developing a more refined analysis and report to guide future management activities and funding decisions based on risk analysis that should be available in 2011. Surface water concerns are expressed best at the statewide scale by the map of current impairments; groundwater concerns are expressed by mapping hydrogeologic settings that are subject to quality and quantity constraints.

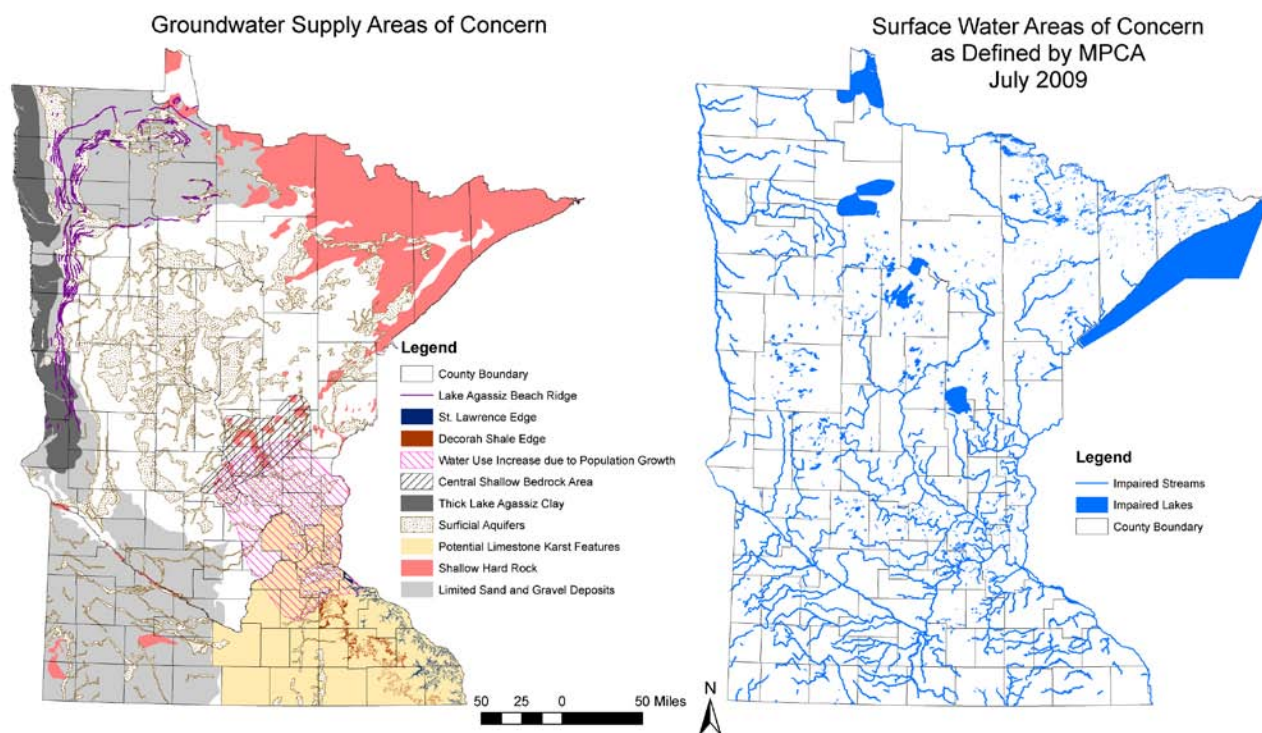


Figure 3: Groundwater and surface water supply areas of concern

In many vulnerable hydrogeologic settings the source of contamination to the aquifers has been attributed to non-point sources including agricultural fertilizers and pesticides, urban runoff, manure applications, septic systems, road salt and stormwater infiltration. Some of the most common contaminants detected include nitrates and pesticides in rural settings, and volatile organic compounds, petroleum compounds and road salt in urban areas. In addition, new chemicals of potential concern to groundwater quality, such as endocrine disrupting compounds (EDCs), are being identified.

Recommendation of Necessary Solutions

Two powerful water policy laws were enacted by the legislature, which if implemented in combination with existing laws and rules, will begin to solve many of our water sustainability problems. If implementation rules and laws were adopted for these policy statutes, uniform application of the principles contained in MS 103A.205 and MS103A.206 would reduce impairment and more sustainably manage the supply of all of our waters.

Minnesota Statute 103A.205 CONSERVATION POLICY FOR RAINWATER states:

“It is the policy of the state to promote the retention and conservation of all water precipitated from the atmosphere in the areas where it falls, as far as practicable. Except as otherwise expressly provided, all officers, departments, and other agencies of the state or political subdivisions having any authority or means for constructing, maintaining, or operating dams or other works or engaging in other projects or operations affecting precipitated water shall use the authority, as far as practicable, to effectuate the policy in this section.”

Minnesota Statute 103A.206 SOIL AND WATER CONSERVATION POLICY states:

*“Maintaining and enhancing the quality of soil and water for the environmental and economic benefits they produce, preventing degradation, and restoring degraded soil and water resources of this state contribute greatly to the health, safety, economic well-being, and general welfare of this state and its citizens. **Land occupiers** (emphasis added) have the responsibility to implement practices that conserve the soil and water resources of the state. Soil and water conservation measures implemented on private lands in this state provide benefits to the general public by reducing erosion, sedimentation, siltation, water pollution, and damages caused by floods. The soil and water conservation policy of the state is to encourage land occupiers to conserve soil, water, and the natural resources they support through the implementation of practices that:*

- (1) control or prevent erosion, sedimentation, siltation, and related pollution in order to preserve natural resources;*
- (2) ensure continued soil productivity;*
- (3) protect water quality;*
- (4) prevent impairment of dams and reservoirs;*
- (5) reduce damages caused by floods;*
- (6) preserve wildlife;*
- (7) protect the tax base; and*
- (8) protect public lands and waters.”*

When taken in context, these two laws must be a major part of a solution to provide long-term protection for Minnesota’s surface and groundwater resources. Minnesota Statutes Chapter 103 already offers multiple options that could deliver an effective implementation process guided by Chapter 103B and Chapter 103C.

Groundwater quality protection policy is expressed in Minnesota Statutes Chapter 103H:

Minnesota Statute 103H.001 DEGRADATION PREVENTION GOAL.

“It is the goal of the state that groundwater be maintained in its natural condition, free from any degradation caused by human activities. It is recognized that for some human activities this degradation prevention goal cannot be practicably achieved. However, where prevention is practicable, it is intended that it be achieved. Where it is not currently practicable, the development of methods and technology that will make prevention practicable is encouraged”,

while the policy on groundwater and surface water sustainability for all uses is contained in Minnesota Statutes 103G:

103G.265 WATER SUPPLY MANAGEMENT.

“Subdivision 1. Assurance of supply.

The commissioner shall develop and manage water resources to assure an adequate supply to meet long-range seasonal requirements for domestic, municipal, industrial, agricultural, fish and wildlife, recreational, power, navigation, and quality control purposes from waters of the state.”

The 2009 Legislature defined “water sustainability” as ways of managing our activities that do not harm ecosystems, degrade water quality, nor compromise the ability of future generations to meet their own needs. To meet these challenges, we must move forward in coordinated ways that manage the health of both our lands and waters as a system. It will take a common vision, shared goals and integrated efforts among federal, state and local governments just to begin effective implementation strategies. It will require some new policies, revisions to laws and rules, and acceptance by Minnesotans as an imperative for a sustainable economy and quality of life. In all of the above, adequate sustained funding over the long term is essential.

We must first manage our lands to manage our waters. Each landowner/occupier must bear the responsibility of holding water longer on the landscape and using natural vegetative systems, where possible, in combination with man-made technologies if we are to make meaningful progress toward addressing the causes and solutions to the problems of long-term protection of our surface and groundwater systems. Treatment of the symptom of impaired waters via technological solutions without changing the causative land-use problems is doomed to failure. The most cost-effective and permanent way to improve conditions is to improve how we manage our lands and the water delivered from them.

Specific recommendations for groundwater resource protection are necessarily similar to those for surface water protection. Surface watersheds are rarely the most useful way to organize groundwater evaluation and protection efforts. Significant aquifers may cross more than one watershed, and recharge and discharge areas for some aquifers are in different watersheds. In these cases, the planning and management of groundwater resources will need to be managed across multiple watersheds, and may be best accomplished by considering aquifer management areas or source water protection areas.

Coordinated interagency strategies for protection of both surface and groundwater systems have been under development and are summarized in the next section of this report. These strategies are not new but represent the culmination of several decades of studies, reports and plans developed by governmental, universities and non-governmental organizations. An annotated bibliography of these efforts is available under separate cover.

Recommendations to Guide Program Delivery

A regionalized support system with diverse and varied expertise should be created to deliver a locally-based land management strategy to protect surface and groundwater resources for the long term. A new system that brings technical partners together in an integrated way to assist local governments and citizens with runoff management, land use and water supply planning, economic alternatives, and basin education; and which provide monitoring and evaluation services must be part of the solution. A common understanding of resource protection and management needs, tailored to local geology, geography, economic, social and environmental conditions is an essential requirement when bringing people together.

These recommendations are in accord with the Strategic Framework for Integrated Resource Conservation and Preservation as detailed in the Minnesota Statewide Conservation and Preservation Plan (Swackhamer et al., 2008). All five strategic areas of the framework are incorporated: integrated planning, critical land protection, land and water restoration and protection, sustainability practices, and economic incentives for sustainability. We recommend Minnesota evaluate regional support system delivery models employed in other jurisdictions, such as the University of Wisconsin-Extension's Water Resources Education system for watershed protection and management found at: <http://clean-water.uwex.edu/>.

Seven major themes have emerged from planning and coordination activities undertaken over the past few decades. As part of the DNR transformation process bringing together the Ecological Resources and Waters divisions, we have identified the importance of many of these themes as we move toward sustainable resource management approaches. Underlying all these themes is one common thread: the resource must be monitored and managed at the local level while agencies provide technical assistance, financial support and delegated authority. These themes are discussed in the order in which they most directly involve land occupiers.

Encourage and Influence Local Engagement in Management, Prevention and Demonstration Efforts

Because water resource boundaries typically cross multiple jurisdictions and because local communities and groups can have a dramatic impact on the availability of funding and the adoption of desired practices, protection efforts must have an effective process for local engagement. Using an integrated environmental agency approach, we must maximize the interest and involvement of all stakeholders in the watershed. Local involvement and engagement is key to the success of protection efforts, since the implementation of best management practices (BMPs) relies on local government or individual action. One potential benefit of the watershed approach is the opportunity to engage local government and individuals in the watershed planning process, and thereby in protection and restoration planning efforts. Roles of citizens, local government, and state and federal government in protection efforts are detailed in Table 4. In particular, protection efforts should:

- Specifically incorporate citizen and local monitoring efforts that augment state and federal monitoring.
- Coordinate all levels of local plans (county water plans, groundwater plans, city comprehensive plans, municipal water supply plans, watershed district management plans, etc.) during watershed plan development.
- Provide access to the watershed planning effort and to the resultant plan to help inform local planning efforts.
- Allow incentives, education, regulation and local action to interact to foster new approaches at the local/individual level.

Table 4. Roles of Citizens, Local Government and State and Federal Government in Protection Efforts

<i>Framework</i>	<i>Individual/Private Level</i>	<i>Local Level</i>	<i>State/Federal Level</i>
Legal Context	Citizens can be engaged on a variety of levels to practice water quality protection. Information and education, incentives, structural practices and regulations are tools for water quality protection.	Local special purpose units of government can be formed. These include watershed districts, soil and water conservation districts, water management organizations and lake improvement districts. Local guidance and ordinances can be effective.	Statutory direction, state rules and enforcement of state or federally permitted activities are primarily functions of the legislative and executive branches of state government.
Data Collection and Analysis	Statewide, approximately 75% of land is privately held. There is a higher percentage of public land ownership in the Northern half of the state. Data collection will require collaboration with landowners for mutual benefit.	Plans should outline data collection activities. Counties may develop Comprehensive Local Water Management Plans; watershed districts and soil and water districts must develop long-range (5-10 year) comprehensive plans. Soil and Water Conservation Districts may adopt the Comprehensive Local Water Management Plan.	State and federal agencies have trained scientists and resource managers, information databases and other analytical data and can function as central repositories or clearinghouses of information.
Land Use Management and Environmental Review	Conservation measures are most often implemented by landowners on a voluntary or incentive-driven basis. Social research suggests that incentive-driven changes in behavior may not be sustained once the incentive is removed unless people recognize personal value in the change.	Land use regulation is primarily a function of local governments and administered through planning and zoning or environmental services offices. Watershed Districts may adopt rules applicable within their boundaries. Locally developed ordinances and rules and state rule adopted by local ordinance are the primary regulatory tools. Some statutory authorities available to local governments are voluntary.	State and federal agencies play key roles in environmental review (EIS), reservoir and dam operations (Army Corps), habitat and fisheries management, (DNR), etc.
Implementation	Valuable water resources deserving protection exist surrounded by both publicly owned lands and privately owned lands. The conservation delivery framework already exists to integrate land ownership, primary landowner contact and technical information delivery.	Local government decision-makers, officials and staff have the most direct contact with landowners and could provide assistance for implementation and could administer grants and other incentives.	State agencies develop standards and protocols to ensure that locally collected data and information meet minimum state requirements.
Community Assistance Day to Day	Contacts with local landowners. Information and Assistance provided.	Local citizens, decision makers and resource managers can articulate generalized threats to water quality and have an understanding of the importance of particular water resources. There are limited resources for analysis of water resources.	State agencies (as well as LGUs) play a key role in formally recognizing the water quality protection efforts of watershed groups, citizens, and other local partners. In addition to monetary incentives, public recognition is critical to sustaining behavior change & successful local efforts.

Deliver Up-to-Date Protection Tools and Recommended Best Management Practices

Three categories of BMPs should be pursued to reduce the risk of water quality degradation. Examples are given for each category. Many are also good illustrations of pollution prevention and product stewardship activities.

Retain/enhance watershed storage to replicate natural runoff rates and volumes as much as possible.

- Incorporate infiltration/low impact development into redevelopment plans in urbanized areas (e.g. rain gardens or other effective storage/treatment options).
- Increase infiltration in fields and pastures (e.g. conservation tillage, managed rotational grazing, cover crops).
- Design new developments in small/rural communities and the developing urban fringe so there is no new increase in runoff following development.

Manage nutrients and potential pollutants wisely.

- Proper management of road salt storage and use.
- Proper manure application timing, methods, and setbacks.
- Enforce subsurface sewage treatment system requirements.
- Evaluate groundwater quality impacts of land application of nutrients and agricultural chemicals

Create buffers or easements between land-disturbing activities and water resources.

- Public easements to protect wetlands and increase storage in urban areas.
- Riparian setbacks and shoreline buffers.
- Water quality buffers in agricultural areas (e.g. filter strips, riparian buffers, grassed waterways).

Finally, many BMPs designed to protect groundwater must be based on field characteristics such as soil types and cropping practices, or focused on a specific product or activity. In these cases, groundwater protection efforts are best organized according to locations that are most at risk for degradation based on land use characteristics or stressors, regardless of the watershed or aquifer management area.

We recommend that the state environmental agencies establish an interagency team to develop and improve available BMPs for different land uses as well as for different water resources. BMPs may be effective in certain situations and inadequate in others and practices may change rapidly over time, thus BMPs must be revised to stay current. Adequate sustained funding should be provided for continued assessment and promotion of BMPs, BMP demonstration and implementation projects, and the development of other tools or approaches that are effective in protecting surface water and groundwater.

Adopt a Long-Term Focus for Monitoring and Prevention Activities

In order to adequately understand changes in our surface and groundwater systems, we need long-term records to understand trends caused by climate and the collective actions of many man-made changes to the land and water systems. Long-term monitoring of stream flow within the major watersheds has not been allocated for in the TMDL assessment phase. Additional monitoring would improve understanding of watershed conditions and landowner engagement in solutions to causes of the impairments. It is particularly important to emphasize the long term for groundwater systems. In most aquifers flow is very slow. Water withdrawals and land use practices can change the natural timing and response in the groundwater system and changes in practices may take years to show declines or improvements in water quality or supply. The state has relatively few long-term groundwater monitoring locations and will need to increase permanent locations and the frequency of readings in order to improve sustainable management and track trends over time.

Enhance Data Collection and Sharing and Simplify Public Access to Data

Monitoring data are needed for both identifying the need for protective actions and to evaluate the effectiveness of those actions. In deciding on where and when to monitor, a risk-based approach is needed to prioritize monitoring towards the most vulnerable systems, i.e. those with greatest potential for use and water quality conflicts as identified by sensitivity mapping – to allow us to identify and fix problems and put practices in place to prevent them in the future.

Easy access to accurate data and information is important to ensure sound management decisions and maximize the use of available resources. Data collection for a wide variety of groundwater management purposes in Minnesota must continue. The information over a growing period of record will be useful to evaluate groundwater levels, aquifer characteristics, groundwater quality, and project strengths and weaknesses. In order to make the most efficient and cost-effective use of existing information and available funds for groundwater monitoring and protection, state agencies should continue to move forward with cooperative efforts to share and simplify public access to environmental and technical data. This information should be made accessible in a variety of formats to encourage adoption by citizens, interest groups, local units of government, watershed groups and other interested parties.

Data sharing among agencies and between agencies and the public should be accelerated and the necessary data infrastructure needs funded as soon as practicable. For example, the state should develop and maintain a “clearing house” for information on surface and groundwater BMPs, research and demonstration activities, and the state should move forward with developing and maintaining an information “portal” which will provide a link to surface and groundwater sources of environmental data.

Answer Key Questions and Meet Key Information Needs

A number of existing tools have been identified for protection efforts, yet some areas require additional research or data collection. A brief summary of information and research needs is found in Table 5 below. A statewide protection strategy will require a stable funding source to support implementation, education, and research needs.

Table 5: Water Resource Protection Information/Research Needs
Assess other states’ research efforts for insights into Minnesota’s protection efforts.
Produce/Provide comprehensive guidance of available BMPs and other management activities to protect waters.
Investigate how best to share information on BMPs and protection opportunities.
Evaluate connections between regulation, education, incentives and protection activities, including individual actions.
Benchmark protection activities in other states and carry out case study evaluations.
Provide research and data on minimally impacted lakes, streams and wetlands to help define what constitutes a high-quality water resources and functioning ecosystem services.
Develop an approach for categorizing protection efforts, and identify lessons learned and successful strategies by category.
Research the cost-benefit relationship of protection vs. restoration in Minnesota watersheds.
Quantify the benefits of funding protection activities to further document the benefits of focusing Clean Water Legacy Act efforts on protection activities.
Develop tools to estimate the overall need for protection efforts.
Research rates and locations of aquifer recharge.

Approach Groundwater and Surface Water Management and Protection as a Comprehensive Hydrologic Flow System

Minnesota must move quickly to fully adopt a watershed approach for surface water management (Figure 4). The Clean Water Legacy Act identifies the watershed itself as a desired approach for organizing studies of the impairment of watershed functions resulting in water quality impairments (TMDL – Total Maximum Daily Load studies), and it is the organizing approach used in the state’s 10-year monitoring strategy for assessing and protecting surface water resources.

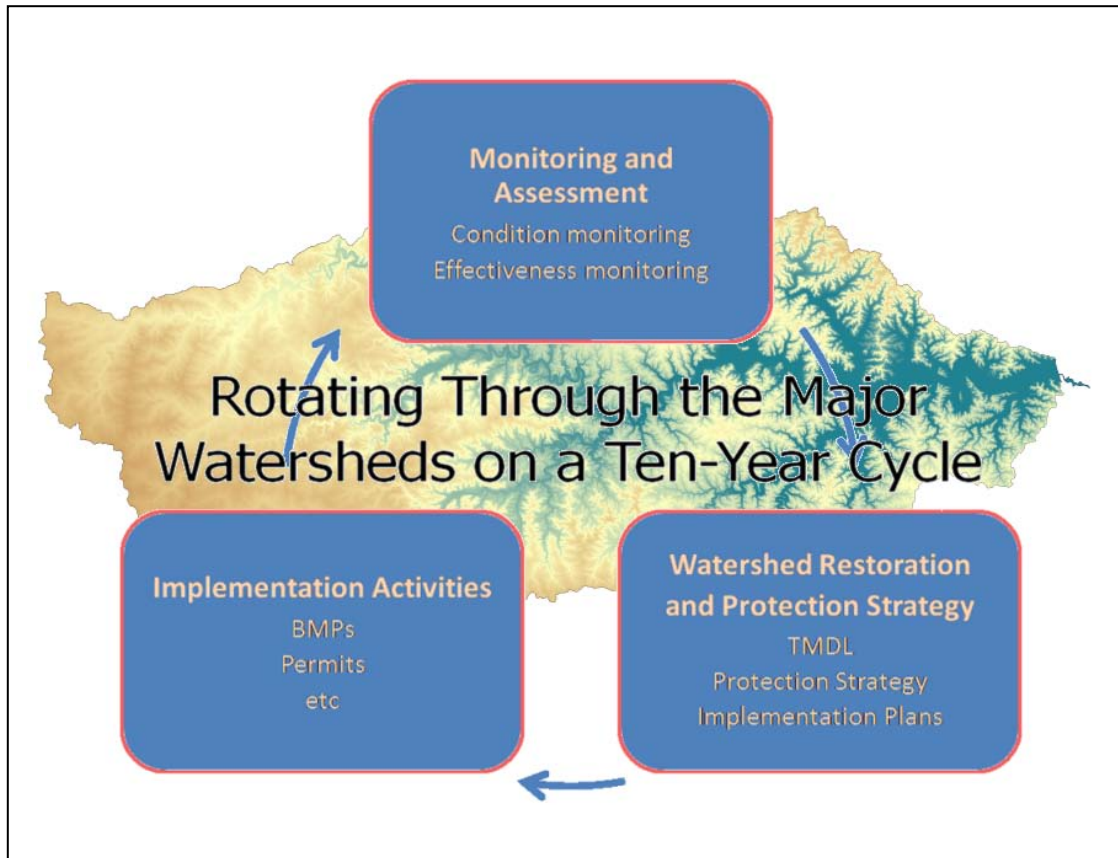


Figure 4. Watershed approach to studies of water quality impairment is modeled in the TMDL process

- Since surface water may infiltrate to groundwater, and groundwater discharges to surface water, they need to be considered together to fully understand either, and to fully protect and restore both.
- Education and prevention actions within a specific watershed that will occur in response to surface water impairments and protection activities may also be used to protect groundwater, providing a significant leveraging of limited resources.
- Understanding quantities, movement, seasonality and rates is the first step in being able to manage the interlinked hydrology of surface and groundwater systems.
- Solutions range from state government programs to citizen-driven educational efforts and from regulatory enforcement to land-use incentives and voluntary actions.
- Protection efforts (as well as restoration goals) must be integrated into a watershed plan developed for each of the state’s major watersheds.
- Each watershed plan needs to identify and evaluate the key risk factors that threaten water quality within the watershed. Implementation activities must be specified to address these risk factors.

Provide Adequate Financial Resources

The plan to protect, enhance or restore our surface waters is embodied in the MPCA's TMDL assessment and implementation efforts. Adequate and continued funding is necessary to effectively deliver this program. This effort is aimed primarily at surface water management and has not adequately linked the relationship between surface water and groundwater systems. Additional monitoring and interlinking management of both systems would be an important and necessary goal.

Adequate quantities of clean, potable groundwater are extremely important for the Minnesotans that currently use groundwater as a drinking water source, and for the future needs of Minnesota. Our knowledge of the status of the groundwater system and the resources needed for sustainable management is evolving based on new information and new pressures on the system. As shallow groundwater supplies become over-allocated or contaminated so they require treatment prior to use, the cost or availability of groundwater may become a significant limitation on future growth. Further, once land use and water appropriation decisions are made it may be extremely difficult to reverse their long-term effects. For these reasons it is important that adequate funding or incentives be provided for actions needed to understand, protect and manage groundwater into the future.

Resources are needed to implement the BMPs and the strategies identified above, including completing the up-front work needed to identify key threats to groundwater quality and quantity, to evaluate BMP and management approach effectiveness and to select BMPs and management strategies to most effectively address those threats. Clean Water Fund implementation and research projects should also include groundwater protection activities. The critical role of local governments and individual landowners in helping implement the identified steps is apparent; funding actions to expand and encourage their involvement is essential.

To meet these needs, agencies should look for opportunities to pilot and fund groundwater protection projects, especially those that involve local protection efforts. This will help to inform the development of groundwater protection efforts and also serve as examples of how an interest group or local government might seek to integrate protection and restoration activities into local planning documents and ordinances.

In addition to these goals, the following criteria should be used when looking at funding priorities to protect groundwater quantity and quality:

- Projects that define the quality, geology, flow pathways and movement rates of water.
- Projects that enhance local awareness and engagement.
- Projects that use innovative tools/approaches to achieve protection goals.
- Projects that emphasize preventing pollution/threats (rather than treating problems).
- Projects that pilot prevention approaches that could inform groundwater protection efforts in general.
- Projects that define the degree to which the aquifer or surface water features are threatened (focus on aquifers with declining trends, areas where withdrawals have the potential to impact surface water features, areas where significant increased demands are projected, etc. as opposed to aquifers with few or no threats).
- Projects that are targeted to provide the greatest amount of protection for the least cost, or that provide additional benefits beyond water quality and quantity protection.
- Projects that assess the ability of resources to supply projected demands without adverse impacts to natural resources.
- Projects that result in enhanced data accessibility and sharing.

Groundwater Protection is Part of the Whole

In all that is said above there is explicit inclusion of groundwater resource protection. Land use is equally important in groundwater protection, not only because of potential vulnerability to contamination due to activities on the land surface, but also due to the water use characteristics of the specific land use. Water use for irrigation and agricultural processing is coupled to crop and livestock production, which in turn are coupled to population growth. The following points summarize key considerations for the continued effort to prevent problems and protect groundwater resources from degradation:

- There is a close link between protecting, restoring, and preserving the quality of Minnesota's groundwater resources and the ability to develop the state's economy, enhance its quality of life, and protect its human and natural resources;
- Achieving the state's water quality and quantity (e.g. groundwater sustainability) goals will require long-term commitment and cooperation by all state and local agencies, and other public and private organizations and individuals with responsibility and authority for water management, planning and protection;
- A key to long-term success involves focusing on providing assistance and incentives to protect groundwater quantity and quality in vulnerable areas, and identifying and encouraging implementation of conservation and protection measures to prevent waters from becoming degraded.

The Minnesota Pollution Control report on groundwater protection found in the Clean Water, Land, and Legacy Funding Bill (House File 1231, Session Law Chapter 172) outlines important short term protection strategies and sets the stage for moving toward long term protection strategies outlined in this report as well. Additional coordination of efforts between agencies will be necessary as we move forward in time toward these long term goals.

Funding of Programs and Financial Assistance

State agency staff recognize that there is currently a funding gap for water protection efforts in Minnesota. Completing our understanding of the complex hydrology and hydrogeology of Minnesota is necessary to guide implementation of both surface and groundwater protection strategies. Adequate monitoring of surface watersheds and mapping and monitoring the geology and how water moves through it are essential to shaping best management practices and protection of our aquifers. DNR has developed a gap report outlining an adequate level of mapping, monitoring and management programs for 10 and 25-year timeframes. It is presented in Attachment A. Additional coordination discussion of the needs of other state agencies in the area of quantity management will need more time to be fully developed.

A valuable reference that previously identified the options for funding of programs that are directly applicable to long term protection of surface and groundwater resources is found in a 2004 report to the Legislature entitled : Impaired Waters Stakeholders Process: Policy Framework (*Minnesota Session Laws 2003 Section 2, Subd. 2*). Appendix C in that report includes an exhaustive list of funding options to generate revenues to implement strategies to address impaired waters. The solutions to addressing impaired waters are the same solutions necessary to provide long term protection of the state's surface and groundwater resources and we include the appropriate portion of Appendix C from this report on pages 20 through 25 below. Protection of surface and groundwater will require contribution from both users of lands and users of water. We have noted with an asterisk the funding options that have more direct applicability to users of water.

Looking forward, Minnesota Session Laws 2009, Chapter 172, Article 2, Section 8(b) provided funding to the University of Minnesota to develop a comprehensive statewide sustainable water resources ten-year and 25-year detailed framework. We believe the results of this water sustainability framework report will be parallel to the goals of this report and will be informative. Agency staff are participating in that process.

Funding options brainstorming list
- For Discussion Purposes Only -
Policy Work Group: Impaired Waters Stakeholder Process

	Funding Sources	Amount Generated/Year	Assumptions
1	Water/Hazardous Waste or Air Fee Increases	\$.5 million \$.5 million	25% water fee increase 60% hazardous waste fee increase
2	General Fund	?	Based on need/availability.
3	Solid Waste Tax	\$22 million	Half that goes to General Fund each year. Modify law to redirect more of tax to environmental purposes. Creates General Fund hole.
4	Tax Fee on Farm Pesticides and Fertilizers	\$65 million	Funding audit – sales tax exemption eliminated
5	Tax Fee on Farm Pesticides and Fertilizers	\$36.8 million	FY03 Est. – 3% surcharge on sales of pesticides, herbicides, and fertilizers, agricultural and household use.
6	Increase Petroleum Distributor Fee	\$39 million – increase to \$.03/gallon	FY03 actual - \$26.8 million. Petroleum distributors pay \$.02/gallon of petroleum products.
7	Gasoline Tax (Motor Fuels)	\$281.6 million	FY03 Est. – sales tax exemption eliminated.
8	Environmental Penalty Revenues	.5 million	8 year avg – portion deposited to General Fund. Creates general fund hole.
9	Increase/Reallocate Motor Vehicle Title Transfer Use instead of Tire Tax	\$4.6 million \$5.8 million \$11.5 million	Existing \$4 title transfer fee – goes to General Fund through FY07. 5 year avg of 1,154 title transfers per year. Increase fee to \$5 per title transfer Increase fee to \$10 per title transfer
* 10	Tax/Fee on Sewer Water	\$27.4 million	FY03 Est. – sales tax exemption eliminated
* 11	Tax/Fee on Residential Water	\$11.2 million	FY03 Est. – sales tax exemption eliminated
12	Carbon Tax	\$1.3 billion	Funding audit – 1998 Legislature proposal - \$50/ton tax on the carbon content of energy inputs
* 13	Lottery	\$21.85 million	FY02 actual – 40% net proceeds currently go to the Environment & Nat'l Resources Trust Fund
14	Residential Heating Fuels	\$80.4 million	FY03 Est. – sales tax exemption elimination
15	Fuel/Energy	\$46.5 million	FY03 Est. – Extend 6.5% general sales tax to selected fuels and energy sources now exempted when used for home heating and agricultural and industrial production. Does not include electricity and natural gas.
16	Deed Tax	\$86 million	FY02 actual – 97% state portion (.33% of price

			paid for the property)
* 17	Dedicated Sales Tax	\$355 million	Half Cent for Nature. Creates General Fund hole if portion of existing sales tax used.
18	Vanity Plates	\$2.5 million	FY03 actual – DNR Critical Habitat Plates. Revenue generated is used to match private contributions.
* 19	Improved parcel run-off surcharge	\$16.6 million	Applies an annual surcharge of \$10 per improved residential, commercial and industrial parcel.
20	Hotel/Motel Tax Fee	\$3 million	1987 Tax Research - 1% hotel/motel room charge
20 a	Litter Control Tax/Fee	\$3 million	1987 Tax Research - .15% of gross income of corporations that manufacture products that contribute to the litter problem.
* 21	Tax/Fee on Bottled Water	\$5.73 million	6.5% surcharge
* 22	Increase Water Appropriation Fee	\$3.86 million – FY04 with 2003 increase	FY03 actual - \$2.6 million, 2003 legislative increase in fee of 37% from \$50 minimum fee for up to 50 million gallons to \$101. Fee increase will generate approx. 1.26 million per year.
* 23	Increase Water Testing Fee	\$7.1 million – increase to \$6 per service connection	FY03 actual - \$6.1 million. Customers pay \$5.21 per service connection.
24	Vehicle Registration Fee Based on Fuel Economy	\$4.7 million - \$5 surcharge \$9.4 million - \$10 surcharge	12/31/02 – 939,769 registered pick up trucks including most SUVs
* 25	Water Protection Fee	\$29 million	6.5% sales tax rate. Cost per household - \$1.36 per month average. Residential estimated to pay 79% and Commercial/Industrial 21%.
* 26	Water Protection Fee	\$39.7 million	\$2 flat fee/month
27	Tax on Clothing	\$404.6 million	FY03 Est. – sales tax exemption eliminated
28	ISTS Maintenance Added Fee	\$.825 million	\$75 fee (to achieve \$25/year in revenue, based on pumping every three years)
29	ISTS Sales Tax on All Work	\$7.1 million	Sales tax on designs, installations and pumping
30	Annual ISTS Fee	\$12.9 million	\$24 annual fee paid by homeowners (\$536,000 ISTS). Collected by local gov't that regulates that ISTS, or by county on property tax
31	State Revolving Fund	\$1.5 billion \$.476 million	Needs based on 2004 Project Priority List for 191 projects. Additional 31 projects have no cost estimates yet. EPA Capitalization Grants and State Match to date (1987-2003)
32	ISTS Environmental Trust Fund Loans Through Activation of 5% Clause	\$2.5 million	Based on \$5,000,000 in trust fund- 5% principal (John Helland estimate).

*	33	Boat License Fee/Tax	\$4,373,301	FY03 – 261,688 boat license sales
			\$.5 million \$1.3 million	\$2 surcharge on boat licenses \$5 surcharge on boat licenses
*	34	Bonding	?	Based on need/availability
	35	Ag Land Preservation	\$.9 million	5 year average. Currently a \$1.6 million balance in the fund. \$5.2 million of balance transferred to the General Fund since FY96.
	36	“Lost” Lottery Revenues	\$10 million	MCEA press release on the lottery, dated April 10, 2003 – average return on sales for 8 states most similar to Minnesota in terms of population and lottery sales would net \$25 million. \$10 million Environmental Trust Fund share.
*	37	Clean Water Check-Off	\$1 million	Chickadee check off – 2001 tax year
	38	Shoreland Development Tax	?	Need to first examine federal laws, current state efforts and then opportunity for increased revenues. Would be county determined – DNR role?
	39	OHV Fee	?	Need to first examine federal laws, current state efforts and then opportunity for increased revenues. Currently funds are projected to be in the red. Fee would depend on the increased revenue needed.
*	40	Recreation Fee on Users of Natural Resources	?	Need to first examine federal laws, current state efforts and then opportunity for increased revenues. Users already pay a fee and are taxed on equipment (federal). Fee would depend on the increased revenue needed.
	41	Impervious Surface Fee	?	No easy way to calculate impervious surface amounts for the state. Satellite technology in the future is a possibility, but it is not ready yet. There may be a way to get certain classification so a fee could be targeted at commercial, industrial and institutional utilizing SIC (standard industrial classification) code.
*	42	Fee per Foot of Drain Tile	?	Tiling is being increasingly installed by farmer-operators using tractor-type plows so cannot just survey contractors. We could get feet of tile sold in MN data from the drainage companies, but so far they haven’t been willing to share that info.

*43 Targeted resources from federal agriculture and conservation legislation

Leveraging Federal Agriculture and Conservation Legislation in Support of Minnesota's Clean Water Vision & Impaired Waters Initiative

Background & Premise

The primary objectives of federal agriculture and conservation legislation (farm bill) programs are to reduce soil erosion, improve soil and water quality and enhance wildlife habitat. The 2002 Farm Bill authorized unprecedented levels of funding for conservation programs, including significantly more for conservation on lands in agricultural production. *As a result, the 2002 Farm Bill provides unprecedented opportunities to leverage and target farm bill conservation program funds for water quality restoration and protection, especially on agricultural working lands. The State of Minnesota can play a significant role in realizing these opportunities.*

Within the Impaired Waters Stakeholder Process, the Minnesota Pollution Control Agency and the Minnesota Environmental Initiative assembled a work group to identify key strategies to leverage the farm bill. Primary members of the work group included Barbara Weisman (lead), Minnesota Department of Agriculture; Wayne Anderson, Minnesota Pollution Control Agency; Doug Thomas, Board of Water and Soil Resources; Wayne Edgerton, Minnesota Department of Natural Resources; and Jerry Heil, Minnesota Department of Agriculture.

The work group identified six key strategies with action steps ranging from state-funded initiatives that would bring in additional farm bill funding for water quality, to efforts that would steer a higher percentage of fixed farm bill allocations toward water quality. The strategies cut across the conservation programs—that is, each strategy may involve more than one program. The work group also identified several principles and considerations to guide efforts to leverage the farm bill.

Below are the principles, considerations and key strategies identified by the work group. Also provided below are estimates of the amount of funding likely to flow to Minnesota in the remaining years of the 2002 Farm Bill for each of the major conservation programs, and a description of the types of investments that would help the State leverage these funds. The work group is in the process of estimating the costs and returns of these investments.

Principles & Considerations

- Targeting farm bill conservation program dollars to impaired waters is an important goal, but it is essential that farm bill funds continue to be available for soil, water and wildlife conservation in other watersheds, too.
- Identifying the conservation practices most likely to address or prevent specific water quality impairments in each region is an important prerequisite to any effort to leverage the farm bill for impaired waters.
- Efforts to leverage the farm bill should acknowledge agricultural producers' significant ongoing financial investment in conservation practices and systems that protect and improve water quality.

- The farm bill leveraging strategies identified below are designed to help fund restoration of impaired waters on the 2002 303-D list as well as protection of other high-priority waters. It is important to note, however, that the list of impaired waters is expected to grow rapidly as more waters are assessed.
- The State should step up its efforts to communicate and coordinate with USDA, from involvement in the USDA State Technical Committee to coordinating key programs.
- The State should invest in tools to fully leverage and enhance farm bill conservation programs, from incentive payments and adequate cost sharing to low-interest loans and technical assistance.
- The State should support innovation by capitalizing on potential opportunities to acquire matching funds for water quality initiatives developed by and for Minnesota.

Six Key Strategies

Action steps for each strategy are available from the work group.

Strategy 1—Share Impaired Waters Information Among Agencies:

Communicate information about 303D listed waters and associated pollution sources and BMPs to facilitate targeting by state, regional and local farm bill conservation program decision-makers.

Strategy 2—Increase Coordination of Programs: Increase coordination between farm bill and state programs that fund water-quality related BMPs at all levels of government involved in implementation (federal, state, regional and local).

Strategy 3—Maximize Landowner Enrollment in Programs: Maximize voluntary enrollment in conservation programs through outreach and incentives for selected water-quality related BMPs, especially in impaired watersheds.

Strategy 4—Ensure Adequate State & Local Capacity to Utilize Farm Bill Funds: Increase the capacity of existing state and local conservation programs to fully meet landowner demand for financial and technical assistance for water quality practices, and keep pace with the anticipated increase in demand due to unprecedented levels of farm bill funding.

Strategy 5—Support Innovation through Focused Research, Evaluation & Demonstration: Support innovation through public and landowner research, demonstration and evaluation of the water quality benefits of selected BMPs and conservation systems.

Strategy 6—Pursue Federal Matching Funds: Prepare to take advantage of significant opportunities that may be provided by two new provisions in the Conservation Title of the 2002 Farm bill: 1) EQIP Conservation Innovation Grants; and 2) Partnerships & Cooperation.

Examples of Investments That Could Help Minnesota Leverage Major Conservation Programs in the 2002-2007 Federal Farm Bill

Note: The work group will complete estimates of the costs and returns of specific investments in February 2004. The examples below are associated mainly with Strategies 3 and 4 above. The Conservation Reserve Enhancement Program (CREP) is not included in the examples below because the State is already doing what it can to leverage those funds (\$180 million through 2007, leveraged by a proposed state contribution of \$44-\$46 million).

Conservation Security Program (CSP): The amount of funding that flows to Minnesota this new program will depend on how many acres landowners voluntarily enroll. We estimate Minnesota will bring in close to \$200 million in 2004 through 2007.

Examples of Investments that Could Target and Increase CSP Funding

- Fund targeted promotion to increase the percentage of CSP contracts that include high-priority practices in high-priority areas.
- Fund incentives to increase the percentage of the state's 24 million acres of working agricultural land devoted to high-priority practices such as cover crops and crop rotations, increasing federal funding by up to \$100 for every dollar invested.
- Invest in demonstration projects that bring in more federal dollars by persuading more producers to enroll land in high-priority working lands practices in key areas.
- Urge NRCS to utilize CSP "enhanced payments" to reward individual participation in watershed-based efforts involving at least 75% of the landowners in a watershed.

Conservation Reserve Program (CRP) Continuous Signup: The amount of funding that flows to Minnesota depends on how many acres landowners voluntarily enroll. We estimate Minnesota will bring in about \$180 million from 2004 through 2007.

Example of an Investment that Could Increase CRP Funding

- Fund targeted promotion to increase federal funding by approximately \$40 for every dollar invested, while targeting the increased conservation buffer and wetland acreage to Clean Water Vision and/or Impaired Waters priorities (e.g., stream banks adjacent to impaired waters in agricultural areas).

Environmental Quality Incentives Program (EQIP): About \$95 million in total is anticipated in the form of fixed allocations to Minnesota from 2004 through 2007.

Examples of Investments to Fully Utilize EQIP Funding

- Increase the investment in existing state cost-share and low-interest loan programs to ensure at least 75% cost-share to producers for high-priority practices in high-priority areas (e.g., fields adjacent to impaired waters).
- Enlarge the pool of public and private-sector technical assistance available to producers to design and install high-priority practices.

Wetlands Reserve Program (WRP): About \$64 million in total is anticipated in fixed allocations to Minnesota from 2004 through 2007.

Example of an Investment to Target WRP Funding

- Fund targeted promotion to align a higher percentage of WRP-funded wetland restoration projects with Clean Water Vision and/or Impaired Waters priorities.

Resources are needed to implement the BMPs identified in this report, including completing the up-front work needed to identify key threats to water quantity and quality and select and site BMPs to most effectively address those threats. The critical role of local governments and individual landowners in helping implement the identified steps is apparent. Taking steps to expand and encourage their involvement is essential. Likewise, the inclusion of protection as part of the overall watershed approach is designed to minimize future expenditure of both state and local resources to restore impaired waters and to maximize the resource value our water resources provide. From a watershed perspective, a quart of protection will likely be worth many thousands of gallons of cure. If we are going to move rapidly and efficiently towards a watershed planning approach, it would make sense to fund protection studies and implementation activities that can serve as pilot projects to inform watershed planning efforts.

To meet this funding need, the agencies should look for opportunities to fund pilot protection projects, including local protection planning efforts. This will help to inform the development of the watershed plans and also serve as examples of how a watershed or local government might seek to integrate protection and restoration activities into local planning documents and ordinances.

We further recommend that Clean Water Legacy Act implementation and research projects continue to include protection activities, that a portion of the implementation funding be dedicated to preventing impaired conditions from developing in Minnesota's waters, and that the need for protection activities be documented (through the watershed planning process or another mechanism) to develop a better estimate of the overall magnitude of need.

The CWLA includes the following as one of several policies intended to guide the implementation of the Act:

"Identify and encourage implementation of measures to prevent waters from becoming impaired and to improve the quality of waters that are listed as impaired but have no approved TMDL addressing the impairment using the best available data and technology, and establish and report outcome-based performance measures that monitor the progress and effectiveness of protection and restoration measures." (MN Statutes 114D.20, subd. 3, subpt. 7)

In addition to this policy and goal, we recommend that the following criteria be added in prioritizing/selecting pilot protection projects for funding:

- Projects that enhance local awareness and engagement.
- Projects that use of innovative tools/approaches to achieve protection goals.
- Projects that emphasize preventing pollution/threats (rather than treating problems).
- Projects that pilot prevention approaches that could inform watershed planning in general.
- Projects that define the degree to which the water resource/watershed is threatened (where the focus is on waters with declining trends, watershed threats, etc. as opposed to waters with few or no threats).
- Projects targeted to provide the greatest amount of protection for the least cost, or that provide additional benefits beyond water quality protection (for example, projects of mutual benefit to the Clean Water Council's water quality goals and the habitat goals of the Lessard-Sams Outdoor Heritage Council).

In final summary, the challenges and funding needs in providing for the long-term protection of the state's surface water and groundwater resources are significant. Priorities will need to be established and refined to address the most pressing needs over time. The Department will work collaboratively with other agencies and governments to assess and establish areas having the greatest need. Managing for healthy watersheds and clean and adequate water will increasingly require understanding of ecosystems, hydrology, limnology, economics, and human needs. Successful watershed management to protect groundwater and surface water will likely require regulation of both land and water resources, and progress will need to employ multiple tools, including market-based tools. These tools include incentives, certification, cap-and-trade, and private or public payment for ecosystem services. The premise of ecosystem services is the idea that healthy natural systems provide a multitude of benefits to humans; some of these benefits have a marketable value and some do not, but all improve the human condition.

We recommend substantial and continued funding of drinking water protection needs and the Clean Water Legacy priorities. The water quantity assessment work and specific funding we have identified in this report are central to these priorities and will help all Minnesotans ensure the success in finding solutions to our water supply and water quality problems.