Root River Field to Stream Partnership

Innovative Research with Innovative Farmers

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Minnesota Department of Agriculture
625 Robert Street North
Saint Paul, MN 55155-4194
www.mda.state.mn.us

Authors and Contributors

Minnesota Department of Agriculture
Pesticide and Fertilizer Management Division

Adam S. Birr, Ph.D.
Impaired Waters Technical Coordinator

Kevin Kuehner
Southeast Water Quality Advisor

Margaret E. Wagner
Environmental Outreach Coordinator

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Executive Summary

- In 2009 a group of diverse organizations came together to form the Root River Field to Stream Partnership.
- Farmers, farmer organizations, academia, state government, local government, private companies and non-profits are all working together to assess the health of water resources and management options in vulnerable agricultural areas of southeastern Minnesota.
- The purpose of this study is to conduct intensive surface and groundwater monitoring at multiple scales in order to provide an assessment of pollution loads and sources and also determine the effectiveness of agricultural Best Management Practices (BMPs).
- The Root River Field to Stream Partnership is using a nested monitoring design in conjunction with eight complementary research tools. Together these techniques help to characterize water quality and hydrology and represent a sophisticated scientific approach to understanding an entire watershed.
- This type of comprehensive assessment has not been done before in Minnesota.
- This project has benefited from enthusiastic participation by agricultural producers and local conservation professionals.

Legislation

In 2009, the Minnesota Department of Agriculture was appropriated $395,000 from Minnesota's Clean Water Fund to evaluate agricultural non-point source pollution and best management practices (BMPs). The bill was passed by the 86th legislative session in the fall of 2009 (Chapter 172-H.F1231) as follows:

"$395,000 the first year is to intensively monitor and analyze three sub-watersheds for changes in agricultural runoff related to land management practices and evaluate best management practices in sub-watersheds within the Root River Watershed in southeastern Minnesota. The commissioner shall submit a report on the use of this appropriation to the chairs of the House of Representatives and Senate Committees with jurisdiction over agriculture, agriculture finance, environment and natural resources, and environment and natural resources finance by January 15, 2012. This appropriation is available until spent."

Introduction

From farmers to policy makers, there is a growing desire to better understand the impacts of agricultural practices on water quality.

In 2009 a group of diverse organizations came together to form the Root River Field to Stream Partnership. This partnership is an unprecedented effort by agricultural businesses, state agencies, producers and landowners to address water quality issues in the Root River watershed. This unique group is the first of its kind in Minnesota and demonstrates the wide interest in restoring and protecting water quality.

This unique partnership adds value by combining the resources, knowledge and experience of a diverse group of individuals and organizations. Together, project partners are addressing the following key questions:

- ✓ What are the long-term trends and relationships between specific farming practices and water quality?
- ✓ What is the range of sediment, nitrogen and phosphorus losses from agricultural fields on real farms in southeast Minnesota watersheds?
- ✓ How do we accurately assign losses to non-point sources within a watershed (agricultural fields, woods, in-stream contributions, stream bank erosion, etc.)?
- ✓ How effective are new and existing Best Management Practices (BMPs)?
- ✓ What is the most effective approach for engaging farmers with respect to water quality issues?
- ✓ How can these efforts be expanded to similar watersheds of southeastern Minnesota?

The Root River Field to Stream Partnership is comprised of farmers, the Minnesota Department of Agriculture (MDA), Minnesota Agricultural Water Resources Center (MAWRC), The Nature Conservancy (TNC), Fillmore and Mower County Soil and Water Conservation Districts (SWCDs), Monsanto, and academic researchers. It is conducting evaluations of water quality and land management at multiple scales using the latest tools and technology. Partners are looking at every angle of water quality within the Root River watershed and working together to restore and protect the health of this valuable water resource.

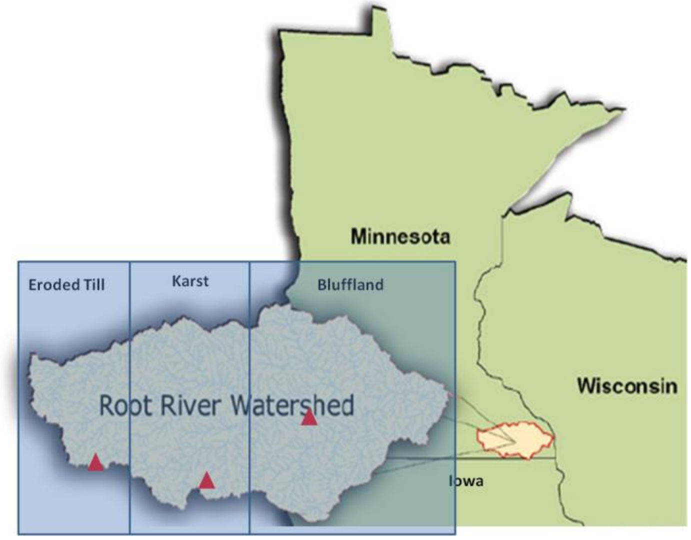
Agricultural fields located in the Root River watershed. Aerial photos provided by The Nature Conservancy, a founding member of the Root River Field to Stream Partnership. Copyright: ColdSnap Photography.

Overall project goals include:

- Understand how farming practices affect water quality at the watershed scale
- Evaluate new and existing conservation practices
- Complete a comprehensive assessment of factors that influence water quality measured in the Root River watershed. This will be accomplished using new and existing research tools.

Research Setting

The Root River watershed is located within the Western Corn Belt Plains and Driftless Area Ecoregions of southeastern Minnesota and northeastern Iowa. This area supports a broad range of outdoor activities and various stakeholder interests. Approximately 97% of the land is privately owned; the remaining 3% are distributed among state, county, federal and conservancy lands or otherwise covered by open water. In 2008, the Natural Resources Conservation Service (NRCS) estimated that approximately 3,027 farms were located in the watershed. Sixty- four percent of the producers are full time and do not rely on off-farm income. In addition to agriculture, the Root River watershed provides abundant recreational opportunities including canoeing, bicycling, camping, hiking, hunting and fishing. This area includes two state parks (Beaver Creek Valley and Forestville-Mystery Cave) and two trout hatcheries that draw visitors from around the state and region throughout the year.



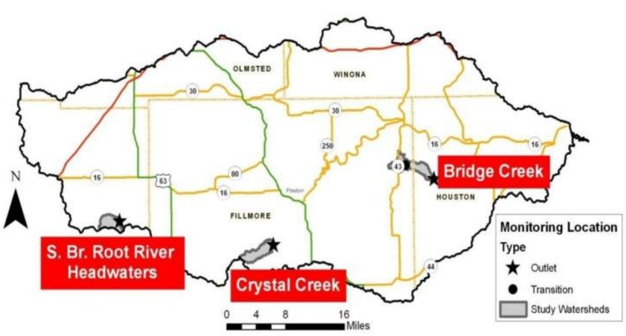
The Root River watershed is located in southeastern Minnesota and northeastern Iowa. For this project, the watershed has been divided into three sub-watersheds that each has unique landscape features.

The 81-mile-long Root River begins in the gently sloping, till plains located in the western portion of the basin. Proceeding east across the watershed, the landscape is characterized by deeply dissected hills and valleys with slope gradients that frequently exceed 30%. The broadly distributed carbonate rocks in the watershed host one of the most extensively developed karst terrains in the upper Midwest. Karst is associated with sinkholes, sinking streams, blind valleys, and groundwater springs. Although less extensively than in the central portion of the watershed, karst features also occur within the bluffs along the downstream reaches of the Root River tributaries in the eastern one-third of the basin.

Land use in the watershed is closely tied to physiographic features. Row crops are prevalent on the glacial till deposited uplands found in the western portion of the watershed. Based on data collected during the 2008 crop year, 36% of the 1,062,932 acre watershed is cultivated farmland, while 33% is grassland, pasture and hay, 23% percent is forested and 7% is residential development.

Segments of the Root and some of its tributaries are considered impaired for sediment, nutrients and bacteria. A Total Maximum Daily Load (TMDL) is currently being prepared by the Minnesota Pollution Control Agency. There are many projects on the ground and various groups working in the area to address the impairments. The diverse terrain within the watershed presents a host of challenges to understanding and managing water quality in the basin. For example, flow routes in the karst topography are very complex and it is often difficult to determine the exchange between surface water and groundwater. When conducting watershed research in the karst areas it is important to consider a comprehensive approach that examines both surface and ground water and to conduct research at a scale that is responsive and takes into account unique landscape features.

Historic and long-term water monitoring is prevalent within the watershed. This monitoring is occurring at a fairly large scale (tens of thousands of acres or more). This approach can yield accurate data about the health of the region but will not show the relationship between specific land use practices and water quality. To answer specific questions about how agricultural practices impact water, a smaller scale monitoring approach is needed. The small-scale monitoring of agricultural areas, coupling edge-of-field and in-stream locations, used in this project has not been attempted elsewhere in the state and there are only a few examples across the country.



Map of the three sub-watershed being monitored in southeastern Minnesota.

In recognition of the Root River watershed's diversity and unique water quality challenges, small study areas (5,000 acres or less) were selected for intensive monitoring. These smaller areas are referred to as sub-watersheds (South Branch of the Root River Headwaters, Crystal Creek and Bridge Creek). Each sub-watershed represents one of the three unique landscapes found in the greater Root River Basin. Those landscapes include the glacial till area in the west, central karst terrain and bluffland landscape in the east. The intensive monitoring strategy being used within the three sub-watersheds will help characterize the processes that impact water quality and the corresponding BMPs best suited to the practices and physical characteristics of the three regions.

Research Activities

The Root River Field to Stream project utilizes a number of different research tools. Together they help to characterize water quality and hydrology and represent a sophisticated scientific approach to understanding an entire watershed.

The Root River Field to Stream Partnership uses multiple research techniques and brings together researchers from multiple disciplines (hydrology, agronomy, biochemistry, and geography). This team is using both long-established tools and new tools based on recent technology to evaluate sources and loads of pollution in this region.

The purpose of this study is to conduct intensive surface and groundwater monitoring at multiple scales in order to provide a comprehensive assessment of pollution loads and sources and also determine the effectiveness of agricultural BMPs. At the core of this project is a nested water quality monitoring design. This includes edge-of-field sites “nested” within sub-watersheds (or small areas within a larger watershed). Edge-of-field sites provide information about the amount of soil and nutrients moving off a given field into an adjacent waterway. Each site captures water from an area of between 16 and 95 acres. In-stream monitoring sites are located at the outlet of three small watersheds (South Branch of the Root River Headwaters, Crystal Creek and Bridge Creek). Each site captures water from an area of 2,700 – 4,800 acres.

The nutrient and sediment losses observed at each scale within this nested design will provide valuable information about how nutrients and sediments are transported from the edge-of-field to the sub-watershed outlet. Significant differences in losses measured at these scales (edge-of-field vs. in-stream) will provide insight into other non-point contributions within the area such as the non-field portions of the watersheds. There are many examples of nested designs using small watersheds monitored within larger watersheds but using edge-of-field monitoring to complement sub-watershed monitoring is a unique aspect of this study that has very practical implications for measuring BMP effectiveness.

Edge-of-Field Monitoring

A total of four edge-of-field monitoring sites have been established within the three sub-watersheds. Each site is equipped to monitor surface runoff for nitrate-nitrogen, phosphorus, and sediment. Sites are fully automated and samples are collected year-round, whenever runoff occurs. In addition, water leaching from the soil horizon is monitored for nitrate-nitrogen. Groundwater monitoring is important in southeastern Minnesota because nitrate-nitrogen impairments appeared for the first time on Minnesota’s 2010 draft list of impaired waters (303d). This project offers a unique opportunity to characterize nitrate-nitrogen transport in this geologic region of the state; these data will help inform studies that will be undertaken to address these impairments.

Sampling began with snowmelt in the spring of 2010, resulting in two full years of monitoring. During this time, more than 160 samples have been collected at the edge-of-field locations. It is important to consider that runoff is very episodic at these locations. On average there are three to five runoff generating events each year; these are often triggered by snowmelt runoff and rainfall runoff during periods of the year when the crop canopy is not well established.

Sub-watershed Outlet Monitoring

Streamgaging sites have been established at the outlets of each of the three sub-watersheds. Monitoring conducted at this scale will assimilate the multitude of agricultural practices, land cover types, and hydrologic processes that dictate the movement of water and soil across the landscape. These sites will also be used to track trends in runoff affected by long-term activities employed as part of the project. The Bridge Creek sub-watershed affords us an opportunity to isolate the agriculturally dominated uplands from the forested ravines and valleys; consequently a site was established at this location (BCT).

Each site is equipped to continuously monitor flow, precipitation, nitrate-nitrogen, phosphorus, sediment, turbidity, and pesticides during ice-free periods. The Crystal and Bridge Creek sub-watersheds are spring-fed systems that generally allow for year-round monitoring. The Headwaters sub-watershed does not have perennial flow during the winter months and is only monitored during the ice free periods (April 1 to November 1) to avoid damage to the monitoring equipment. Spring monitoring is also conducted in the Crystal and Bridge Creek sub-watersheds to characterize surface-groundwater interactions common in the region.

As with the edge-of-field locations, sampling began at the sub-watershed outlet sites with snowmelt in the spring of 2010 resulting in two full years of monitoring. More than 635 samples have been collected at these locations. This is a significant number of samples reflecting the perennial nature of in-stream monitoring as compared to edge-of-field monitoring where the presence of runoff is less frequent. Moreover, in-stream sampling at the small watershed scale requires a large number of samples because concentrations for constituents measured can vary by several-fold over the course of a few minutes. Runoff events at this scale may only last a few hours thus necessitating an aggressive sampling approach that utilizes automated techniques to accurately quantify nutrient and sediment losses sustained during the events.

Evaluation of Bioavailable Phosphorus

A comprehensive understanding of the source, fate and influence of phosphorus (P) on a water body requires an understanding of the amount of total phosphorus available to aquatic organisms. Phosphorus is an extremely important nutrient in freshwater systems, as it is often the limiting nutrient for primary production. Yet, excess amounts of phosphorus can cause eutrophication of a water body, leading to a host of undesirable consequences. Since algae and higher plants cannot use all forms of P, the effects of P are heavily dependent on the bioavailability of the P forms present. The goal of this research is to determine the amount of bioavailable phosphorus (BAP) present in the water and sediment and to quantify the impact of BAP in the Root River watershed. Over the last year and a half, Dr. Adam Hoffman of the University of Dubuque has analyzed BAP from storm runoff samples collected at various locations around the study sub-watersheds.

By analyzing sediment samples from the edge-of-field, in the stream bed, and sub-watershed outlets researchers will be able to determine how the bioavailability of P is being influenced by transport and storage in the Root River. Also, this research aims to predict the role that sediments will have on the water quality as BMPs are implemented. This is especially important as P stored in sediments could actually increase P concentrations in the Root River as runoff water is cleaned up. Combining the TP data with BAP data will allow for determination of the percent of total P that is bioavailable - an important measure for determining and accessing P's influence in the watersheds. Also coupling the BAP data to Dr. Patrick Belmont's sediment fingerprinting data will provide a clearer understanding of the timing of BAP transport in the sub-watersheds.

All the water samples have been analyzed, along with a small subset of sediment samples. One interesting area of BAP analysis is the variation in the percent of P that is bioavailable during these runoff events. It seems that site-specific characteristics influence the TP:BAP ratio in the sub-watersheds. The percent of P that is bioavailable ranges from the single digits, up above 80%, however most samples fall within the 10-50% range. The timing of runoff events also seems to play an important role as the percent of TP that is made up of the BAP fraction varies from early season to late, this holds true even when comparing similar sized events. Further analysis from the sub-watersheds should allow researchers to accurately assess how different sites (and management activities) do or do not influence BAP in runoff and its fate in the Root River.

Farm Practice Surveys

MDA staff conducting a farm practice survey with a producer that is participating in the edge-of-field monitoring for this program.

In 2010, a survey was developed by MDA to document farming practices within the study watersheds. These surveys were based on a diagnostic tool called Farm Nutrient Management Assessment Program (FANMAP), also developed by MDA. The voluntary survey is conducted with each producer and gathers field-specific information related to tillage, nutrient and pesticide management. The information is important in helping scientists better understand the long-term relationship between agricultural land use activities and the water quality. The survey will also help characterize some of the social and human factors associated with the adoption of BMPs. The first round of surveys took place in early 2011. Twenty-eight producers participated in the survey; this represents approximately 70% of the roughly 6,000 cultivated acres in the three sub-watersheds. Farmers managing the remaining acres will be surveyed in 2012. Results will be analyzed and summarized during the summer of 2012. Farm practice surveys will continue in subsequent years to evaluate farming practice trends and serve as a benchmark for overall project performance.

On-farm BMP Evaluations

On-farm BMP evaluations are being used to help growers compare different management practices. Growers involved in this project compare their normal nitrogen application practices and rates to alternative practices and rates using replicated strip trials (i.e. 154 lbs N per acres versus 124 lbs N per acre). The basal stalk nitrate test combined with a basic economic analysis is used to determine which rate was the most appropriate. In 2011, three producers participated in nitrogen rate evaluations and one producer participated in a reduced tillage comparison. On-farm projects provide producers with the scientific information they need to balance conservation and production. They have also proven to be very effective tools in initiating a constructive dialogue between producers and their advisors regarding nutrient management practices.

End of Season Basal Stalk Nitrate Test

For producers, it's easy to tell when a corn field may have a nitrogen deficiency. The yellowing of the lower corn leaves is a tell-tale sign that their crop is suffering from a lack of this important nutrient. On the contrary, it can be very difficult for a producer to determine whether their nitrogen fertilizer program is supplying too much nitrogen. The risks of over fertilization can result in decreased profitability and/or excessive nitrogen loss to the environment. Because it can be extremely difficult to predict the exact amount of nitrogen that must be applied to corn for a given year, a corn tissue test is being demonstrated.

Equipment used for end of season basal stalk nitrate testing

The end-of-season stalk nitrate test is a tool that can help growers evaluate their nitrogen management. After the corn plant has reached maturity, nitrate-nitrogen concentrations are measured in stalk sections from the lower portion of the plant. Researchers have found that concentrations above 2000 parts per million (ppm) may indicate a high probability that nitrogen was in excess of what the corn plant needed. If concentrations are below 700 ppm there is a high probability that nitrogen was deficient. Remote sensing information such as aerial photographs and vegetation index images are used to help guide where to collect representative field samples. The interpretation of the results offers no assistance in fine-tuning nitrogen management for the current year, but rather provides insight into nitrogen management options for future years. The stalk nitrate test was demonstrated and evaluated on 127 corn fields (360 samples) in 2010 and about 115 corn fields (344) in 2011. There has been strong interest in the test and it has expanded into other study areas in southeastern Minnesota.

Delineation of Spring-sheds Using Sinkhole Dye Tracing

The term "karst" is defined as a geologic formation shaped by the dissolution of soluble bedrock, usually carbonate rock such as limestone or dolomite, producing fissures, sinkholes, underground streams, and caverns. The formation of karst features limits the soil's capacity to filter contaminants from percolating water. Our current understanding is that nitrates in southeast Minnesota karst streams are delivered primarily through spring flow. However, little is known about where the water from these springs is derived. Knowing the land area that contributes to these springs (springsheds) is important when trying to evaluate the effects of various nitrogen management practices. With assistance from the Minnesota Department of Natural Resources (DNR), springshed mapping is being conducted within the karst sub-watershed of Crystal Creek. Springshed mapping entails the use of fluorescent dyes to track groundwater flow (directions and travel

Researchers pour dye into a sinkhole and then trace flow patterns by monitoring where the dye reappears. The dye moves through underground streams and often emerges in springs miles away.

times). The dye is poured into a sinkhole or sinking stream; from there, it flows through the karst conduit system until it re-emerges at a spring (this dye does not cause any permanent impact). Carbon samplers are used to determine where the dye originated. A total of eight sinkholes have been traced since the project began resulting in the delineation of three distinct springsheds. Results from the most recent dye trace study indicate that the land area feeding the largest spring extends significantly past the surface watershed boundary thereby increasing the amount of land and producers involved with the project. Additional tracing is planned for 2012 and 2013.

Digital Terrain Analysis/LIDAR

Digital Terrain Analysis (DTA) is being conducted by Dr. Toby Dogwiler and Andrew Simmons from the Southeastern Minnesota Water Resources Center (SEWRC) at Winona State University. DTA is a technique that uses high-resolution digital elevation data to analyze and predict landscape processes, such as erosion. The terrain analysis project has focused on deriving and interpreting the Stream Power Index (SPI) for Bridge Creek, Crystal Creek and the South Branch of the Root River Headwaters. The SPI in simplified terms determines the catchment area and contributing slope for each part of the landscape. When the product of these two variables is higher there tends to be a greater potential for erosion. The goal of the project is to develop digital terrain analysis as a low cost and effective tool for identifying critical sources areas of erosion in southeastern Minnesota. Critical source areas are portions of the landscape that are vulnerable to erosion and tend to contribute a disproportionate amount of sediment or nutrients.

As part of this project we have derived the SPI for all three sub-watersheds at various resolutions and have focused on the 3 meter scale. Researchers have also developed and employed a field- and remote sensing-based technique for verifying the erosion predictions derived from the SPI analysis. This verification technique is almost complete in the Bridge Creek sub-watershed and is on going in the other two sub-watersheds. We anticipate completion of the verification process in spring 2012.

During the summer of 2011 significant effort was invested in developing a method for using the SPI results to identify “Highly Connected Corridors”, or HCCs. The HCCs are portions of the watershed where critical sources areas are highly-connected to riparian stream zones through continuous corridors of high erosive potential. We are testing this technique in Bridge Creek and are optimistic that it will be a tool for leveraging digital terrain analysis data to prioritize the most critical source areas within a watershed. This will be another major focus as we work to complete this project in 2012.

Assessment of Stream Channel Characteristics

Dr. Dogwiler and Andrew Simmons of the SEWRC at Winona State University are characterizing the stream channels within each of the three sub-watersheds. The purpose of this study is to generate an underlying base knowledge that will help us understand how the implementation of BMPs in the future will affect the hydraulic and geomorphic characteristics of the sub- watersheds.

In the summer of 2010, the streams in the three sub-watersheds were surveyed. The surveys were conducted using a Total Station to determine position and elevation of the various stream reach characteristics and features. The assessment included, a profile survey identifying bedforms, measurements of multiple cross-sections, pebble counts, and measurement of discharge. The surveys were broken down into individual reaches and were classified differently according to Rosgen’s Stream

Classification system. Stream discharge was also measured at each cross section with a flow meter and a stream walk was also conducted to document the substrate type and also to look for erosional features within the reach. In the summer of 2011, Microsoft Excel, ArcGIS, and RiverMorph software packages were used to organize and process data from the profile survey, cross sections, pebble counts, and discharge data.

Sediment Fingerprinting

Sediment remains one of the most difficult non-point source pollutants to quantify at the watershed scale. Annual erosional losses over large areas are typically on the order of hundredths of an inch, with significant variability within a given watershed, and therefore can't be readily measured directly. Dr. Patrick Belmont, of the University of Minnesota's National Center for Earth Surface Dynamics, is using multiple fingerprinting tracers to identify contributions of sediment from different sources within each sub-watershed. Sediment fingerprinting is a technique that uses the geochemical composition of suspended sediment to determine the proportion derived from different parts of the landscape.

Dr. Belmont's research team developed and implemented a sediment fingerprinting approach that measures concentrations of long- and short-lived radionuclide tracers (specifically, Beryllium-10 (^{10}Be), Lead-210 (^{210}Pb), and Cesium-137 (^{137}Cs)) associated with suspended sediment to specifically determine the proportion of sediment derived from upland versus near-channel sources. Multiple samples collected over the course of individual storm hydrographs provide watershed-integrated snapshots of the proportion of sediment derived from these two sediment sources. This information can be used independently as a basis for determining what type of BMPs might be needed and for evaluating the effectiveness of BMP implementation.

Over the last two monitoring seasons, multiple samples have been collected at the sub-watershed outlets and edge-of-field locations during runoff events. Researchers require approximately 20 gallons of water for sample analysis; therefore the samples are collected manually without the aid of the automated equipment. The samples collected thus far represent a range of different runoff events, at different times of the year, which will provide useful information on how sediment is transported both currently and historically (over the past several decades) within the study sub-watersheds.

Timescale Required for Comprehensive Watershed Research

Comprehensive watershed research is being conducted to evaluate long-term trends (>10 years) in water quality within each of the sub-watersheds. The first phase of the project will serve to establish baseline relationships between current land use activities, including existing BMPs, and water quality. Monitoring in this phase will help determine some of the underlying mechanisms that dictate observed water quality. Baseline information will help researchers evaluate opportunities for alternative practices and make recommendations based on water quality and other associated data gathered as part of the project. The long-term goal is to use the baseline data as a pre-treatment phase to evaluate alternative practices that may be implemented in the future.

Similar research has demonstrated that time is the most constraining factor in measuring responses to BMPs implemented at the watershed scale. This is due, in part, to variability in annual precipitation timing and intensity, as well as other climatic factors. Consequently, several years will be required to effectively deliver conservation practices in the sub-watersheds and measure a response to those activities.

Outreach Activities

Education and outreach is a vital element of the Root River Field to Stream project. MDA is the lead partner on coordinating events and is responsible for overall communication and outreach planning. MDA has worked hard to engage producers, support local partners and foster regional cooperation. There is a great relationship between the Root River partners and the participating producers; one filled with mutual respect and a desire to learn more. The four producers are strong advocates for the program and very important for the success of the project.

Field Days

Project partners have hosted four field days during the first two years of this project. Field days include a tour of an edge-of-field and in-stream monitoring site. Each tour begins with a description of both the farming operation and monitoring equipment. These have tended to be informal events that foster open dialogue and insightful discussions. They have proven to be a successful way to engage local producers and interested neighbors. Field days have attracted other stakeholders including agricultural producer groups, local government officials and researchers working on similar water quality projects.

Producers, non-profit, state agency and ag industry staff talk about agriculture and water quality at a field day in southeastern Minnesota.

The largest field day was held on September 9, 2011. This tour included leadership from the MDA, DNR, MPCA, BWSR, producer groups and farm organizations, as well as state legislators, county commissioners and local conservation professionals. This was an excellent opportunity to engage a diverse group of people in a discussion about agriculture and show them what farmers are doing to protect water quality and address the challenges that exist.

The producers are gracious hosts, eager to share their experience in the program and talk about water quality. The four producers with edge-of-field sites on their property are very interested in the results and learning what they can do to minimize losses on their land. In the words of one producer "*We live here. We eat and drink the water here. It doesn't make sense to be over applying nutrients*" He concluded by saying, "*If I'm losing nutrients from my field, I want to be the first to know*". Each producer has hosted at least one field day and is committed to hosting additional events in the future.

Presentations

The Root River Field-to-Stream Partnership has been invited to give oral and poster presentations at multiple conference and research meetings. This is a great way to raise awareness about the project and will be an important way to share results in the future. MDA will begin sharing the first full year of monitoring results at meetings in 2012.

Promotional Video

Project partners are leveraging resources to make a promotional video for the project. This video will include aerial video footage of the Root River watershed as well as interviews with producers, researchers, and project managers. It will be a communication tool to raise awareness about the project and explain the scope of the research. This video will be critical when explaining this project to various groups and will enhance outreach efforts by capturing the opinions and voices of local producers.

Aerial video footage was collected by The Nature Conservancy and is being used by the MDA free of charge. The Fillmore County Soil and Water Conservation District purchased a handheld camcorder and is working with the MDA to conduct interviews. MDA has not committed any financial resources to this project.

Budget

To date $161,104 has been spent with $233,896 of the original allocation remaining. A majority of the funds have been passed through to Fillmore and Mower County Soil and Water Conservation Districts with $140,840 remaining on the contract with the SWCDs. SWCD staff members are responsible for the operation and maintenance of the monitoring stations and also help collect samples needed for the agronomic assessments (soil and basal stalk samples). Additionally, the SWCDs have developed sub-contracts with academic researchers working on various components of this project and have assisted them with field work. Another significant portion of the budget is the analytical cost for water, soil, and basal stalk analysis. Lastly, producers participating in the project have been given a nominal payment for participating in farm management surveys and allowing access to their farms for monitoring activities. The remaining funds will ensure that the baseline monitoring and assessment period can continue through the spring of 2013.

The CWF funds allocated to MDA have been leveraged significantly to support various components of the project. Project partners Monsanto, The Nature Conservancy and MAWRC contributed $125,000 to purchase monitoring equipment. This initial investment provided critical support for monitoring activities during phase 1 of this project. MDA has committed the equivalent of approximately 0.6 FTE in staff support for overall project management, technical support for the SWCDs, coordination with project participants, and development of outreach materials and events. Funding for approximately 0.6 FTE in staff support was provided by MDA's Technical Assistance allocation from the FY10-11 Clean Water Fund. This support will continue through FY13 using the latest Clean Water Fund Technical Assistance allocation.

In addition to MDA's resources, additional services and funds have been provided by other state agencies. Examples of these contributions include:

- **DNR Division of Waters Sub-contract with TNC-** A sub-contract was developed with the DNR and TNC to obtain stage/discharge relationships for the in-stream monitoring stations. The contract will be for two years with funding from TNC. **($13,800)**
- **MPCA Root River Comprehensive Strategy, Fillmore SWCD and WSU -**Funds will be used to conduct electronic resistivity mapping and additional lysimeter sampling at select on-farm nutrient management demonstration sites. Information will provide detailed depth to bedrock maps and help inform the effects of various nitrogen management BMPs on soil water nitrate concentrations. **($25,000)**

Next Steps and Conservation Delivery

It is anticipated that baseline monitoring will continue through the 2013 monitoring season and that field monitoring data will be available within the next year. The data will be evaluated and summarized in a comprehensive report outlining what has been learned about sediment and nutrient movement within the three sub-watersheds. This information will serve as the foundation for the next phase of the project focusing on BMP implementation.

Beginning in 2012, a steering committee made up of farmer leaders within each of the sub-watersheds will be formed. This group will meet annually and help develop strategies to deliver lessons learned and information gathered throughout the study to their neighbors and help guide the delivery of additional conservation practices.

Monitoring will be on going throughout the conservation delivery and implementation phase (phase 2) of the project beginning during the 2014 monitoring season. Similar studies have demonstrated that an additional five to ten years of monitoring may be needed to measure a significant response to these activities. Both the timing and magnitude of the response are dependent on the degree and placement of conservation practices in the sub-watersheds. The approach will evaluate costs and benefits of BMPs and determine those with the greatest benefit at lowest cost for the unique field conditions in southeast Minnesota.

Annual reports, including data analysis, will be prepared and shared with all interested stakeholders. The nested monitoring design will serve to provide a timely feedback mechanism for adaptive management. Conservation activities within the sub-watersheds can be guided by observed responses at the edge-of-field sites. Observations at the sub-watershed scale can in turn inform activities within the broader region.

The approach used in this project represents the evolution of watershed science and BMP effectiveness research that has been recognized both nationally and internationally. The cornerstone of this program is a comprehensive approach to characterize and quantify processes that are expressed at the sub-watershed outlet using tools developed in multiple disciplines such as hydrology, agronomy, geomorphology, soil science, and biology. Through this multi-faceted approach we will gain insight into the effects of management practices and land use on water quality within the unique geomorphic setting in southeastern Minnesota.

Perhaps as valuable as the science is the demonstration of how different stakeholders can forge partnerships to address a very complex issue. It’s this partnership between farmers, farmer organizations, academia, state government, local government, private companies and non-profits that is both a unique and critical component to the success of the Root River Field to Stream Partnership to date. The landowner participation demonstrated thus far combined with the support of each of the partners will help to ensure the goal of evaluating the effectiveness of watershed-scale conservation practices can be realized.