

Outcomes of Clean Water Fund Activities to Develop Targeted, Science-Based Watershed Restoration and Protection Strategies (WRAPS)

Report to the Minnesota Legislature

January 2016



Minnesota Department of Natural Resources

The Minnesota Department of Natural Resources (DNR) prepared this report in response to Minnesota Laws 2013, Chapter 137 (Clean Water, Land, and Legacy), Article 2 (Clean Water Fund), Section 6 (DNR), Paragraph (d), which states: \$1,850,000 the first year and \$1,850,000 the second year are for developing targeted, science-based watershed restoration and protection strategies, including regional technical assistance for TMDL plans and development of a watershed assessment tool, in cooperation with the commissioner of the Pollution Control Agency. By January 15, 2016, the commissioner shall submit a report to the chairs and ranking minority members of the senate and house of representatives committees and divisions with jurisdiction over environment and natural resources policy and finance providing the outcomes to lakes, rivers, streams, and groundwater achieved with this appropriation and recommendations.

The estimated cost of preparing this report (as required by Minn. Stat. § 3.197) was \$10,600.

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Executive summary

This report describes the outcomes of a \$3.7 million appropriation to the Minnesota Department of Natural Resources (DNR) from the Clean Water Fund (CWF) in the 2014-2015 biennium. The appropriation continued an initiative that began in fiscal year 2010 to apply the science of watershed health to Total Maximum Daily Load (TMDL) studies and watershed restoration and protection strategies (WRAPS).

The report discusses the DNR's approach to the work supported by this appropriation, the outcomes of this work, and recommendations for continuing this work. The appropriation is referred to throughout this report as the **FY14-15 WRAPS appropriation**.

The FY14-15 WRAPS appropriation to the DNR

The DNR's data, information, and expertise are critical to designing and implementing effective, efficient solutions that address the root causes of water quality issues and deliver multiple environmental benefits.

The FY14-15 WRAPS appropriation enabled the DNR to:

- ❑ Assist individual WRAPS efforts and TMDL studies by:
 - Helping the Minnesota Pollution Control Agency (MPCA) identify water quality problems;
 - Helping watershed teams develop targeted, science-based restoration and protection strategies;
- ❑ Coordinate this assistance at the watershed, regional, and state level in ways that improve the WRAPS process statewide; and,
- ❑ Enhance the Watershed Health Assessment Framework (WHAF), an interactive mapping tool that encourages users to explore watersheds and watershed health.

These activities support the Minnesota Water Management Framework, a 10-year cycle of collaboration among state and local partners to monitor, study, restore, and protect Minnesota's 81 major watersheds. The framework recognizes that water quality depends greatly on the surrounding watershed. Healthy watersheds deliver clean water to lakes, rivers, streams, and aquifers and provide a whole range of other environmental benefits.

The FY14-15 WRAPS appropriation accounted for approximately 17% of the CWF funds provided to the DNR in FY14-15. Outcomes of the other 83% are described on the Legislative Coordinating Committee's Legacy Amendment website.

Outcomes of the FY14-15 WRAPS appropriation

Assisting individual WRAPS and TMDLs

- ❑ **Helping the MPCA identify water quality problems:** DNR staff gathered and analyzed existing and new biology, hydrology, stream geomorphology and connectivity data for 49 watersheds in FY14 and 57 watersheds in FY15. This work included 211 stream geomorphology and hydrology field surveys in FY14 and 161 surveys in FY15. Surveys take several years to complete. In a given fiscal year, staff complete some and continue others, while starting new surveys where a new WRAPS cycle is beginning. Staff also assisted with 30 TMDL studies in FY14 and 18 TMDL studies in FY15. All of the above information improves models and enhances our understanding of how water and pollutants move through watersheds and provides a foundation for targeting restoration and protection efforts.

- ❑ **Developing watershed restoration and protection strategies:** DNR staff helped local WRAPS teams develop strategies in 37 watersheds in FY14 and 45 watersheds in FY15. The FY15 figure includes many of the same watersheds as FY14 since the work typically spans more than one fiscal year. The DNR's participation helps teams identify strategies that target the root causes of water quality issues and deliver multiple environmental benefits. Examples in this report show that we are making a significant difference.

Improving the WRAPS process

DNR staff coordinate the agency's WRAPS work at the state, regional, and watershed levels in ways that improve the WRAPS process overall. Key accomplishments in FY14-15 included:

- ❑ Initiating and launching Interagency Watershed Core Teams to enhance collaboration among state agencies and local partners on individual WRAPS and/or One Watershed One Plan projects.
- ❑ Collaborating with the MPCA to jointly train over 100 staff and managers from both agencies on stream stressor identification and geomorphology techniques; and,
- ❑ Starting an internal project to standardize the types of data and information the DNR contributes to every WRAPS.

Enhancing the Watershed Health Assessment Framework (WHAF)

Developed by the DNR in FY12-13, the WHAF is a powerful tool that enables anyone with an Internet connection to map and explore Minnesota's 81 watersheds interactively. Users can access a wealth of up-to-the-minute environmental data from many sources all on one website and view the data at multiple watershed scales. Central to the WHAF are watershed health scores that go beyond water quality alone to score 35 different aspects of watershed health. The FY14-15 WRAPS appropriation enabled several key improvements to the tool. These included enhanced ease of use, continuous automatic updating of health scores and data layers, and the ability to share dynamically generated maps with collaborators on the fly.

Recommendations

Supporting WRAPS

The DNR's recommendation is to maintain funding and current levels of effort to support WRAPS as part of the Executive Branch's carefully crafted Minnesota Water Management Framework.

The Watershed Health Assessment Framework (WHAF)

The DNR's recommendations for the WHAF are to:

- ❑ Maintain existing tool features;
- ❑ Leverage advances in technology;
- ❑ Intensify outreach and training to fully use the tool's powerful data synthesis, visualization, and collaboration capabilities; and,
- ❑ Keep updating watershed health scores to help calculate index trends and generate dynamic watershed characterization reports.

The FY14-15 WRAPS appropriation to the DNR

The DNR's data, information, and expertise are critical to finding effective, efficient solutions to water quality issues. Local governments use this information to design and implement projects that address the root causes of water quality issues and deliver multiple environmental benefits.

The DNR used the FY14-15 WRAPS appropriation to:

- ❑ Assist individual WRAPS efforts and TMDL studies by:
 - Collecting and analyzing data that help the MPCA identify water quality problems;
 - Using the resulting information to help watershed teams develop targeted, science-based restoration and protection strategies;
- ❑ Coordinate this assistance at the watershed, regional, and state levels, including integration with other CWF programs at the DNR and other state agencies; and,
- ❑ Enhance the Watershed Health Assessment Framework (WHAF), an interactive mapping tool that helps users explore watersheds and watershed health.

Through its contributions to the WRAPS process and development of the WHAF, the DNR is taking the science of water quality to a watershed scale to help inform and target site-specific solutions. The DNR's partnerships with the MPCA, other state agencies, and local governments are flourishing. Momentum is building toward higher overall capacity to apply watershed science and engage communities in solving complex water quality problems and threats.

Supporting the State's watershed approach

The DNR's clean water work supports state and local partners at every stage of the Minnesota Water Management Framework (Figure 1). The framework is a 10-year cycle of collaboration among state and local partners to monitor, analyze, restore, and protect Minnesota's 81 major watersheds.

Within this framework, the MPCA leads efforts to develop WRAPS for every watershed. WRAPS focus on water quality because they are designed to meet federal Clean Water Act requirements. The Clean Water Act requires states to submit plans for fixing waters that are too polluted for drinking, swimming, fishing, or supporting the plants and animals that live there. WRAPS reports developed by the MPCA and local governments set numeric goals for reducing water pollution and identify high-level strategies and actions throughout the watershed to meet these goals.

As noted in the 2014 Minnesota Clean Water Roadmap, Minnesota's water quality and water quantity challenges are the result of 150 years of major land use conversions -- from prairie and forest to cities, industry, and agriculture. We can only expect CWF activities to result in measurable progress on a small scale over the short term. Moving the needle on long-term goals at regional and statewide scales, however, will require significant efforts.

The anticipated outcomes to lakes, rivers, streams, and groundwater of the work supported by the DNR's FY14-15 WRAPS appropriation will take time to confirm, for several reasons.

- ❑ First, as noted in the forthcoming 2015 CWF Performance Report, better water quality is not always immediately evident due to lag times between implementation and results. Ongoing monitoring is needed to confirm that improved or stable water quality is a trend and not just an anomaly.
- ❑ Second, attributing water quality outcomes to CWF activities is complicated. Positive outcomes are often the result of years of partnership and multiple sources of funding. Also, external factors such as climate change and land use conversions can counteract improvements. Given these dynamics, it is difficult to discern what the outcomes in a particular watershed would have been without intervention.

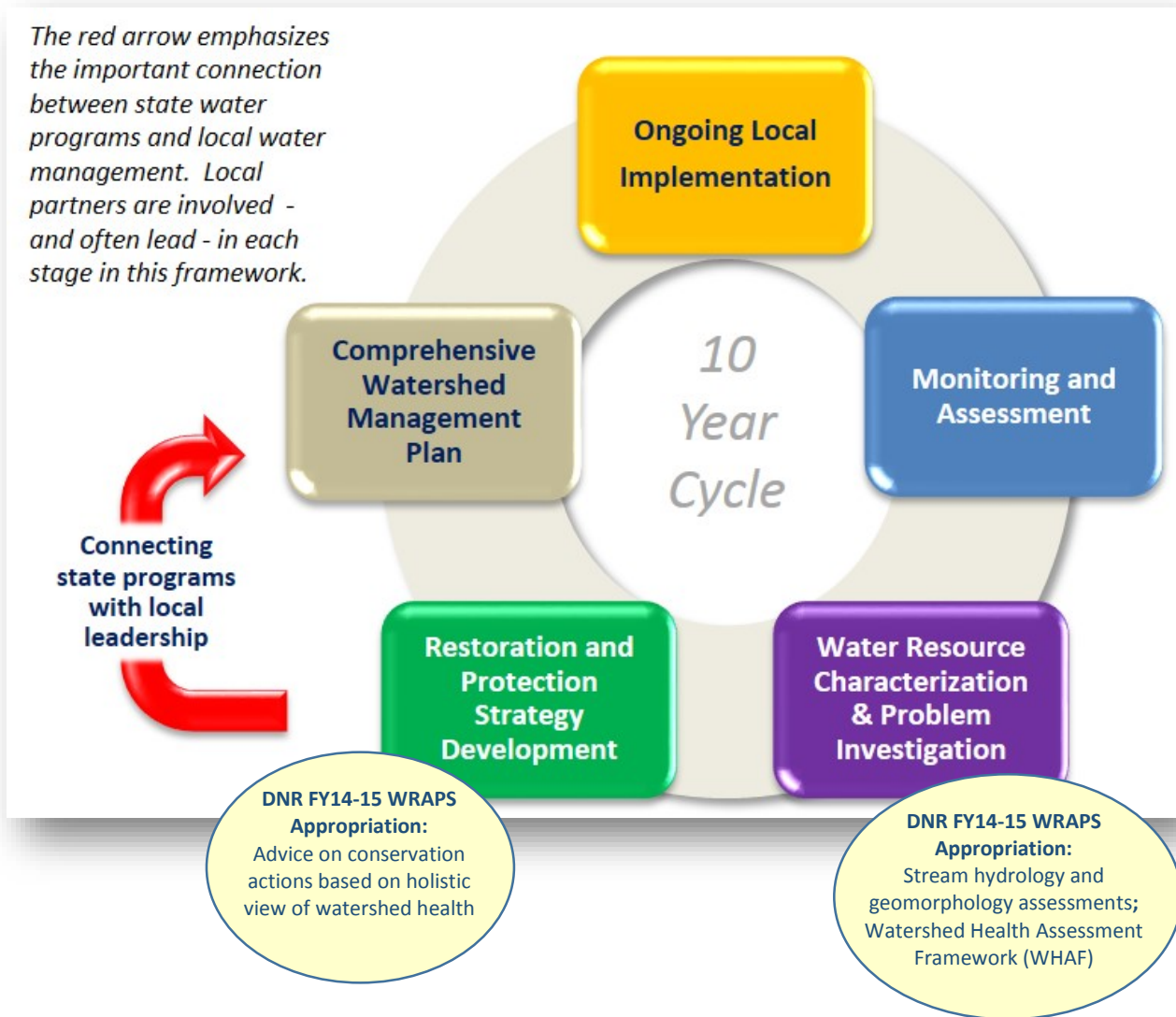


Figure 1. The Minnesota Water Management Framework. The DNR supports state and local partners at every stage of the cycle. DNR activities supported by the FY14-15 WRAPS appropriation (the focus of this report) are noted in the yellow ovals.

Advancing the science of watershed health

The State's watershed approach recognizes that water quality depends greatly on the surrounding watershed. The process leading up to restoration and protection strategy development (the green box in Figure 1) also includes watershed-wide water quality monitoring and assessment (the blue box in Figure 1) and water resource characterization and problem investigation (the purple box in Figure 1).

The DNR's contributions to the WRAPS process (see yellow ovals in Figure 1) help partners identify strategies and actions that improve watershed health. Healthy watersheds deliver clean water to lakes, rivers, streams, and aquifers and provide a whole range of other environmental benefits.

Sustainable water quality

Investing in solutions that lead to sustainable water quality rather than short-term fixes requires understanding the health of the surrounding watershed, including the root causes of unhealthy symptoms.

Water quality data can tell us if a waterbody is clean enough to drink, swim, fish, and support plants and animals – but they don't necessarily tell us why. As with human health, symptoms alone don't tell the whole story. The same symptoms – such as too much sediment in streams – may have very different causes in different places. This requires tailoring solutions to each situation.

Watershed health components

The five components of watershed health are described below. The DNR collects and analyzes data and information on four of the five components – biology, hydrology, geomorphology, and connectivity.

Biology: Plants and animals on the land and in the water interact with soil, air, and water to form an ecosystem. Healthy ecosystems filter air and water, prevent erosion, and cycle nutrients.

Hydrology: The amount and timing of precipitation, evaporation, and infiltration – and how water moves through natural and man-made drainage networks – determine lake and stream levels, droughts, and floods.

Geomorphology: Topography, soils, and underlying bedrock determine the shape of lakes and rivers – shallow, deep, curvy and flat, or straight and steep.

Connectivity: Dams, culverts, and other floodplain alterations prevent the natural movement of water, sediment, and fish. Water also moves vertically underground. Connected habitat corridors and stream systems provide essential places for plants and animals to move and find refuge.

Water Quality: Water properties such as temperature, alkalinity, and concentrations of dissolved oxygen, sediment, nutrients, and contaminants help describe the health of a stream or lake.

The five components of watershed health interact with each other. For example, less year-round vegetation (**biology**) on the land means more runoff, as less water permeates the soil or evaporates (**hydrology**). This can accelerate streambank erosion, causing stream channels to deepen (**geomorphology**) and get disconnected from their floodplains (**connectivity**). This can lead to more sediment in streams, carrying excess nutrients that lower the amount of dissolved oxygen in the water (**water quality**).

Outcomes of the FY14-15 WRAPS appropriation

Assisting individual WRAPS and TMDLs

The FY14-15 WRAPS appropriation allowed the DNR to use its unique expertise to:

- ❑ Collect and analyze geomorphology, hydrology, connectivity, and biology data (see definitions on page 9) to help the MPCA identify water quality problems (see the purple box in Figure 1); and,
- ❑ Use the resulting information to help watershed teams develop more effective, efficient restoration and protection strategies (see the green box in Figure 1).

Measurable outcomes for each type of assistance are provided below. Figure 2 shows the major watersheds where the DNR provided either type of assistance using the FY14-15 WRAPS appropriation.

Collecting and analyzing data to help identify water quality problems

Below are measurable outcomes and a summary of DNR's data collection and analysis work using the FY14-15 WRAPS appropriation.

*DNR field staff gathered and analyzed existing and new data for **49 watersheds in FY14** and **57 watersheds in FY15** to provide information that enhances our understanding of how water and pollutants move through watersheds. This information provides a foundation for targeting restoration and protection efforts. This work included **211 stream geomorphology and hydrology field surveys in FY14** and **161 surveys in FY15**. Surveys take several years to complete. In a given fiscal year, staff complete some surveys and continue others, while starting new ones where a new WRAPS cycle is beginning. Independent of major watershed projects, staff also assisted with **30 TMDL studies in FY14** and **18 TMDL studies in FY15**.*

- ❑ **Watershed characterization:** Early in the WRAPS process, staff compiled and analyzed a wealth of mostly existing data about important resources to protect and conditions that affect the watershed's ability to deliver clean water. Examples include, but are not limited, to watershed-scale changes in rainfall and runoff, shallow lake and calcareous fen locations, lake depth and outlet elevations, and data on straightened channels, culverts, dams, and other man-made hydrologic features. Staff interpret and communicate the resulting new information to aid subsequent water quality problem investigations and watershed modeling as part of the WRAPS process.
- ❑ **Stressor identification:** Staff worked with MPCA stream stressor identification (stressor ID) leads to identify root causes of streams that are biologically impaired (too polluted to support healthy populations of fish or other plants and animals). At carefully selected sites, staff used scientific geomorphology methods to survey the condition and shape (pattern and profile) of streams, collect stream connectivity metrics, and assess streambank erosion. Staff analyze and interpret these data to help the MPCA draw cause-and-effect links between factors such as stream connectivity to floodplains, streambank erosion, excess sediment in streams, and biological impairments. Information from DNR studies is included in MPCA stressor ID reports.

Much of the data and analysis the DNR provides to the MPCA for watershed characterization and stressor ID also helps the MPCA calculate pollutant loads using the Hydrological Simulation Program-Fortran (HSPF) model.

Developing restoration and protection strategies

The DNR's expertise in biology, geomorphology, connectivity, and hydrology is instrumental in developing high-level restoration and protection strategies and actions. Below are measurable outcomes and a summary of the DNR's strategy development work using the FY14-15 WRAPS appropriation.

*DNR staff helped local partners and interagency teams develop **restoration and protection strategies in 37 watersheds in FY14 and 45 watersheds in FY15.** The FY15 figure includes many of the same watersheds as in FY14 since the work typically spans more than one fiscal year.*

- ❑ At WRAPS team meetings, DNR staff used the information they provided earlier in the WRAPS process to help teams identify strategies that target the root causes of water quality issues and deliver multiple environmental benefits. As described in some of the examples on pages 14-16, the DNR's presence and participation makes a significant difference.
- ❑ The DNR is using its shoreland management expertise to help interested local governments find ways to strengthen existing land use strategies where development is a major water quality threat. Using the FY15 WRAPS appropriation, field staff supported several WRAPS teams in the northern half of the state to better understand land use practices as a key protection strategy.
- ❑ DNR information provided to the WRAPS process is also used in the DNR's separately funded CWF work to help local governments develop and design clean water projects. Using CWF implementation money, the DNR assisted 84 water quality projects in FY14 alone. A number of local implementation project proposals funded in FY14-15 were developed or improved with the DNR's help. This type of assistance is not readily available from other sources.
- ❑ Two other DNR CWF projects further leverage the information developed with the FY14-15 WRAPS appropriation by using it to refine local priority-setting and targeting tools. In one effort, the DNR is using a tool called Zonation or Systematic Conservation Planning to help communities identify values-based natural resource priorities. At the request of local WRAPS and 1W1P leaders, staff have led exercises in 12 watersheds to date. This work is supported by CWF implementation money, but leverages data collected with the FY14-15 WRAPS appropriation. In another effort, the DNR is refining the Gridded Surface Subsurface Hydrologic Analysis (GSSHA) tool to measure and model the water quality benefits of agricultural best management practices. Staff are using the results to enhance CWF Discovery Farm and Targeted Watershed projects in partnership with the Minnesota Department of Agriculture (MDA) and the Minnesota Board of Water and Soil Resources (BWSR). The DNR work is supported by CWF research and tool development money, but leverages the FY14-15 WRAPS appropriation.

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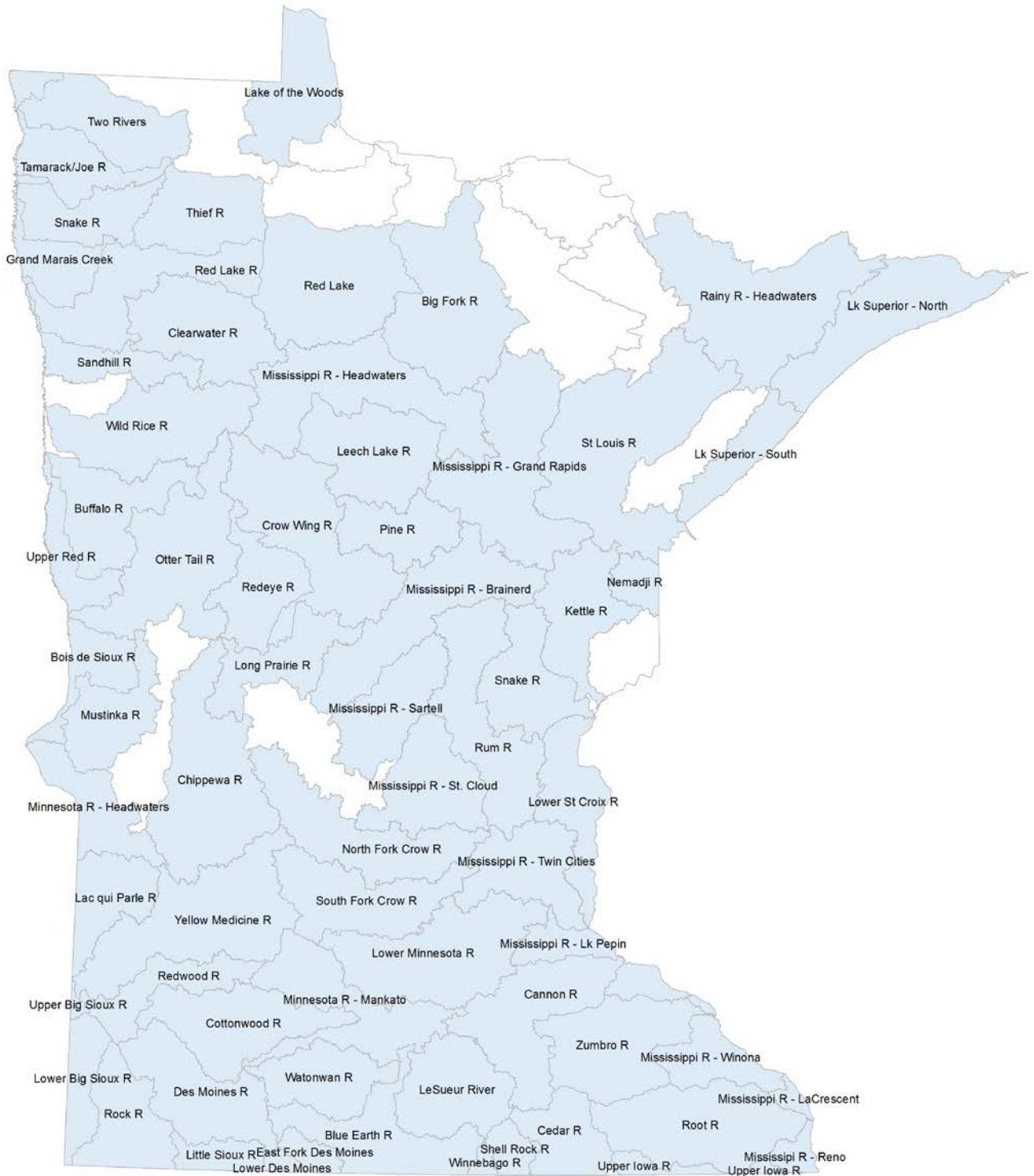


Figure 2. Major watersheds where the DNR assisted with WRAPS or TMDLs using the FY14-15 WRAPS appropriation.

Improving the WRAPS process

As noted earlier, the FY14-15 WRAPS appropriation included funding to coordinate the DNR's WRAPS work with other CWF programs at the state, regional, and watershed level. The following FY14-15 accomplishments exemplify the outcomes of this work.

Interagency Watershed Core Teams

In FY14-15, the DNR's Clean Water Coordinator suggested a new approach to ensure communication and coordination among the state agencies involved in individual WRAPS efforts. In consultation with the CWF Interagency WRAPS and Implementation Team, the coordinator developed and disseminated guidelines for establishing and managing Interagency Watershed Core Teams.

Each watershed team includes a representative from each of the state agencies that receive CWF appropriations (the MPCA, the DNR, the BWSR, the MDA, and the Minnesota Department of Health) and the Metropolitan Council where applicable. The resulting coordination has improved assistance to local governments as they develop WRAPS.

Interagency technical training

In FY15, the DNR and the MPCA organized a joint training event on the stressor ID process. MPCA and DNR staff presented to over 100 staff and managers, including more than 40 from the DNR. Attendees gained a better understanding of each agency's contributions to the stressor ID process. The event strengthened interagency relationships at the watershed and regional levels. In FY14 and FY15, key DNR staff joined MPCA stressor ID staff at a Minnesota Stream Practitioners Workshop designed to share stream geomorphology methods and build a statewide network of technical experts.

DNR standard deliverables

Building on several years of innovative CWF process and product developments at the DNR and other agencies, DNR staff launched an internal initiative in FY15 to identify a standard suite of WRAPS-related products and services that field staff will strive to deliver for every WRAPS. Chief among these are the products and services supported by the FY14-15 WRAPS appropriation: geomorphology, hydrology, and connectivity assessments; and assistance with strategy development. The initiative will also identify opportunities to streamline and increase capacity for this work. For example, the DNR's Watershed Health Assessment Framework (WHAF) could potentially be used as a platform to deliver hydrology assessments. (Read more about the WHAF later in this report.)

Setting the stage for One Watershed One Plan (1W1P)

The work funded by the WRAPS appropriation to DNR has evolved and matured in step with the State's transition to the watershed approach and development of the Minnesota Water Management Framework (Figure 1). All of the watershed science in WRAPS will help local partners prioritize and target their implementation efforts as part of the 1W1P planning process. DNR staff and expertise play a significant supporting role in both WRAPS and 1W1P. The DNR is therefore well positioned to help participants bridge the two processes.

The impact and outcomes of the DNR's contributions to WRAPS

Below are some examples of the outcomes of the DNR's work to collect and analyze geomorphology, hydrology, and connectivity data and help develop watershed restoration and protection strategies. This work informs not only WRAPS but also comprehensive watershed management planning (1W1P) and clean water implementation projects.

Multiple Benefits in the Missouri River Basin:

One of the first hydrology, geomorphology, and connectivity assessments DNR conducted was for the Missouri River Basin in southwestern Minnesota. The expertise gained from this work enables staff to reach out to local and federal partners and offer ideas and technical assistance for projects that have multiple environmental benefits. For example, when Pipestone County sought a public waters permit to move a straightened stretch of creek in order to widen a road, the DNR proposed and helped implement an alternative meandering design for the relocated creek (Figure 3). The natural design will not only help prevent water pollution but will also help restore aquatic habitat. In another example, the DNR used its knowledge of the basin to help select sites for a major US Fish & Wildlife Service (USFWS) effort to restore and protect habitat for Topeka Shiner, an Endangered Species. The DNR proposed targeting sites where USFWS habitat



Figure 3. Re-meandered section of Flandreau Creek next to Pipestone County Road 10 in the Missouri River Basin. Traces of the old, straightened creek are visible just below the road in this Google Earth image.



Figure 4. Clean Water Council members learn about Big Trout Lake protection strategies in September 2015.

projects could serve double duty by also addressing impaired waters and surface-groundwater interactions.

Protecting Big Trout Lake: With help from the DNR, the Pine River Watershed WRAPS team identified Big Trout Lake (Figure 4) as a high priority for protection efforts. The lake is an important community asset, providing unique lake trout fishing near a regional metropolitan hub. Like many lakes in the area, Big Trout is likely to receive increasing amounts of phosphorus from intensive shoreland development, forestland conversion, and road runoff. Too much phosphorus can reduce water clarity, and some lakes are more sensitive to this than others. A DNR analysis showed that Big Trout Lake is highly sensitive. Also, a DNR Fisheries study found that Big Trout is more likely to sustain lake trout and cisco in a future, warmer climate than some other nearby lakes that now support these coldwater fish. The DNR's information gave the team more reason to prioritize Big Trout Lake for protection efforts. State and local partners established a water quality protection goal for the lake, and a strategy to

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Priority Ranking	HUC 12	High Value & Sensitive Water Resources	DNR Land Resources	Areas of Biodiversity & Significance	Current or Future Changes, Pressures & Risks to Condition & Quality
1	Mantrap Lake	Mantrap Lake	Paul Bunyan State Forest	* Tullibee in Buck, Bad Axe, Mantrap * Musky in Mantrap, Bad Axe * Wild Rice in Mantrap & Sand Creek	*Shoreline Development - ___% Change *Currently under 75% Upland Protected from land use conversion – 47% protected including all upstream catchments
1	Big Sand Lake	Big Sand Lake	Bottle Lake AMA	* Tullibee in Big Sand, Emma, Upper and Lower Bottle * Wild Rice in Upper & Lower Bottle	*Shoreline Development - ___% Change *Currently under 75% Upland Protected from land use conversion – 48% protected including all upstream catchments

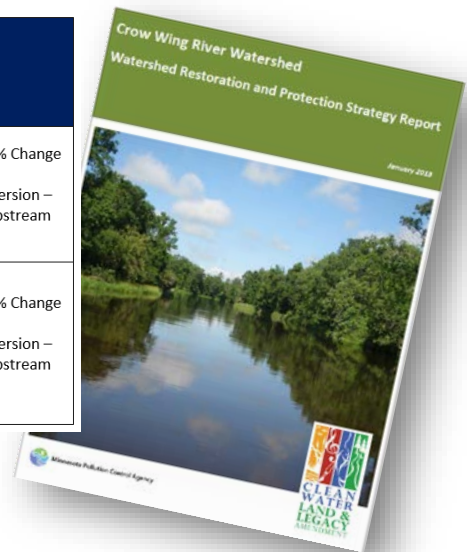


Figure 5. An excerpt of some of the information and analysis the DNR contributed to strategy development for the Crow Wing River Watershed WRAPS.

get there. The goal is to reduce phosphorus by 90 pounds. The strategy is to keep up to 75% of the lake’s watershed forested via a mix of local land use controls, private forestland stewardship, and other programs and practices. The DNR is helping by using CWF implementation dollars to develop forest stewardship plans. SWCDs are helping landowners implement the plans.

Crow Wing River WRAPS: The DNR was a key participant in developing implementation strategies for the watershed. DNR staff helped the WRAPS team identify waters with high-value habitat that face significant threats to water quality. The team incorporated this information into the WRAPS report (Figure 5).

Buffalo River Natural Channel Restoration: DNR staff used geomorphology field survey data to collaborate with the City of Hawley, the Buffalo-Red Watershed District, and other partners to re-meander a straightened stretch of the Buffalo River. The stream channel is now reconnected to its floodplain and over 1700 feet was added to its length (Figure 6).

North Fork Crow River WRAPS: The completed WRAPS report incorporates hydrology, geomorphology, and biology information and high-level strategy recommendations contributed by the DNR. The report also notes that watershed health



Figure 6. Buffalo River natural channel restoration at the City of Hawley, 2015: Before (top) and after (bottom).

scores from the DNR's Watershed Health Assessment Framework (WHAF) will help the MPCA and local partners decide which lakes to assess in the next watershed cycle.

Stabilizing the Sand Hill River. The Sand Hill River is impaired due to too much sediment. A DNR hydrologist approached the West Polk SWCD about installing rock riffles in the stream channel to reduce streambank erosion, stabilize the streambed and banks and reduce sediment in the river. The SWCD was very receptive and assumed leadership of a CWF project to install 16 riffles. The riffles will not only address the water quality issue but will also improve fish passage. The project would not have happened without the DNR's technical expertise and outreach.

Birds-Eye Tour of the Yellow Medicine River Watershed: DNR staff used the WHAF to provide a virtual flying tour of the watershed at a meeting with 1W1P participants. A birds-eye view, moving upstream and downstream along the river and its tributaries, helped the group visualize some of the driving forces that influence water quality in the watershed.

Restoring Natural Stream Functions at Cascade Creek: The DNR is partnering with the City of Rochester and Olmsted County to implement flood control measures on the south branch of Cascade Creek in a way that also helps fix water quality problems. The stream currently has too much sediment and cannot support a healthy fish population. To control flooding, the city initially proposed downsizing culverts and/or installing weirs at many road crossings to temporarily hold back water during spring runoff and heavy rains. DNR staff with training in geomorphology outlined how the city's proposed approach would likely destabilize the creek and worsen the water quality problem. This information led to a cooperative approach. The city will install just two of the originally proposed flood-control structures and the DNR is designing and overseeing a natural-channel stream restoration

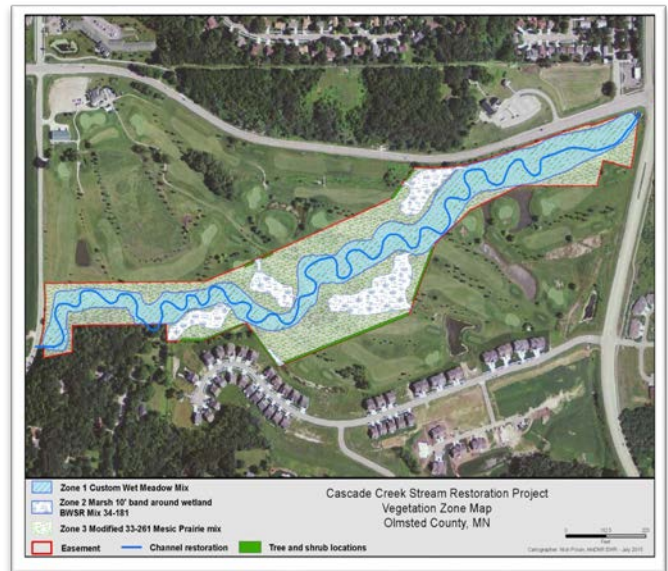


Figure 7. Cascade Creek stream restoration design.

(Figure 7). With help from the DNR and the city, Olmsted SWCD received multiple CWF implementation grants for the restoration effort. Reconnecting the stream to its floodplain is the key objective of the stream restoration. This will reduce streambank erosion, increase storage for water and sediment when flooding occurs, and create habitat for fish and other aquatic plants and animals. Staff will conduct monitoring to evaluate the impact of the completed restoration on water quality, flood control, and habitat enhancement. The project may become a model for using stream restorations to address biological and sediment impairments.

Mapping Potential Sources of Pollution: DNR staff in northwestern Minnesota are using LiDAR data and aerial photography to map features such as feedlots, field drains and gullies. Without adequate conservation practices and control measures, these can become sources of water pollution. The MPCA is using this information in the stressor ID and strategy development stages of the WRAPS process. Watershed Districts and other local governments are using it to help identify potential conservation project sites.

Making the science accessible: The DNR's Watershed Health Assessment Framework (WHAF)

Helping people see their watershed in context

The Watershed Health Assessment Framework (WHAF) is a powerful web-based mapping and exploration tool developed by the DNR in FY12-13. The FY14-15 WRAPS appropriation supplemented other funding to improve the tool, keep it current, and help users realize its full potential. The WHAF is proving especially effective at helping citizen groups, local officials, and students understand what a watershed is and how healthy watersheds lead to sustainable water quality. The tool helps people visualize how a wide range of natural conditions and land use changes affect a watershed's ability to deliver clean water and other environmental benefits

*The WHAF lets users select any point of interest on the map and display the surrounding catchment, major watershed, and basin, or outline upstream and downstream areas. Users can explore any of **35 health scores** and display them at the various watershed scales. This puts local water resource issues into a larger context. **Context is important for selecting solutions that match the scale of the issue** and understanding how multiple, interrelated factors determine a watershed's health.*

There is perhaps no better way to explain what a watershed is than to show someone on a map where they are currently standing and display the boundary of the surrounding watershed – with aerial photography, stream lines, and other landscape features on the map for context. The WHAF helps users understand that watersheds exist at multiple, nested scales. Minnesota has six major basins, within which are 81 major watersheds, within which are 10,000 catchments. Catchments are the smallest watershed unit that the DNR has mapped for the whole state (Figure 8).

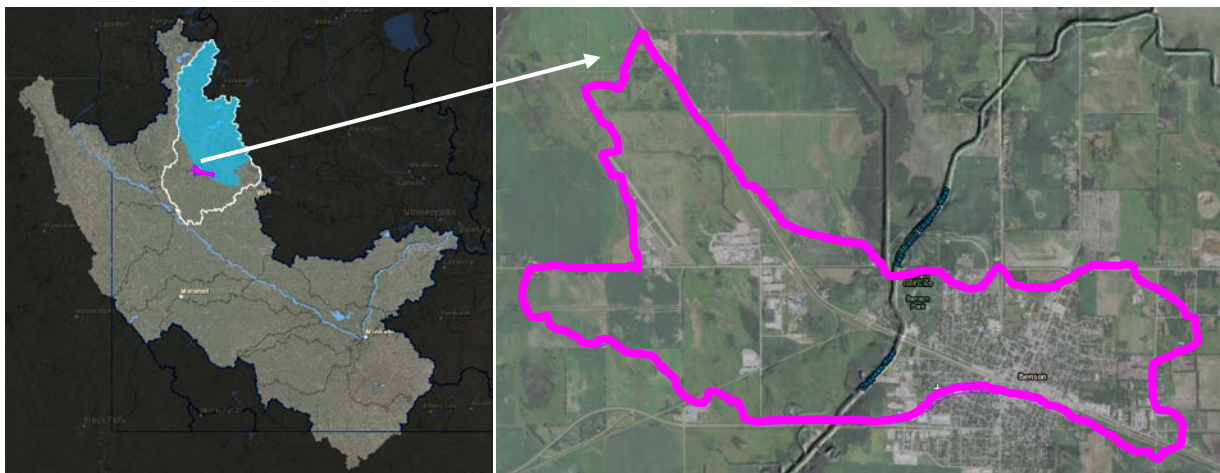


Figure 8. The image on the right shows a catchment boundary (purple outline) encompassing most of the City of Benson. The image on the left shows the same catchment (in purple) nested within its upstream contributing area (in blue). The upstream contributing area is nested within both the Chippewa River Watershed (white outline) and the Minnesota River Basin (in grey).

Watershed health scores

Tapping in to more than 50 layers of existing environmental data from the DNR and other state and federal agencies, the WHAF goes beyond water quality alone to score 35 different aspects of watershed health (Figure 9). The scores combine multiple layers of data organized around the five components of watershed health – biology, connectivity, geomorphology, hydrology, and water quality.

An earlier version of the WHAF provided only static maps of health scores at the major watershed scale with a few other data layers. In late FY13, the website became interactive, encouraging users to explore health scores and up to 65 other land and water data layers on-the-spot at multiple scales. Users can focus on an individual watershed or compare the health of multiple watersheds.

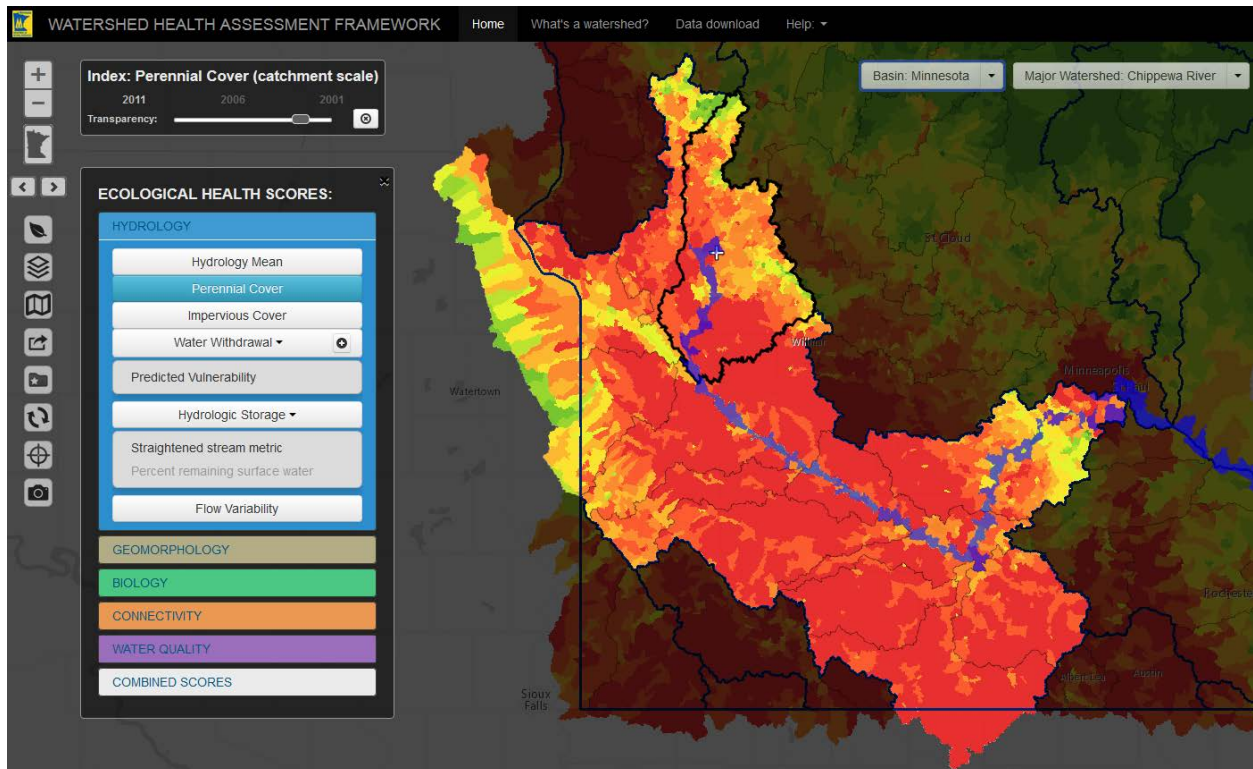


Figure 9. Perennial Cover Index scores for the Minnesota River Basin. Scores range from low (red) to high (green). Users can use select other watershed health scores, view scores at the major watershed and catchment scales, and add other data layers for context.

Progress on the WHAF in FY14-15

The FY14-15 WRAPS appropriation made possible significant updates and improvements to the WHAF that will help users realize its full potential.

- ❑ **Improved ease of use:** The website now offers one-click access to health scores, a list of data layers, and watershed boundaries at different scales. Five new instructional videos, an introductory slide show and a series of guides provide comprehensive user support.

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- ❑ **Enhanced ability to collaborate:** Users can now create a map and instantly generate a link to share with others. Others can then view and interact with the very same map. This provides a powerful platform for collaboration.
- ❑ **Expanded access to changing data:** It happens behind the scenes, but the data and health scores the WHAF delivers are now more current and dynamic than ever. Capitalizing on recent advances in shared web services and improvements to the Minnesota Geospatial Data Commons (GeoCommons), the WHAF puts a wealth of up-to-the-minute data from many sources at users' fingertips – all delivered seamlessly on one website, viewable at multiple scales. The WHAF now allows GIS users to download watershed health scores and metadata from the GeoCommons.
- ❑ **Dynamically updated health scores:** DNR staff used advanced data-sharing and GIS technologies to create models that make it possible for the WHAF to quickly recalculate and deliver updated health scores as the underlying data change. They developed six new Water Quality Index health scores and enhanced the Perennial Cover Index and Impervious Cover Index health scores based on time-series data for 2001, 2006 and 2011.

The new version of the WHAF leverages Minnesota's visionary investments in GIS, LiDAR, and statewide biology, water quality, and hydrology datasets collected by multiple agencies.

Using the WHAF to teach, learn, and share

The WHAF can help citizens, local officials, and local and state government professionals better understand and communicate the science of watersheds. It allows users to explore complex interrelationships among watershed health factors and encourages them to develop implementation strategies that take these complexities into account.

In a growing number of watersheds, the WHAF is being used as part of the WRAPS or 1W1P process to help participants visualize the root causes of water quality issues from a watershed perspective and match the scale of the solution to the scale of the problem or threat. To date, the WHAF has been used for WRAPS and/or 1W1P in several watersheds, including: the Lower Minnesota, the North Fork Crow, the Pine, the Pomme de Terre, the Root, the Snake, and the Yellow Medicine.

The WHAF is also being used more generally to help educate citizens about watersheds. Examples include an open house for the Bonanza Valley Groundwater Management Area planning initiative led by the DNR, a workshop for staff at Wild

What users are saying about the WHAF

The WHAF and other tools helped provide a conceptual understanding of both the natural conditions and human uses that influence water quality. [Mike Weckwerth, MPCA Project Manager for the Yellow Medicine River Watershed](#)

The policy committee really engaged with the WHAF model and presentation at a high level... the first step toward many future conversations. [Lucas Youngsma, DNR Area Hydrologist](#)

Thank you for speaking to my water quality class. You...were well prepared, well spoken, engaging and informative. The students and I enjoyed your perspective. You offer a great overview of...the WHAF as a tool for understanding basins and land uses....It gave clear evidence that Minnesota is leading the nation in so many aspects of water resource management. The students are excited about...spending a semester using the WHAF to understand current conditions and think about the future. [Jim Perry, University of Minnesota](#)

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River State Park, a high school Watershed Learning Experience at Whitewater State Park, and interpretive signs on Brown's Creek State Trail.

User feedback has been positive. Over 1,000 people have received one or more issues of a WHAF electronic newsletter introduced in FY14-15. Interest is spreading as users discover how the WHAF lets them quickly and easily explore a wealth of watershed data as only a skilled GIS user could in the past.

Recommendations

Supporting WRAPS

The DNR's recommendation is to maintain funding and current levels of effort to support WRAPS as part of the Executive Branch's carefully crafted interagency watershed management framework (Figure 1).

The Watershed Health Assessment Framework (WHAF)

The DNR's recommendations for the WHAF are to:

- Maintain existing tool features;
- Leverage advances in technology;
- Intensify outreach and training to fully use the tool's powerful data synthesis, visualization, and collaboration capabilities; and,
- Keep updating watershed health scores to help calculate index trends and generate dynamic watershed characterization reports.