Mississippi River (Winona) Watershed Monitoring and Assessment Report

Minnesota Pollution Control Agency

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List of Acronyms

AUID Assessment Unit Identification Determination

CCSI Channel Condition and Stability Index

CI Confidence Interval

CLMP Citizen Lake Monitoring Program

CSAH County State Aid Highway

CSMP Citizen Stream Monitoring Program

CWA Clean Water Act

CWLA Clean Water Legacy Act

DOP Dissolved Orthophosphate

E Eutrophic

EPA U.S. Environmental Protection Agency

EQuIS Environmental Quality Information System

EPT Ephemeroptera, Plecoptera and Trichoptera

EX Exceeds Criteria (Bacteria)

EXP Exceeds Criteria, Potential Impairment

EXS Exceeds Criteria, Potential Severe Impairment

FS Full Support

FWMC Flow Weighted Mean Concentration

H Hypereutrophic

HUC Hydrologic Unit Code

IBI Index of Biotic Integrity

IF Insufficient Information

K Potassium

LRVW Limited Resource Value Water

M Mesotrophic

MCES Metropolitan Council Environmental Services

MDA Minnesota Department of Agriculture

MDH Minnesota Department of Health

MDNR Minnesota Department of Natural Resources

MIBI Macroinvertebrate Index of Biotic Integrity

MINLEAP Minnesota Lake Eutrophication

Analysis Procedure

MPCA Minnesota Pollution Control Agency

MSHA Minnesota Stream Habitat Assessment

MTS Meets the Standard

N Nitrogen

Nitrate-N Nitrate Plus Nitrite Nitrogen

NA Not Assessed

NHD National Hydrologic Dataset

NH_3 Ammonia

NRCS National Resource Conservation Service

NS Not Supporting

NT No Trend

OP Orthophosphate

P Phosphorous

PCB Poly Chlorinated Biphenyls

PFOS Perfluorooctane Sulfonate

PWI Protected Waters Inventory

RNR River Nutrient Region

SWAG Surface Water Assessment Grant

SWCD Soil and Water Conservation District

SWUD State Water Use Database

TALU Tiered Aquatic Life Uses

TKN Total Kjeldahl Nitrogen

TMDL Total Maximum Daily Load

TP Total Phosphorous

TSS Total Suspended Solids

UMRBA Upper Mississippi River Basin Association

USGS United States Geological Survey

WPLMN Water Pollutant Load Monitoring Network

Contents

Table of Figures

Table of Tables

Executive summary

The Mississippi River (Winona) Watershed drains roughly 660 mi^2 of southeastern Wabasha, western Olmsted and Winona counties stretching from the outlet of Lake Pepin 50 miles southeast along the Minnesota Wisconsin border. Significant portions of these waters are classified as wild or semi-wild trout waters making the area popular among anglers. The Whitewater is the watershed's principle river; its three branches begin as warmwater streams in the watershed's western plains and transition to spring fed coldwater streams moving east into the steep valleys of southeastern Minnesota's bluff country. The landscape provides a vast resource for recreation and wildlife, while also providing for an important agricultural economy rich in crop production and livestock operations.

Early pioneers and their descendants brought catastrophic erosion and flooding to the Whitewater River valley when marginal lands on upland slopes were plowed and steep valley slopes were stripped for lumber and burned to provide grass for grazing livestock (Waters, 1977). Conservation efforts from the 1930s to present times have reduced soil erosion rates by more than half; however, legacy impacts from the late 19th and early 20th centuries persist (Argabright et al., 1996 and Mast et al., 1999). Water quality impairments are complex and widespread across the watershed. Twenty-eight of fifty AUIDs were assessed for aquatic life and/or aquatic recreation. Of the assessed streams, only twelve AUIDs were considered fully supporting for aquatic life and no streams were fully supporting of aquatic recreation. Eighteen AUIDs are non-supporting for aquatic life and/or recreation.

Drinking water, aquatic recreation and aquatic life uses are compromised by high nitrate, bacteria and turbidity levels. These stressors are likely impacting biological communities, most notably macroinvertebrates which have low tolerance for high nitrate levels, a pattern observed across southeastern Minnesota. Karst features in the region further complicate impairments by providing an easy pathway for contaminants, especially nitrates, to move from the surface to groundwater increasing contamination and challenging restoration efforts. Sediment causing today's turbidity impairments likely stem from stream bank erosion as streams cut into banks of alluvial sediment; sediments that were deposited from the watershed's uplands prior to 1940 (Nerbonne and Vondracek, 2001).

The watershed has been a poster child for sediment impairment for more than 70 years when the Soil Conservation Service, now the National Resource Conservation Service (NRCS), established the third conservation district in the country within the Whitewater watershed's boundaries in 1941 to address erosion concerns (Winona County SWCD, 2013). Despite reductions in upland erosion and efforts made in recent years to improve the watershed's water quality, more work is needed to bring surface waters into compliance with water quality standards. Future turbidity reduction efforts should consider joining stream restoration projects to include measures to stabilize stream banks and reduce erosion. Attainment for bacteria and nitrates should focus on nonpoint sources of pollution including fertilizer management, livestock waste and failing septic systems. Best management practices (BMPs) should be implemented in a targeted approach toward sensitive features on the landscape that are known to impact surface water quality to insure restoration resource dollars are spent in areas where they will do the most good. Local cooperation will be crucial to making surface water quality improvements as using regulatory authority to reduce nonpoint source pollution is limited.

Introduction

Water is one of Minnesota's most abundant and precious resources. The Minnesota Pollution Control Agency (MPCA) is charged under both federal and state law with the responsibility of protecting the water quality of Minnesota's water resources. The MPCA's water management efforts are tied to the 1972 Federal Clean Water Act (CWA) which requires states to adopt water quality standards to protect their water resources and the designated uses of those waters, such as for drinking water, aquatic recreation, fish consumption and aquatic life. States are required to provide a summary of the status of their surface waters and develop a list of water bodies that do not meet established standards. Such waters are referred to as "impaired waters" and the state must make appropriate plans to restore these waters, including the development of Total Maximum Daily Loads (TMDLs). A TMDL is a comprehensive study determining the assimilative capacity of a waterbody, identifying all pollution sources causing or contributing to impairment, and an estimation of the reductions needed to restore a water body so that it can once again support its designated use.

The MPCA currently conducts a variety of surface water monitoring activities that support our overall mission of helping Minnesotans protect the environment. To successfully prevent and address problems, decision makers need good information regarding the status of the resources, potential and actual threats, options for addressing the threats and data on the effectiveness of management actions. The MPCA's monitoring efforts are focused on providing that critical information. Overall, the MPCA is striving to provide information to assess, and ultimately, to restore or protect the integrity of Minnesota's waters.

The passage of Minnesota's Clean Water Legacy Act (CWLA) in 2006 provided a policy framework and the initial resources for state and local governments to accelerate efforts to monitor, assess, restore and protect surface waters. This work is implemented on an on-going basis with funding from the Clean Water Fund (CWF) created by the passage of the Clean Water Land, and Legacy Amendment to the state constitution. To facilitate the best use of agency and local resources, the MPCA has developed a watershed monitoring strategy which uses an effective and efficient integration of agency and local water monitoring programs to assess the condition of Minnesota's surface waters and to allow for coordinated development and implementation of water quality restoration and improvement projects.

The strategy behind the watershed monitoring approach is to intensively monitor streams and lakes within a major watershed to determine the overall health of water resources, identify impaired waters, and to identify waters in need of additional protection. The benefit of the approach is the opportunity to begin to address most, if not all, impairments through a coordinated TMDL process at the watershed scale, rather than the reach-by-reach and parameter-by-parameter approach often historically employed. The watershed approach will more effectively address multiple impairments resulting from the cumulative effects of point and non-point sources of pollution and further the CWA goal of protecting and restoring the quality of Minnesota's water resources.

This watershed-wide monitoring approach was implemented in the Mississippi River (Winona) Watershed beginning in the summer of 2010. This report provides a summary of all water quality assessment results in the Mississippi River (Winona) Watershed and incorporates all data available for the assessment process including watershed monitoring, volunteer monitoring and monitoring conducted by local government units.

I. The Watershed Monitoring Approach

The watershed approach is a 10-year rotation for monitoring and assessing waters of the state on the level of Minnesota's 81 major watersheds (Figure 1). The major benefit of this approach is the integration of monitoring resources to provide a more complete and systematic assessment of water quality at a geographic scale useful for the development and implementation of effective TMDLs, project planning, effectiveness monitoring and protection strategies. The following paragraphs provide details on each of the four principal monitoring components of the watershed approach. For additional information see: Watershed Approach to Condition Monitoring and Assessment (MPCA 2008) (http://www.pca.state.mn.us/publications/wq-s1-27.pdf).

Pollutant Load Monitoring Network

The Watershed Pollutant Load Monitoring Network (WPLMN) is a long-term monitoring approach designed to measure levels of key pollutants in the state's watersheds, and compare regional differences and long-term trends in water quality among Minnesota's major rivers including the Red, Rainy, St. Croix, Mississippi and Minnesota. Since the network's inception in 2007, the WPLMN has adopted a multi-agency monitoring design that combines site specific stream flow data from United States Geological Survey (USGS) and Minnesota Department of Natural Resources (MDNR) flow gaging stations, with water quality data collected by the Metropolitan Council Environmental Services (MCES), local monitoring organizations and Minnesota Pollution Control Agency WPLMN staff to compute annual pollutant loads at 79 river monitoring sites across Minnesota. Intensive water quality sampling occurs year round at all WPLMN sites. Data will also be used to assist with TMDL studies and implementation plans, watershed modeling efforts and watershed research projects.

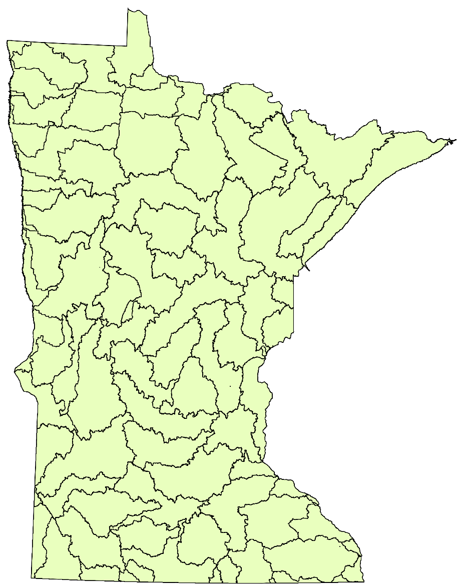

Figure 1. Major watersheds within Minnesota (8-Digit HUC).

Intensive Watershed Monitoring

The intensive watershed monitoring strategy utilizes a nested watershed design allowing the sampling of streams within watersheds from a coarse to a fine scale (Figure 2). Each watershed scale is defined by a hydrologic unit code (HUC). These HUCs define watershed boundaries for water bodies within a similar geographic and hydrologic extent. The foundation of this approach is the 81 major watersheds (8-HUC) within Minnesota. Using this approach many of the smaller headwaters and tributaries to the main stem river are sampled in a systematic way so that a more holistic assessment of the watershed can be conducted and problem areas identified without monitoring every stream reach. Each major watershed is the focus of attention for at least one year within the 10-year cycle.

River/stream sites are selected near the outlet of each of three watershed scales, 8-HUC, 11-HUC and 14-HUC (Figure 2). Within each scale, different water uses are assessed based on the opportunity for that use (i.e., fishing, swimming, supporting aquatic life such as fish and insects). The major river watershed is represented by the 8-HUC scale. The outlet of the major 8-HUC watershed (purple dot in Figure 3) is sampled for biology (fish and macroinvertebrates), water chemistry and fish contaminants to allow for the assessment of aquatic life, aquatic recreation and aquatic consumption use support. The 11-HUC is the next smaller watershed scale which generally consists of major tributary streams with drainage areas ranging from 75 to 150 mi^2. Each 11-HUC outlet (green dots in Figure 3) is sampled for biology and water chemistry for the assessment of aquatic life and aquatic recreation use support.

Within each 11-HUC, smaller watersheds (14 HUCs, typically 10-20 mi^2), are sampled at each outlet that flows into the major 11-HUC tributaries. Each of these minor watershed outlets is sampled for biology to assess Aquatic Life Use support (red dots in Figure 3).

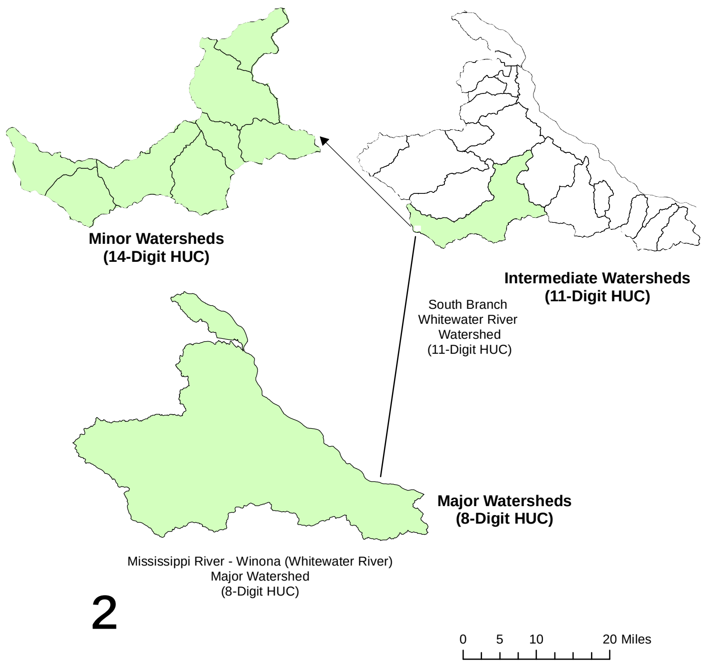

Figure 2. The Intensive Watershed Monitoring Design.

Within the intensive watershed monitoring strategy, lakes are selected to represent the range of conditions and lake type (size and depth) found within the watershed. Lakes most heavily used for recreation (all those greater than 500 acres and at least 25% of lakes 100-499 acres) are monitored for water chemistry to determine if recreational uses, such as swimming and wading, are being supported. Lakes are sampled monthly from May-September for a 2-year period. There is currently no tool that allows us to determine if lakes are supporting aquatic life; however, a method that includes monitoring fish and aquatic plant communities is in development.

Specific locations for sites sampled as part of the intensive monitoring effort in the Mississippi River (Winona) Watershed are shown in Figure 3 and are listed in Appendix 2, Appendix 4.2, Appendix 4.3, Appendix 5.2 and Appendix 5.3.

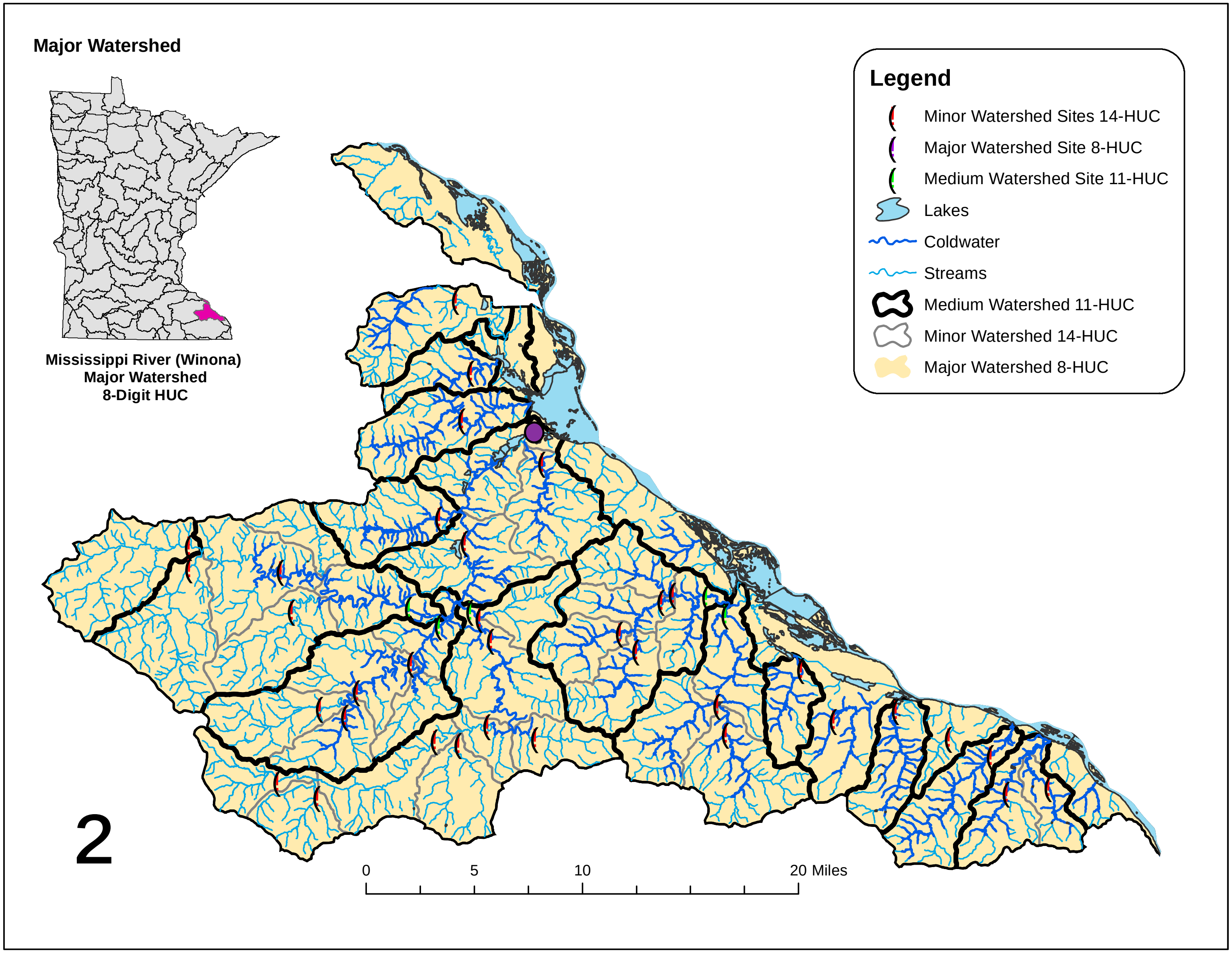

Figure 3. Intensive watershed monitoring sites for streams in the Mississippi River (Winona) Watershed.

Citizen and local monitoring

Citizen and local monitoring is an important component of the watershed approach. The MPCA and its local partners jointly select the stream sites and lakes to be included in the intensive watershed monitoring process. Funding passes from MPCA through Surface Water Assessment Grants (SWAGs) to local groups such as counties, soil and water conservation districts (SWCDs), watershed districts, nonprofits and educational institutions to support lake and stream water chemistry monitoring. Local partners use the same monitoring protocols as the MPCA, and all monitoring data from SWAG projects are combined with the MPCA's to assess the condition of Minnesota lakes and streams. Preplanning and coordination of sampling with local citizens and governments helps focus monitoring where it will be most effective for assessment and observing long-term trends. This allows citizens/governments the ability to see how their efforts are used to inform water quality decisions and track how management efforts affect change. Many SWAG grantees invite citizen participation in their monitoring projects and their combined participation greatly expand our overall capacity to conduct sampling.

The MPCA also coordinates two programs aimed at encouraging long term citizen surface water monitoring: the Citizen Lake Monitoring Program (CLMP) and the Citizen Stream Monitoring Program (CSMP). Like the permanent load monitoring network, having citizen volunteers monitor a given lake or stream site monthly and from year to year can provide the long-term picture needed to help evaluate current status and trends. Citizen monitoring is especially effective at helping to track water quality changes that occur in the years between intensive monitoring years. Figure 4 provides an illustration of the locations where citizen monitoring data were used for assessment in the Mississippi River (Winona) Watershed.

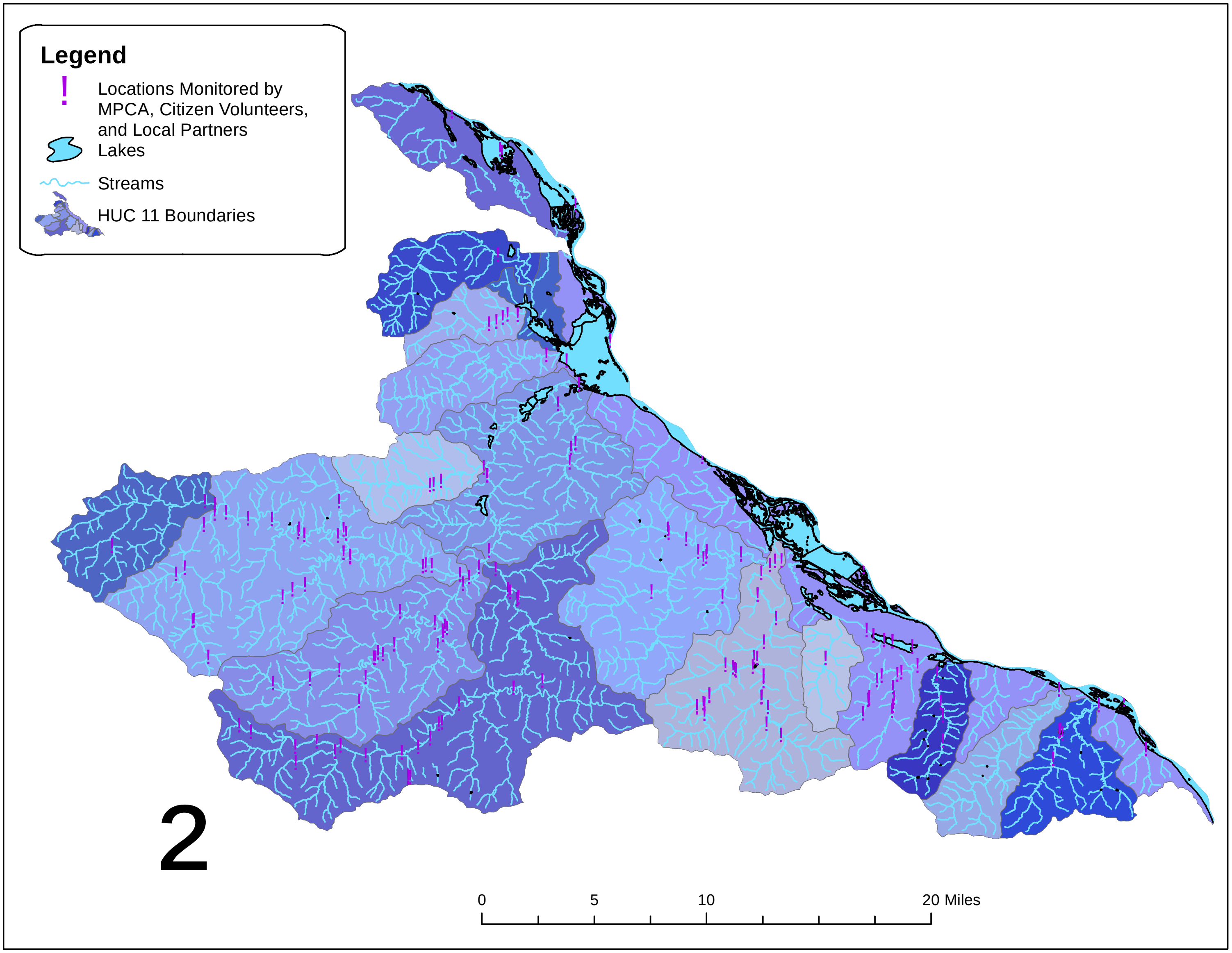

Figure 4. **Monitoring locations of local groups, citizens and the MPCA lake monitoring staff in the Mississippi River (Winona) Watershed.**

II. Assessment methodology

The CWA requires states to report on the condition of the waters of the state every two years. This biennial report to Congress contains an updated list of surface waters that are determined to be supporting or non-supporting of their designated uses as evaluated by the comparison of monitoring data to criteria specified by Minnesota Water Quality Standards (Minn. R. Ch. 7050 2008; https://www.revisor.leg.state.mn.us/rules/?id=7050). The assessment and listing process involves dozens of MPCA staff, other state agencies and local partners. The goal of this effort is to use the best data and best science available to assess the condition of Minnesota's water resources. For a thorough review of the assessment methodologies see: Guidance Manual for Assessing the Quality of Minnesota Surface Waters for the Determination of Impairment 305(b) Report and 303(d) List (MPCA 2012). http://www.pca.state.mn.us/index.php/view-document.html?gid=8601.

Water quality standards

Water quality standards are the fundamental benchmarks by which the quality of surface waters are measured and used to determine impairment. These standards can be numeric or narrative in nature and define the concentrations or conditions of surface waters that allow them to meet their designated beneficial uses, such as for fishing (aquatic life), swimming (aquatic recreation) or human consumption (aquatic consumption). All surface waters in Minnesota, including lakes, rivers, streams and wetlands are protected for aquatic life and recreation where these uses are attainable. Numeric water quality standards represent concentrations of specific pollutants in water that protect a specific designated use. Narrative standards are statements of conditions in and on the water, such as biological condition, that protect their designated uses.

Protection of aquatic life means the maintenance of a healthy aquatic community, including fish, invertebrates and plants. The sampling of aquatic organisms for assessment is called biological monitoring. Biological monitoring is a direct means to assess aquatic life use support, as the aquatic community tends to integrate the effects of all pollutants and stressors over time. Interpretations of narrative criteria for aquatic life in streams are based on multi-metric biological indices including the Fish Index of Biological Integrity (Fish IBI), which evaluates the health of the fish community, and the Macroinvertebrate Index of Biological Integrity (Invert IBI), which evaluates the health of the aquatic invertebrate community. Additionally, chemical parameters are measured and assessed against numeric standards developed to be protective of aquatic life, including pH, dissolved oxygen, un-ionized ammonia nitrogen, chloride and turbidity.

Protection of aquatic recreation means the maintenance of conditions safe and suitable for swimming and other forms of water recreation. In streams, aquatic recreation is assessed by measuring the concentration of E. coli bacteria in the water. To determine if a lake supports aquatic recreational activities its trophic status is evaluated, using total phosphorus, secchi depth and chlorophyll-a as indicators. Lakes that are enriched with nutrients and have abundant algal growth are eutrophic and do not support aquatic recreation.

Protection of consumption means protecting citizens who eat fish from Minnesota waters or receive their drinking water from waterbodies protected for this beneficial use. The concentrations of mercury and polychlorinated biphenyls (PCBs) in fish tissue are used to evaluate whether or not fish are safe to eat in a lake or stream and to issue recommendations regarding the frequency that fish from a particular water body can be safely consumed. For lakes, rivers and streams that are protected as a source of drinking water the MPCA primarily measures the concentration of nitrate in the water column to assess this designated use.

A small percentage of stream miles in the state (~1% of 92,000 miles) have been individually evaluated and re-classified as a Class 7 Limited Resource Value Water (LRVW). These streams have previously demonstrated that the existing and potential aquatic community is severely limited and cannot achieve aquatic life standards either by: a) natural conditions as exhibited by poor water quality characteristics, lack of habitat or lack of water; b) the quality of the resource has been significantly altered by human activity and the effect is essentially irreversible; or c) there are limited recreational opportunities (such as fishing, swimming, wading or boating) in and on the water resource. While not being protective of aquatic life, LRVWs are still protected for industrial, agricultural, navigation and other uses. Class 7 waters are also protected for aesthetic qualities (e.g., odor), secondary body contact, and groundwater for use as a potable water supply. To protect these uses, Class 7 waters have standards for bacteria, pH, dissolved oxygen and toxic pollutants.

Assessment units

Assessments of use support in Minnesota are made for individual waterbodies. The waterbody unit used for river systems, lakes and wetlands is called the "assessment unit." A stream or river assessment unit usually extends from one significant tributary stream to another or from the headwaters to the first tributary. A stream "reach" may be further divided into two or more assessment reaches when there is a change in use classification (as defined in Minn. R., ch. 7050) or when there is a significant morphological feature, such as a dam or lake, within the reach. Therefore, a stream or river is often segmented into multiple assessment units that are variable in length. The MPCA is using the 1:24,000 scale high resolution National Hydrologic Dataset (NHD) to define and index stream, lake and wetland assessment units. Each river or stream reach is identified by a unique waterbody identifier (known as its Assessment Unit Identification Determination [AUID]), comprised of the United States Geological Survey (USGS) eight digit hydrologic unit code (8-HUC) plus a three character code that is unique within each HUC. Lake and wetland identifiers are assigned by the Minnesota Department of Natural Resources (MDNR). The Protected Waters Inventory (PWI) provides the identification numbers for lake, reservoirs and wetlands. These identification numbers serve as the AUID and are composed of an 8 digit number indicating county, lake and bay for each basin.

It is for these specific stream reaches or lakes that the data are evaluated for potential use impairment. Therefore, any assessment of use support would be limited to the individual assessment unit. The major exception to this is the listing of rivers for contaminants in fish tissue (aquatic consumption). Over the course of time it takes fish, particularly game fish, to grow to "catchable" size and accumulate unacceptable levels of pollutants, there is a good chance they have traveled a considerable distance. The impaired reach is defined by the location of significant barriers to fish movement such as dams upstream and downstream of the sampled reach and thus often includes several assessment units.

Determining use attainment

For beneficial uses related to human health, such as drinking water or aquatic recreation, the relationship is well understood and thus the assessment process is a relatively simple comparison of monitoring data to numeric standards. In contrast, assessing whether a waterbody supports a healthy aquatic community is not as straightforward and often requires multiple lines of evidence to make use attainment decisions with a high degree of certainty. Incorporating a multiple lines of evidence approach into MPCA's assessment process has been evolving over the past few years. The current process used to assess the aquatic life use of rivers and streams is outlined below and in Figure 5.

The first step in the aquatic life assessment process is a comparison of the monitoring data to water quality standards. This is largely an automated process performed by logic programmed into a database application and the results are referred to as 'Pre-Assessments'. Pre-assessments are then reviewed by either a biologist or water quality professional, depending on whether the parameter is biological or chemical in nature. These reviews are conducted at the workstation of each reviewer (i.e., desktop) using computer applications to analyze the data for potential temporal or spatial trends as well as gain a better understanding of any attenuating circumstances that should be considered (e.g., flow, time/date of data collection, or habitat).

Figure 5. Flowchart of Aquatic Life Use assessment process.

The next step in the process is a Comprehensive Watershed Assessment meeting where reviewers convene to discuss the results of their desktop assessments for each individual waterbody. Implementing a comprehensive approach to water quality assessment requires a means of organizing and evaluating information to formulate a conclusion utilizing multiple lines of evidence. Occasionally, the evidence stemming from individual parameters are not in agreement and would result in discrepant assessments if the parameters were evaluated independently. However, the overall assessment considers each piece of evidence to make a use attainment determination based on the preponderance of information available. See the *Guidance Manual for Assessing the Quality of Minnesota Surface Waters for the Determination of Impairment 305(b) Report and 303(d) List* (MPCA 2012) http://www.pca.state.mn.us/index.php/view-document.html?gid=8601 for guidelines and factors considered when making such determinations.

Any new impairment (i.e., waterbody not attaining its beneficial use) is first reviewed using GIS to determine if greater than 50% of the assessment unit is channelized. Currently, the MPCA is deferring any new impairments on channelized reaches until new aquatic life use standards have been developed as part of the Tiered Aquatic Life Use (TALU) framework. For additional information, see: http://www.pca.state.mn.us/index.php/water/water-monitoring-and-reporting/water-quality-and-pollutants/the-tiered-aquatic-life-use-talu-framework.html). However, in this report, channelized reaches with biological data are evaluated on a "good-fair-poor" system to help evaluate their condition (see Section IV and Appendix 5.1).

The last step in the assessment process is the Professional Judgment Group meeting. At this meeting results are shared and discussed with entities outside of the MPCA that may have been involved in data collection or that might be responsible for local watershed reports and project planning. Information obtained during this meeting may be used to revise previous use attainment decisions (e.g., sampling events that may have been uncharacteristic due to annual climate or flow variation, local factors such as impoundments that do not represent the majority of conditions on the AUID). Waterbodies that do not meet standards and therefore do not attain one or more of their designated uses are considered impaired waters and are placed on the draft 303(d) Impaired Waters List. Assessment results are also included in watershed monitoring and assessment reports.

Data management

It is MPCA policy to use all credible and relevant monitoring data to assess surface waters. The MPCA relies on data it collects along with data from other sources, such as sister agencies, local governments and volunteers. The data must meet rigorous quality assurance protocols before being used. All monitoring data required or paid for by MPCA are entered into EQuIS (Environmental Quality Information System), MPCA's data system and are also uploaded to the U.S. Environmental Protection Agency's data warehouse. Data for monitoring projects with federal or state funding are required to be stored in EQuIS (e.g., Clean Water Partnership, CWLA Surface Water Assessment Grants and TMDL program). Many local projects not funded by MPCA also choose to submit their data to the MPCA in an EQuIS-ready format so that the monitoring data may be utilized in the assessment process. Prior to each assessment cycle, the MPCA sends out a request for monitoring data to local entities and partner organizations.

Period of record

The MPCA uses data collected over the most recent 10 year period for all water quality assessments. This time-frame provides a reasonable assurance that data will have been collected over a range of weather and flow conditions and that all seasons will be adequately represented; however, data for the entire period is not required to make an assessment. The goal is to use data that best represents current water quality conditions. Therefore, recent data for pollutant categories such as toxics, lake eutrophication, and fish contaminants may be given more weight during assessment.

III. Watershed overview

The Mississippi River (Winona) Watershed originates at the outlet of Lake Pepin in southeastern Minnesota. This segment of the Mississippi River flows approximately 50 miles southeast along the Minnesota Wisconsin border to where the Black River (WI) joins the Mississippi near Trempealeau, Wisconsin. The watershed shares a USGS code with the Buffalo River Watershed, its sister watershed on the Wisconsin side of the Mississippi River. In addition to its namesake, the Mississippi River (Winona) includes the Whitewater River system and a collection of small direct tributary streams to the mainstem Mississippi River. Significant portions of these waters are classified as wild or semi-wild trout waters making the area popular among anglers. The watershed is an important resource for recreation and wildlife, home to Whitewater State Park and Weaver Bottoms, a nationally significant waterfowl staging area.

The watershed drains roughly 660 mi^2 of southeastern Wabasha, western Olmsted, and Winona counties and is entirely housed within the Driftless Area ecoregion (Figure 6) (Omernik and Gallant, 1988). The driftless area is a region of the northern United States that was not covered by glaciers during the Wisconsin glaciation. This limestone plateau stands above the surrounding plains that were covered by the Superior and Des Moines Lobes. "The driftless area is a geologic relic—affected by surrounding glaciers, but not covered with their remains" (Waters, 1977). Today's landscape is characterized by gently rolling uplands that give way to steep bluffs resulting in highly dissected hills and valleys. Karst formations, a unique landform formed by the dissolution of soluble bedrock, resulting in sink holes, caves and underground rivers, are common. The watershed falls in the Northern Mississippi Valley Loess Hills Major Land Resource Area (MLRA) (Figure 7). MLRAs identify nearly homogeneous areas of land use, elevation, topography, climate, water resources, potential natural vegetation and soils. Soils of the region are classified as Alfisols which are formed in semiarid to humid areas typically under hardwood forest cover. The watershed's soils are well drained to moderately well drained, highly erodible and developed in loess over bedrock residuum (NRCS, 2008).

Prior to European settlement, the watershed was a transitional zone between eastern hardwood forests and western tall grass prairies. Pre-settlement vegetation consisted of hardwood forest, oak savanna and prairie (Whitewater River Watershed Project, 2013). In 1851, treaties with the Native Americans opened southeastern Minnesota to European settlement. Pioneers rapidly plowed the open prairies into fields of wheat and cleared the steep hillsides for pasture. In less than 50 years the Whitewater River Valley was transformed from pristine wilderness into a valley of 100 farmers and 5 towns (Whitewater River Watershed Project, 2013). Advancing agriculture brought severe flooding; by 1920 the Whitewater flooded up to 20 times annually. Homes and fields in the valleys were buried under 15 feet of eroded sand and silt, eventually resulting in the abandonment of the towns of Beaver and Whitewater Falls (Whitewater River Watershed Project, 2013). The crystalline waters of the Whitewater that had teemed with native brook trout only decades earlier had become a shallow turbid marginalized fishery. In 1938, the Whitewater River flooded a record 28 times. After the impacts of decades of flooding and sediment deposition, much of the valley was abandoned and natural resource management was entrusted to the state.

Despite intense rainfall events and floods, the valley has not experienced destructive erosion in over half a century (Whitewater River Watershed Project, 2009). Improved farming practices and the reestablishment of perennial vegetation on bluff land slopes and within floodplains have helped stabilize the landscape.

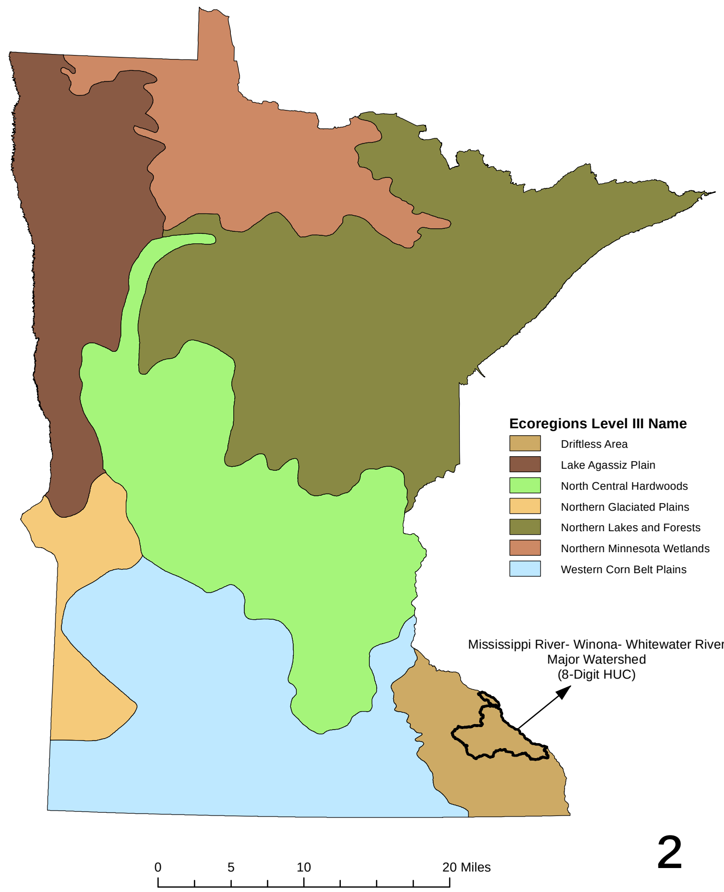

Figure 6. The Mississippi River (Winona) Watershed within the Driftless Area ecoregion of southeastern Minnesota.

Land use summary

The Mississippi River (Winona)'s landuse can be characterized as forest/shrub (33.9%), rangeland (27.5%), cropland (24.4%), developed (6.2%), wetland (5.2%), open water (2.7%) and barren land (0.06%) (Figure 8). The western region of the watershed is dominated by row crop agriculture with scattered livestock operations. Cropland is predominately planted in corn, forage for livestock and soybeans (MNDA 2009 and MNDA 2010). Both Wabasha and Winona counties are important dairy producers for the state; Winona County ranked second and Wabasha County ranked fifth (MDA, 2009 and MDA, 2010). Winona County also ranked fourth for cattle production. Moving east, rangeland and forested uses increase. Rangeland typically surrounds heavily forested blufflands as its steep terrain limits utility for crop production. Forested landuse is greatest on the watershed's eastern boundaries. Frac sand mining is a growing industry in the watershed but this landuse is not adequately reflected in the landuse coverage utilized in this report.

The watershed is predominately rural, with populations clustered in its largest city Winona (27,952), smaller towns (Saint Charles: 3,736, Plainview: 3,340, Eyota: 1,977) and rural communities (Stockton: 697, Rollingstone: 664, Altura: 493, Elba: 152) (U.S. Census Bureau, 2010). A majority of the watershed's land is privately owned - roughly 85% (NRCS, 2008).

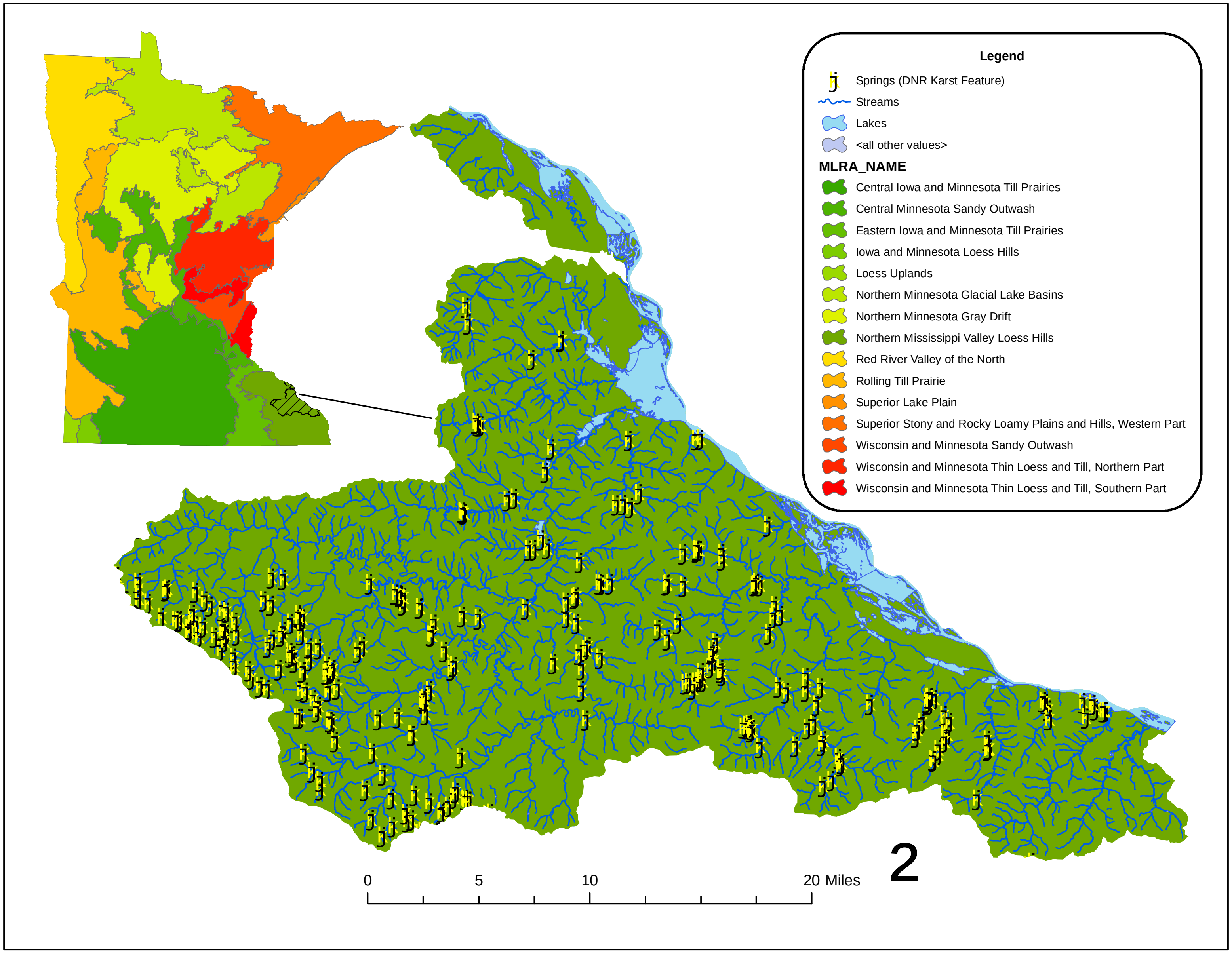

Figure 7. Major Land Resource Areas (MLRA) and springs in the Mississippi River (Winona) Watershed.

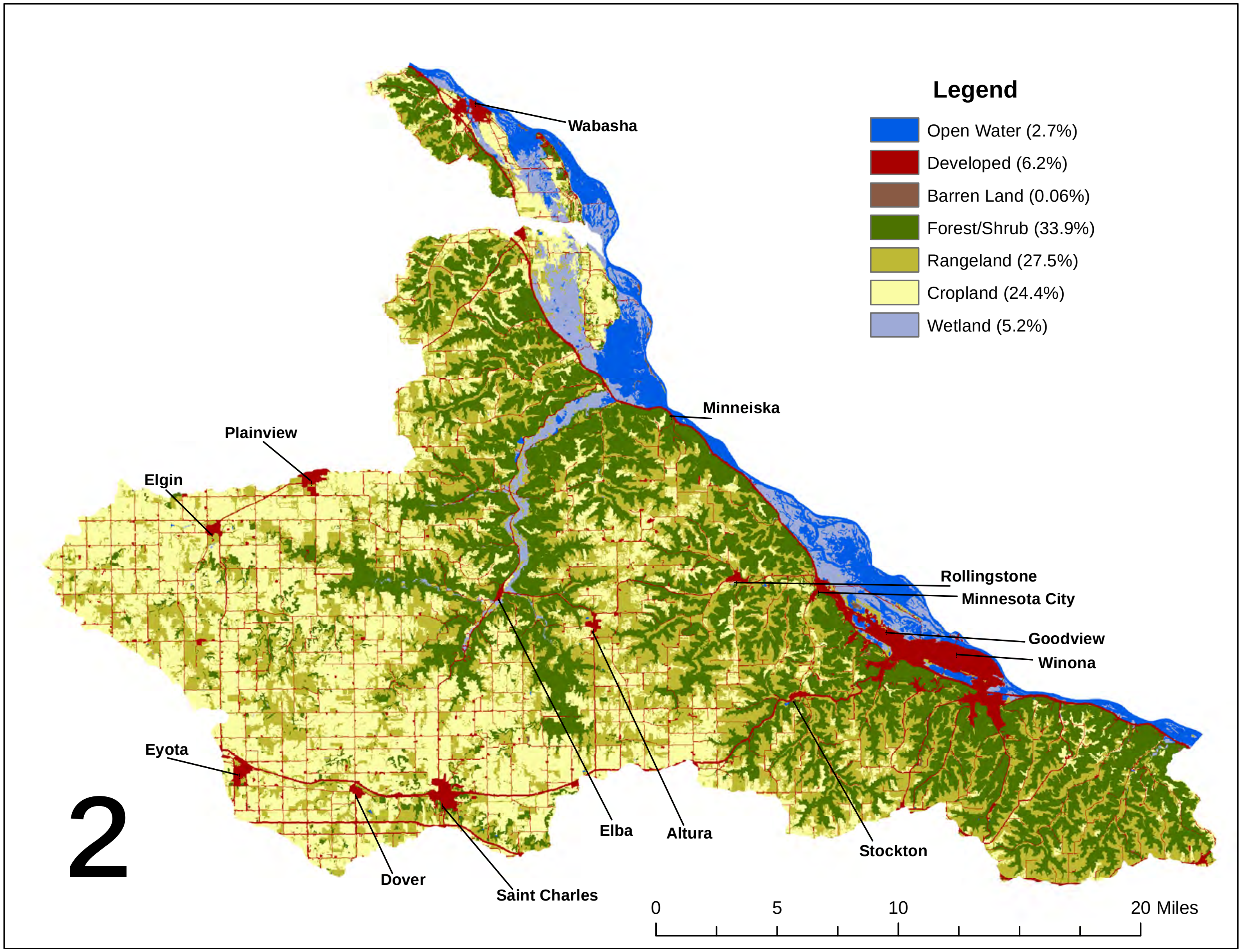

Figure 8. Land use in the Mississippi River (Winona) Watershed.

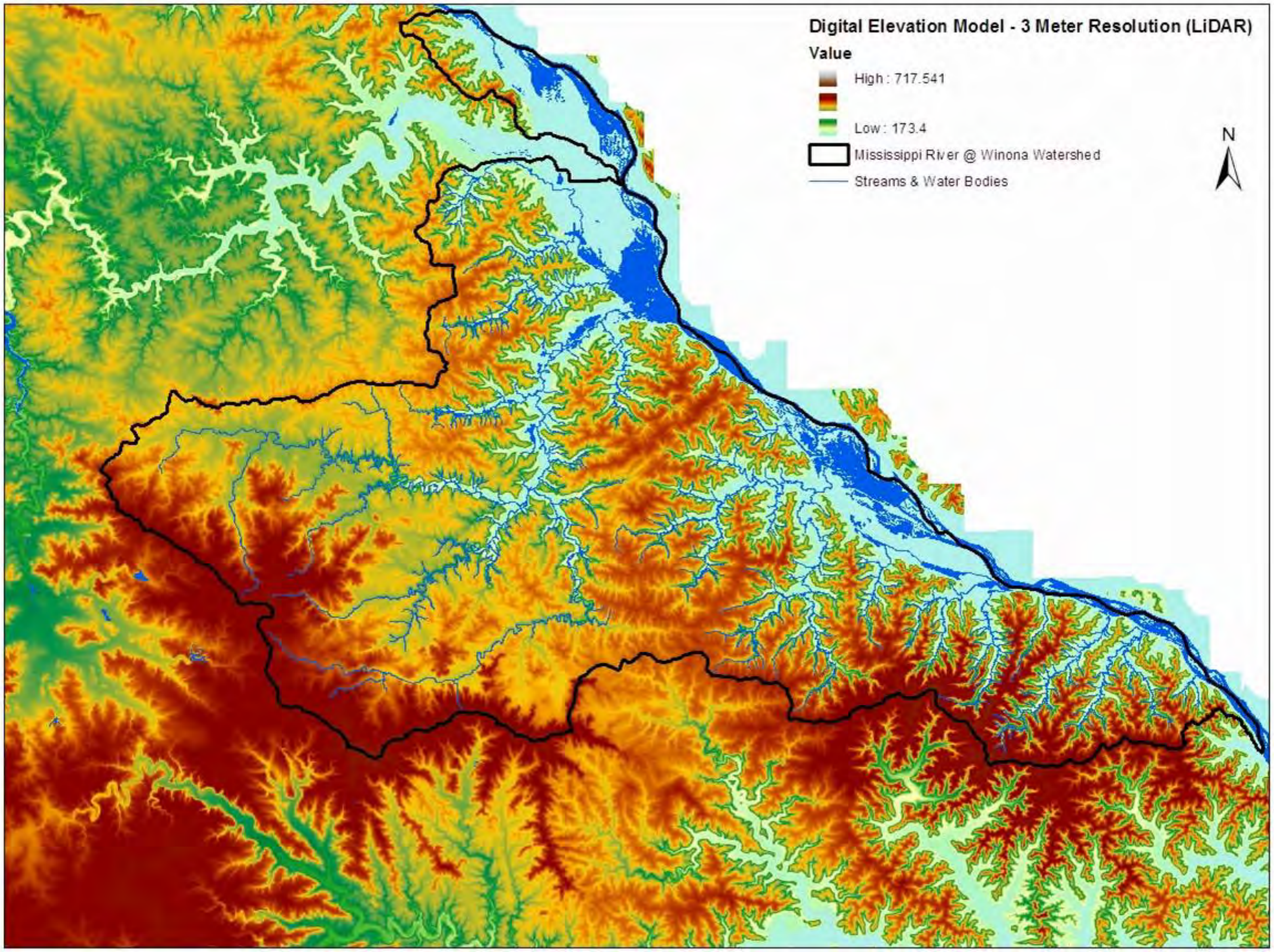

Figure 9. LiDAR (Light Detection and Ranging) Digital Elevation Display for Southeastern Minnesota.

Surface water hydrology

The Mississippi River (Winona) watershed is a flow-through section of the Mississippi River, stretching from the outlet of Lake Pepin in Wabasha County for some 50 miles to the Black River's (WI) confluence. In the Minnesota portion, the watershed receives water from the Zumbro River, Whitewater River, and many small spring-fed tributaries. Comprised of 18 subwatersheds (11 HUC), the Mississippi River (Winona)'s tributaries include the Whitewater River, East Indian Creek, Snake Creek, Gorman Creek, Pleasant Valley Creek, Rollingstone Creek, Garvin Brook, Gilmore Creek, Beaver Creek, Pickwick Creek and Cedar Creek. A majority of the wetlands in the watershed are found along the floodplain of the Mississippi River. Lakes are not a prominent feature of the Mississippi River – Winona Watershed. There are 13 MDNR protected lakes greater than four hectares (10 acres) including Lake Winona. LIDAR data reveals previously unavailable detail on the drainage patterns off the hills in the west portion of the watershed, including more accurate depictions of the degree of elevation change and how it varies across the landscape (Figure 9, preceding page).

Climate and precipitation

Average precipitation in the region ranges from 31 – 33 inches annually (NRCS, 2008). During the 2010 water year (October 2009 thru September 2010), when the majority of data were collected within the watershed, the precipitation levels in southeastern Minnesota were above normal (Figure 10). In 2010, Wabasha County averaged 46.31 inches of precipitation, Winona County averaged 45.04 inches and Olmsted County averaged 40.56 inches (Minnesota State Climatologists Office, 2012).

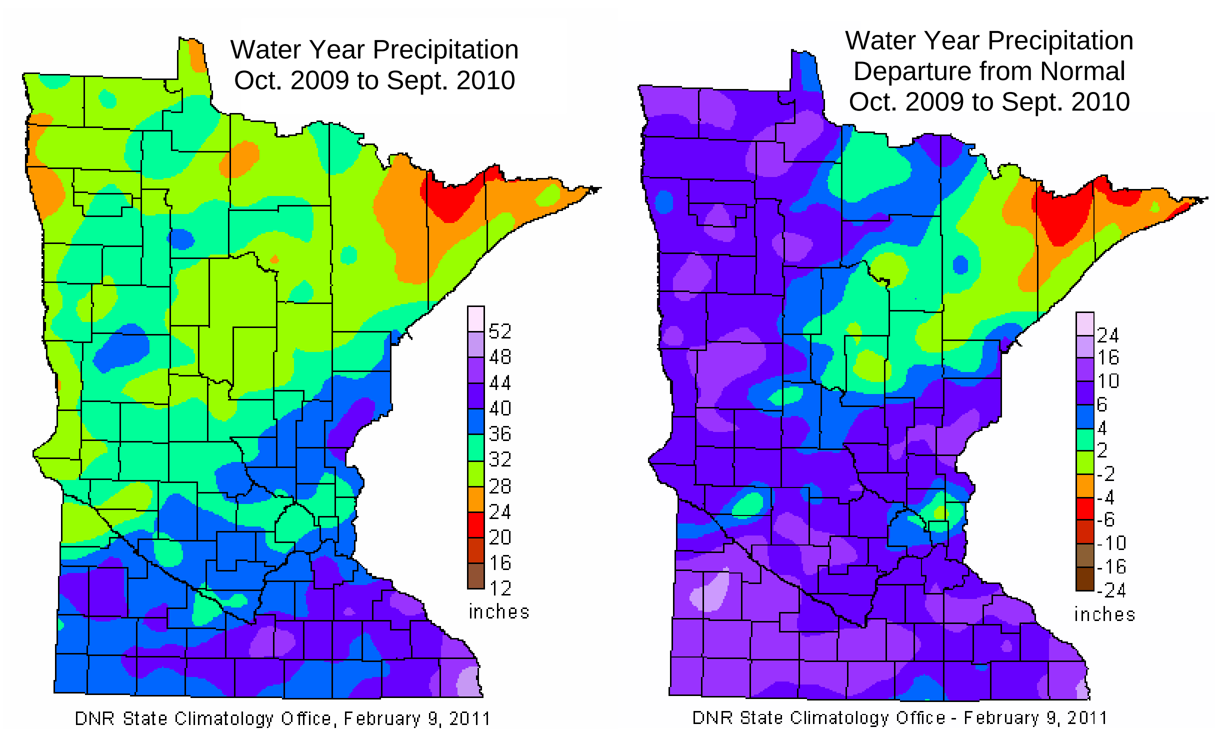

Figure 10. State-wide precipitation levels during the 2010 water year.

Figure 11 displays the areal average of precipitation in Southeast Minnesota. An areal average is a spatial average of all the precipitation data collected within a certain area presented as a single dataset. This data is taken from the Western Regional Climate Center, available as a link off of the University of Minnesota Climate website: http://www.wrcc.dri.edu/spi/divplot1map.html.

Rainfall in the southeast region displays no significant trend over the last 20 years. Though rainfall can vary in intensity and time of year, it would appear that precipitation in southeastern Minnesota has not changed dramatically over this time period.

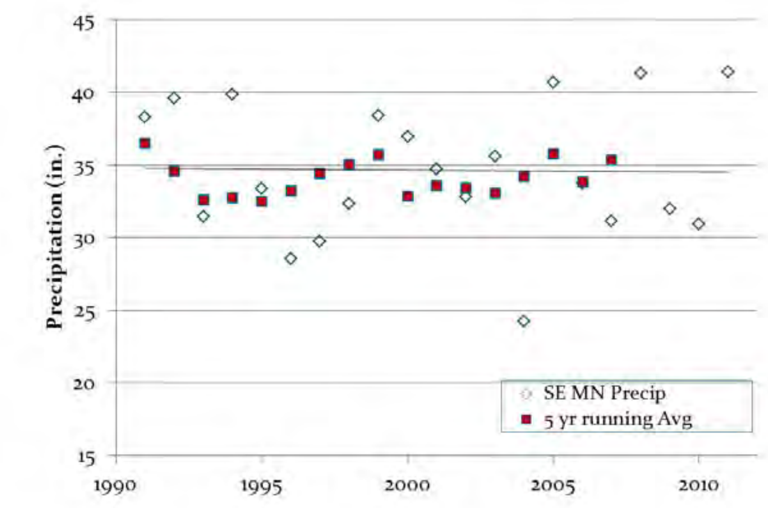

Figure 11. Precipitation trends in southeastern Minnesota (1990-2011) with 5 year running average.

However, precipitation in southeast Minnesota exhibits a statistically significant rising trend over the past 100 years, $p = 0.001$ (Figure 12). This is a strong trend and matches similar trends throughout Minnesota.

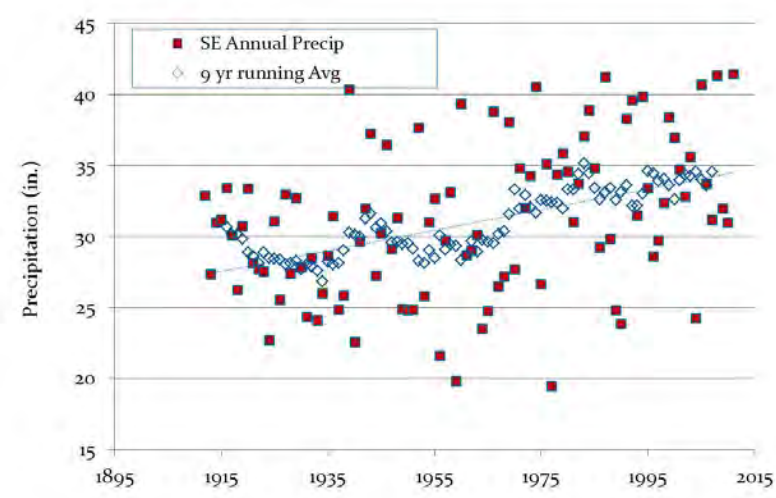

Figure 12. Precipitation Trends in southeastern Minnesota (1895 - 2011) with 9 year running average.

Hydrogeology and groundwater quality

The Ambient Groundwater Monitoring Program maintains 15 monitoring locations within the Mississippi River (Winona) Watershed. Data from these wells shows the presence of naturally-occurring minerals like iron, calcium and magnesium. These commonly will cause discoloration, odors or hardness but are not typically risks to human health.

Residence and movement of contaminants in groundwater is heavily influenced by geology. Geology in southeastern Minnesota is characterized by karst features (Figure 13). These geologic features occur where limestone is slowly dissolved by infiltrating rainwater, sometimes forming hidden, rapid pathways from pollution release points to drinking water wells or surface water.

Karst aquifers, like those commonly found in the watershed of the Mississippi River at Winona, are very difficult to protect from activities at the ground surface; for while pollutants are quickly transported to drinking water wells or surface water, conventional hydrogeologic tools, such as monitoring wells, are of limited usefulness. The best strategy for pollution prevention in karst landscapes is to target common sources, like septic systems, abandoned wells and animal feedlot operations. Additional information regarding Karst landscapes in Minnesota can be found at: http://www.pca.state.mn.us/index.php/water/water-types-and-programs/groundwater/about-groundwater/karst-in-minnesota.html.

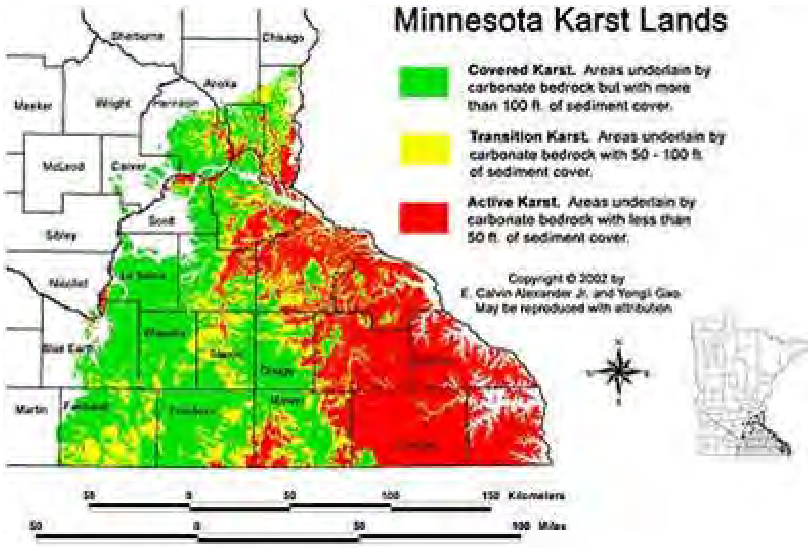

Figure 13. Karst Land in Minnesota.

High capacity withdrawals

The MDNR permits all high capacity water withdrawals where the pumped volume exceeds 10,000 gallons/day or one million gallons/year (See Figure 14 for locations of permitted groundwater and surface water withdrawals). Permit holders are required to track water use and report back to the MDNR yearly. Information on the program and the program database are found at: http://www.dnr.state.mn.us/waters/watermgmt_section/appropriations/wateruse.html.

The three largest permitted consumers of water in the state (in order) are municipalities, irrigation and industry. The Mississippi River, Winona Watershed withdrawals are mostly municipal use. Total groundwater withdrawals from the watershed have increased significantly ($p=0.001$) since 1988 (Figure 15). The changes in withdrawal volume depicted in this report are a representation of groundwater use and demand in the watershed and are taken into consideration when MDNR issues permits for water withdrawals. Other factors not discussed in this report, but considered when issuing permits, include: interactions between individual withdrawal locations, cumulative effects of withdrawals from individual aquifers and potential interactions between aquifers. This holistic approach to water allocations is necessary to ensure the sustainability of Minnesota's groundwater resources.

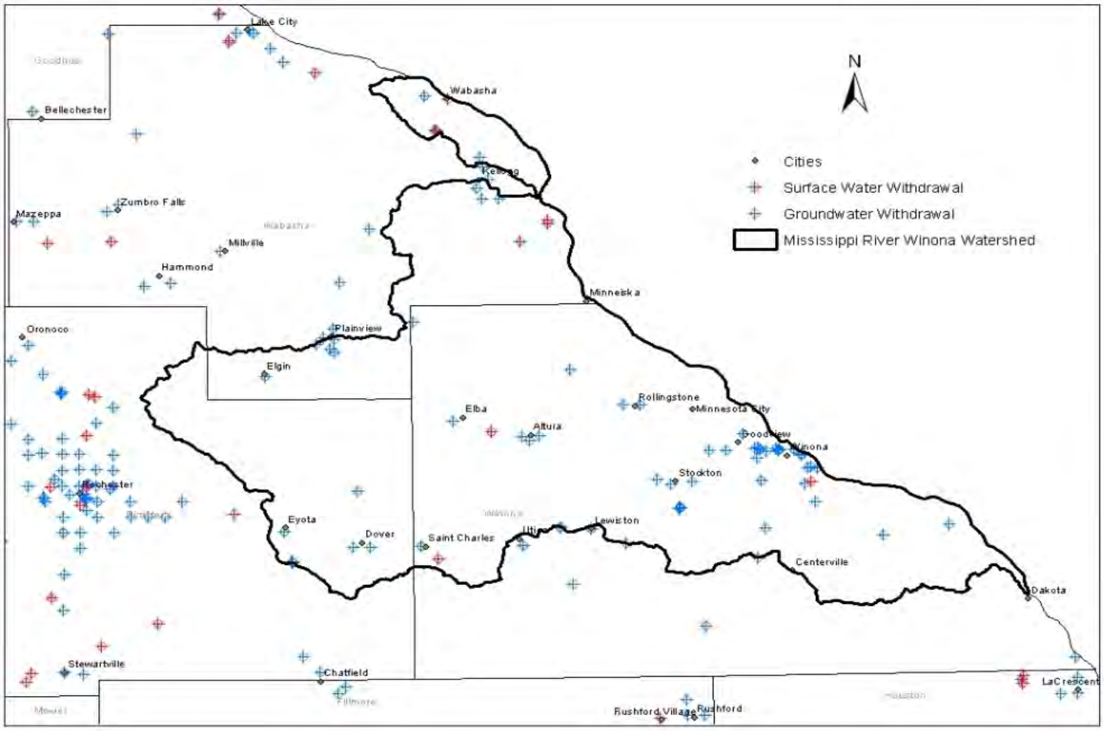

Figure 14. Locations of permitted groundwater withdrawals in the Mississippi River (Winona) Watershed.

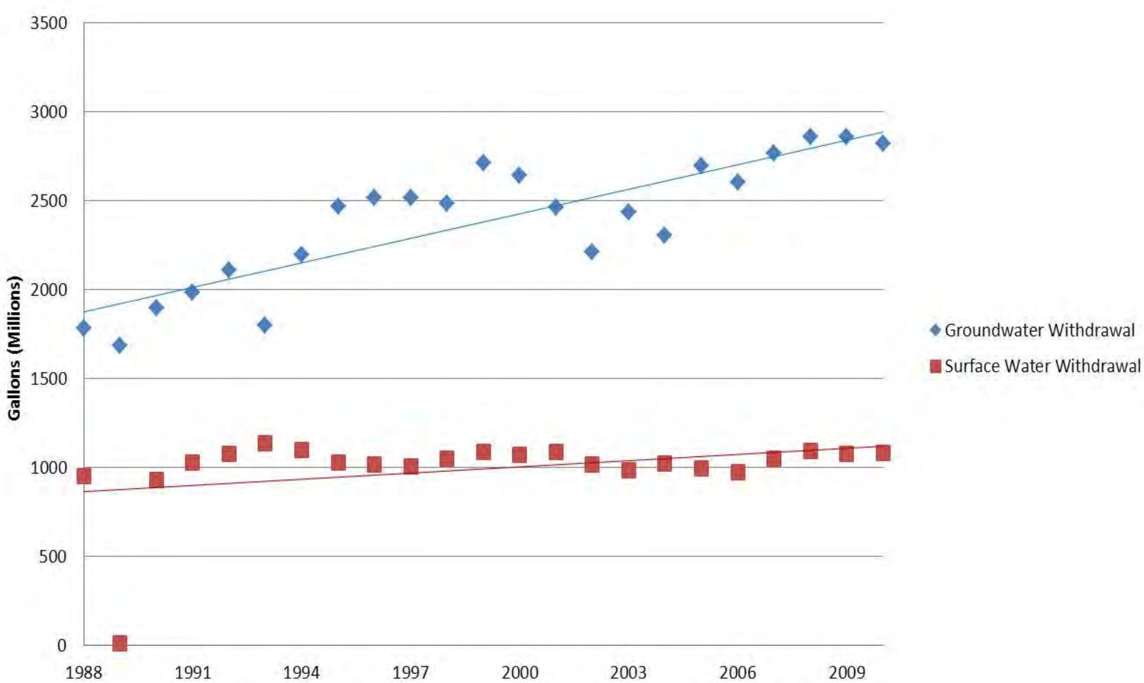

Figure 15. Total annual groundwater and surface water withdrawals in the Mississippi River (Winona) Watershed (1988-2010).

IV. Watershed-wide data collection methodology

Load monitoring

Intensive water quality sampling occurs throughout the year at all WPLMN sites. Between 27 and 35 mid-stream grab samples were collected per year at the Whitewater River on CSAH 30 near Beaver, Minnesota focusing the greatest sampling frequency during periods of moderate to high flow. Because correlations between concentration and flow exist for many of the monitored analytes, and because these relationships can shift between storms or with season, computation of accurate load estimates requires frequent sampling of all major runoff events. Low flow periods are also sampled but sampling frequency tends to be less as concentrations are generally more stable when compared to periods of elevated flow. Despite discharge-related differences in sample collection frequency, this staggered approach to sampling generally results in samples being well distributed over the entire range of flows.

Annual water quality and daily average discharge data are coupled in the "Flux32," pollutant load model, originally developed by Dr. Bill Walker and recently upgraded by the U.S. Army Corp of Engineers and the MPCA. Flux32 allows the user to create seasonal or discharge constrained concentration/flow regression equations to estimate pollutant concentrations and loads on days when samples were not collected. Primary output includes annual and daily pollutant loads and flow weighted mean concentrations (pollutant load/total flow volume). Loads and flow weighted mean concentrations are calculated for total suspended solids (TSS), total phosphorus (TP), dissolved orthophosphate (DOP), and nitrate plus nitrite nitrogen (nitrate-N).

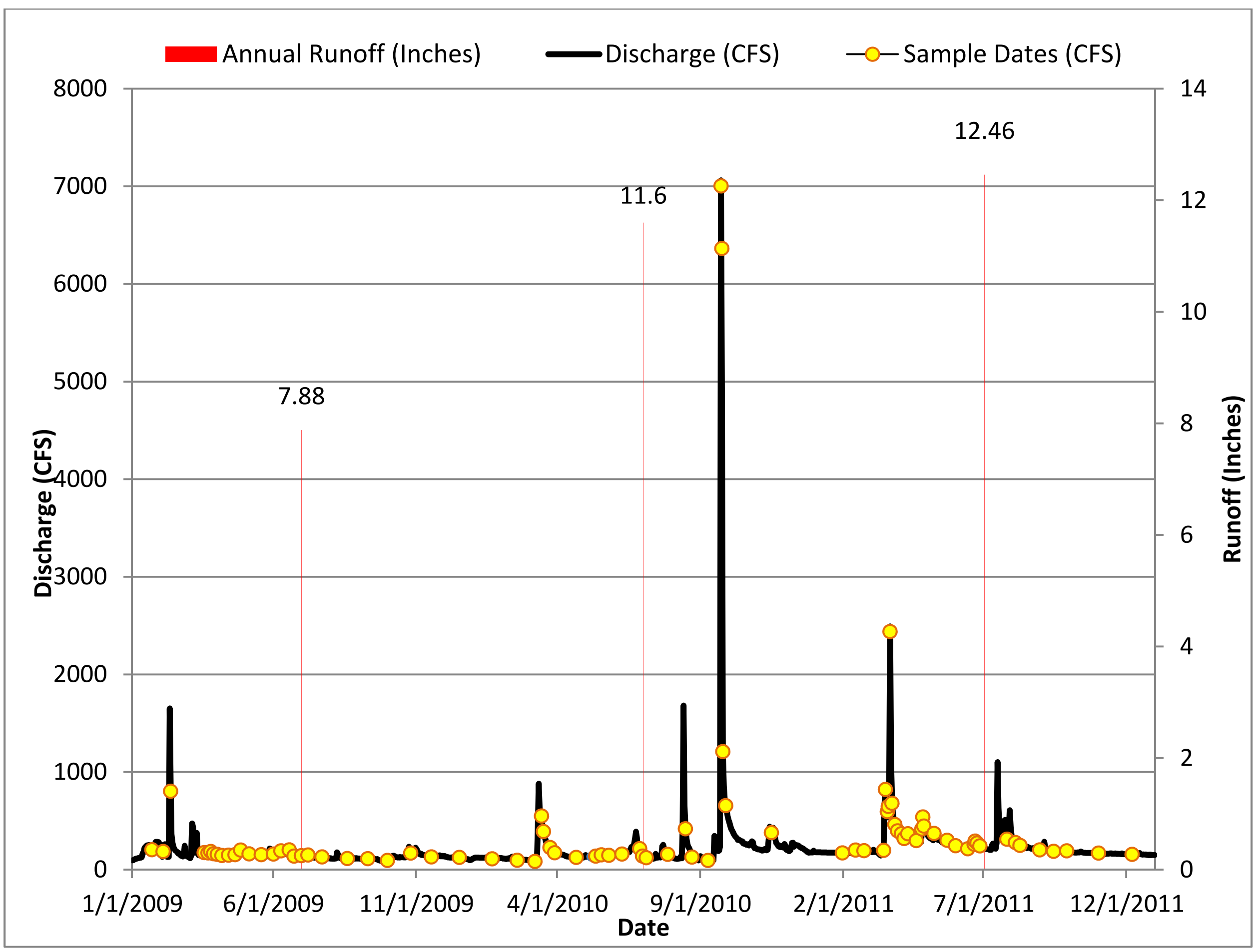

Figure 16. Hydrograph, Sampling Regime and Annual Runoff for the Whitewater River near Beaver (2009-2011).

Stream water sampling

Six water chemistry stations were sampled from May thru September in 2010, and again June thru August of 2011. Samples were collected to provide sufficient water chemistry data to assess all components of the aquatic life and recreation use standards. Following the IWM design, water chemistry stations were placed at the outlet of each 11-HUC subwatershed greater than 40 mi^2 in area (purple dots and green dots/triangles in (Figure 3). The MPCA staff collected water chemistry at all six stations, all of which were co-located with existing monitoring stations. (See Appendix 2 for locations of stream water chemistry monitoring sites. See Appendix 1 for definitions of stream chemistry analytes monitored in this study).

Due to the small drainage area (<40 mi^2) of the Wabasha, Cooks Valley, Snake Creek, East Indian, Mississippi River Direct, Dry Creek, Beaver Creek, Gilmore Creek, Pleasant Valley, Cedar Creek, Pickwick Valley and Dakota Valley subwatersheds (11-HUC), an intensive chemistry collection station was not placed at their outlets; however, a biological station was placed at the outlet of Cooks Valley, Snake Creek, East Indian, Dry Creek, Beaver Creek, Gilmore Creek, Pleasant Valley, Cedar Creek, Pickwick Valley, and the tributary of West Burns Valley Creek in the Dakota Valley watersheds, and were assessed for aquatic life where appropriate. The Wabasha, Mississippi River Direct and Dakota Valley watersheds are not true watersheds but are flow-through sections of the Mississippi River. Tributary streams large enough to meet site selection criteria were monitored for biology; however, biological monitoring did not occur on the mainstem Mississippi River.

Stream biological sampling

The biological monitoring component of the intensive watershed monitoring in the Mississippi River (Winona) Watershed was completed during the summer of 2010. A total of 38 stations were newly established across the watershed and sampled. These sites were located near the outlets of most minor HUC-14 watersheds. In addition, six existing biological monitoring stations within the watershed were revisited in 2010. These monitoring stations were initially established as part of a random Lower Mississippi River Basin wide survey in 2004, or as part of a 2003 survey by the MDNR. While data from the last 10 years contributed to the watershed assessments, the majority of data utilized for the 2012 assessment was collected in 2010. A total of 40 AUIDs were sampled for biology in the Mississippi River (Winona) Watershed. Waterbody assessments to determine aquatic life use support were conducted for 33 AUIDs. Waterbody assessments were not conducted for 7 AUIDs because criteria for channelized reaches had not been developed prior to the assessments. Nonetheless, the biological information that was not used in the assessment process will be crucial to the stressor identification process and will also be used as a basis for long term trend results in subsequent reporting cycles. Qualitative ratings for non-assessed reaches area included in Appendix 5.1.

To measure the health of aquatic life at each biological monitoring station, indices of biological integrity (IBIs), specifically Fish and Invertebrate IBIs, were calculated based on monitoring data collected for each of these communities. A fish and macroinvertebrate classification framework was developed to account for natural variation in community structure which is attributed to geographic region, watershed drainage area, water temperature and stream gradient. As a result, Minnesota's streams and rivers were divided into 7 distinct warm water classes and 2 cold water classes, with each class having its own unique Fish IBI and Invert IBI. Each IBI class uses a unique suite of metrics, scoring functions, impairment thresholds, and confidence intervals (CIs). (For IBI classes, thresholds and CIs, see Appendix 4.1.) IBI scores higher than the impairment threshold and upper CI indicate that the stream reach supports aquatic life. Contrarily, scores below the impairment threshold and lower CI indicate that the stream reach does not support aquatic life. When an IBI score falls within the upper and lower confidence limits additional information may be considered when making the impairment decision such as potential local and watershed stressors and additional monitoring information (e.g., water chemistry, physical habitat, observations of local land use activities). For IBI results for each individual biological monitoring station, see Appendix 4 and Appendix 5.

Fish contaminants

Mercury and polychlorinated biphenyls (PCBs) were analyzed in fish tissue samples collected from the Whitewater River, Garvin Brook and Lake Winona. MPCA biomonitoring staff collected the fish from Whitewater River in 2010. The MDNR fisheries staff collected all other fish in several surveys over the past two decades.

In addition, select fish from Lake Winona were tested for perfluorochemicals (PFCs) in 2009. The PFC that bioaccumulates in fish and is a known health concern for human consumption is perfluorooctane sulfonate (PFOS) and thus is the only PFC concentration reported for fish tissue. PFCs became a contaminant of emerging concern in 2004 when high concentrations of PFOS were measured in fish from the Mississippi River, Pool 2. Extensive statewide monitoring of lakes and rivers for PFCs in fish was continued through 2010. More focused monitoring for PFCs will continue in known contaminated waters, such as the Mississippi River, the Fish Lake Flowage near Duluth and the Chain of Lakes in Minneapolis.

Captured fish were wrapped in aluminum foil and frozen, until they were thawed, scaled, filleted, and ground. The homogenized fillets were placed in 125 mL glass jars with Teflon™ lids and frozen, until thawed for mercury or PCBs analyses. The Minnesota Department of Agriculture Laboratory performed all mercury and PCBs analyses of fish tissue.

For PFCs, the MPCA shipped whole fish to AXYS Analytical Services Ltd in Sidney, British Columbia, Canada. AXYS completed fish measurements and processing before analyzing the tissue samples for 13 PFCs. The detection limit from AXYS is approximately 4.8 ng/g PFOS.

The MPCA has included waters impaired for contaminants in fish on the 303d Impaired Waters List since 1998. Impairment assessment for PCBs and PFCs in fish tissue is based on the fish consumption advisories prepared by the Minnesota Department of Health. If the consumption advisories restrict consumption of a particular fish species to less than a meal per week because of PCBs or PFCs, the MPCA considers the lake or river impaired. The threshold concentration for impairment (consumption advice of one meal per month) is 0.22 mg/kg for PCBs and 0.200 mg/kg (200 ppb) for PFOS.

Prior to 2006, mercury concentrations in fish tissue were assessed for water quality impairment based on the Minnesota Department of Health's fish consumption advisory. An advisory more restrictive than a meal per week was classified as impaired for mercury in fish tissue. Since 2006, a waterbody has been classified as impaired for mercury in fish tissue if 10% of the fish samples (measured as the 90^{th} percentile) exceed 0.2 mg/kg of mercury (one of Minnesota's water quality standards for mercury). At least 5 fish samples per species are required in order to make this assessment and only the last 10 years of data are used for statistical analysis. MPCA's Impaired Waters Inventory includes waterways that were assessed as impaired prior to 2006 as well as more recent impairments.

PCBs in fish have not been monitored as intensively as mercury in the last three decades due to monitoring completed in the 1970s and 1980s. These studies identified that high concentrations of PCBs were only a concern downstream of large urban areas in large rivers, such as the Mississippi River and in Lake Superior. Therefore, continued widespread frequent monitoring of smaller river systems was not necessary. However, limited PCB monitoring of forage fish was included in the watershed sampling design to confirm PCBs are not appearing in the smaller streams.

Lake water sampling

MPCA sampled the two basins of Lake Winona in 2010-11. There are currently no volunteers enrolled in the MPCA's Citizens Lake Monitoring Program (CLMP) that are conducting lake water clarity monitoring within the watershed. Sampling methods are the same among all groups involved with data collection and are described in the document entitled "MPCA Standard Operating Procedure for Lake Water Quality" found at http://www.pca.state.mn.us/publications/wq-s1-16.pdf. The lake water quality assessment standard requires eight observations/samples within a 10 year period for phosphorus, chlorophyll-a and Secchi depth.

Groundwater monitoring

The Ambient Groundwater Monitoring Program monitors trends in statewide groundwater quality by sampling a network of both domestic and monitoring wells for a comprehensive suite of chemicals including nutrients, metals, and volatile organic compounds. The goals of the program are to determine the status groundwater conditions and monitor trends in water quality over time. There are 15 MPCA Ambient Groundwater monitoring sites within the Mississippi River, Winona watershed. Fourteen are domestic water wells and one is a monitoring well.

V. Individual watershed results

The Mississippi River (Winona) watershed is a flow-through watershed which includes a segment of the Mississippi River. Current data from this segment of the Mississippi River has been omitted from this report. The main stem Mississippi River below Saint Anthony Falls is considered a great river and is not currently being monitored and assessed in conjunction with the Intensive Watershed Monitoring Strategy. An interstate working group, the Upper Mississippi River Basin Association (UMRBA),in a cooperative effort amongst state agencies in Minnesota, Wisconsin, Iowa, Illinois and Missouri, are currently working to develop a unified approach for monitoring and assessing this great river system.

HUC-11 watershed units

Assessment results for aquatic life and recreational use are presented for each HUC-11 watershed unit within the Mississippi River (Winona) Watershed. The primary objective is to portray all full support and impairment listings within an 11-HUC watershed unit resulting from the complex and multi-step assessment and listing process. (A summary table of assessment results for the entire 8-HUC watershed including aquatic consumption, and drinking water assessments (where applicable) is included in Appendix 3.1. This scale provides a robust assessment of water quality condition at a practical size for the development, management, and implementation of effective TMDLs and protection strategies. The graphics presented for each of the HUC-11 watershed units contain the assessment results from the 2012 Assessment Cycle as well as any impairment listings from previous assessment cycles. Discussion of assessment results focuses primarily on the 2010 intensive watershed monitoring effort, but also considers available data from the last ten years.

The proceeding pages provide an account of each HUC-11 watershed. Each account includes a brief description of the subwatershed and summary tables of the results for each of the following: a) stream aquatic life and aquatic recreation assessments, b) biological condition of channelized streams and ditches, c) stream habitat quality, d) channel stability, and where applicable, e) water chemistry for the HUC-11 outlet, and f) lake aquatic recreation assessments. Following the tables is a narrative summary of the assessment results and pertinent water quality projects completed or planned for the subwatershed. A brief description of each of the summary tables is provided below.

Stream assessments

A table is provided in each section summarizing aquatic life and aquatic recreation assessments of all assessable stream reaches within the watershed (i.e., where sufficient information was available to make an assessment). Primarily, these tables reflect the results of the 2012 assessment process (2014 EPA reporting cycle); however, impairments from previous assessment cycles are also included and are distinguished from new impairments via cell shading (see footnote section of each table). These tables also denote the results of comparing each individual aquatic life and aquatic recreation indicator to their respective criteria (i.e., standards) with determinations made during the desktop phase of the assessment process (see Figure 5). Assessment of aquatic life is derived from the analysis of biological (fish and invertebrate IBIs), dissolved oxygen, turbidity, chloride, pH and un-ionized ammonia (NH_3) data, while the assessment of aquatic recreation in streams is based solely on bacteria (Escherichia coli (E. coli) or fecal coliform) data. Included in each table is the specific aquatic life use classification for each stream reach: cold water community (2A); cool or warm water community (2B); or indigenous aquatic community (2C). Stream reaches that do not have sufficient information for either an aquatic life or aquatic recreation assessment (from current or previous assessment cycles) are not included in these tables, but are included in Appendix 5.2 and Appendix 5.3. Where applicable and sufficient data exists, assessments of other designated uses (e.g., class 7, drinking water, aquatic consumption) are discussed in the summary section of each HUC-11 as well as in the Watershed-Wide Results and Discussion section.

Channelized stream evaluations

Biological criteria have not been developed yet for channelized streams and ditches; therefore, assessment of fish and macroinvertebrate community data for aquatic life use support was not possible at some monitoring stations. A separate table provides a narrative rating of the condition of fish and macroinvertebrate communities at stations based on IBI results. Evaluation criteria are based on aquatic life use assessment thresholds for each individual IBI class (see Appendix 5.1). IBI scores above this threshold are given a "good" rating, scores falling below this threshold by less than ~15 points (these value varies slightly by IBI class) are given a "fair" rating, and scores falling below the threshold by more than ~15 points are given a "poor" rating. For more information regarding channelized stream evaluation criteria refer to Appendix 5.1.

Stream habitat results

Habitat information documented during each fish sampling visit is provided in each HUC-11 section. These tables convey the results of the Minnesota Stream Habitat Assessment (MSHA) survey, which evaluates the section of stream sampled for biology and can provide an indication of potential stressors (e.g., siltation, eutrophication) impacting fish and macroinvertebrate communities. The MSHA score is comprised of five scoring categories including adjacent land use, riparian zone, substrate, fish cover and channel morphology, which are summed for a total possible score of 100 points. Scores for each category, a summation of the total MSHA score, and a narrative habitat condition rating are provided in the tables for each biological monitoring station. Where multiple visits occur at the same station, the scores from each visit have been averaged. The final row in each table displays average MSHA scores and a rating for the HUC-11 watershed.

Stream stability results

Stream channel stability information evaluated during each invertebrate sampling visit is provided in each HUC-11 section. These tables display the results of the Channel Condition and Stability Index (CCSI) which rates the geomorphic stability of the stream reach sampled for biology. CCSI results may provide an indication of recent stream channel geomorphic changes and loss of habitat quality, which may be related to changes in watershed hydrology, stream gradient, sediment supply, or sediment transport capacity. The CCSI score is comprised of three scoring zones associated with three different areas of the stream channel (upper banks, lower banks, and substrate). Within each zone, individual metrics are rated and summed and both the zone and total scores are included in the 11 HUC tables. The CCSI total score range is from 13 to 138 where higher scores indicate greater channel instability. The final row in each table displays the average CCSI scores and a rating for the HUC-11 watershed. The CCSI was recently implemented in 2008, and is collected once at each biological station. Consequently, the CCSI ratings are only available for biological visits sampled in 2010 or later.

Watershed outlet water chemistry results

These summary tables display the water chemistry results for the monitoring station representing the outlet of the HUC-11 watershed. This data along with other data collected within the 10 year assessment window can provide valuable insight on water quality characteristics and potential parameters of concern within the watershed. Parameters included in these tables are those most closely related to the standards or expectations used for assessing aquatic life and recreation. While not all of the water chemistry parameters of interest have established water quality standards, McCollor and Heiskary (1993) developed ecoregion expectations for a number of parameters that provide a basis for evaluating stream water quality data and estimating attainable conditions for an ecoregion. For comparative purposes, water chemistry results for the Mississippi River (Winona) Watershed are compared to expectations developed by McCollor and Heiskary (1993) that were based on the 75th percentile of a long-term dataset of least impacted streams within each ecoregion.

Lake assessments

A summary of lake water quality is provided in the HUC-11 sections where available data exists. For lakes with sufficient data, basic modeling was completed. Assessment results for all lakes in the watershed are available in Appendix 3.2. Lake models and corresponding morphometric inputs can be found in Appendix 6.2.

Wabasha Watershed Unit HUC 07040003065

The Wabasha Watershed Unit is located in the northern-most reaches of the Mississippi River (Winona) Watershed, draining 23 mi^2 of Wabasha County. This subwatershed is not a true watershed as it includes the segment of the Mississippi River that flows from Wabasha to the confluence of the Zumbro River and a few small direct tributaries to the Mississippi River. Sixty percent of the watershed's natural land use remains intact (forest 23%, open water 22%, wetland 16%), while 30% is utilized for agricultural production (cropland 20%, rangeland 10%). As aforementioned, this segment of the Mississippi River was not monitored in this study as it is a great river. No additional waterbodies were monitored or assessed in this watershed due to their small size or drainage area. Figure 17 provides additional spatial context of the subwatershed.

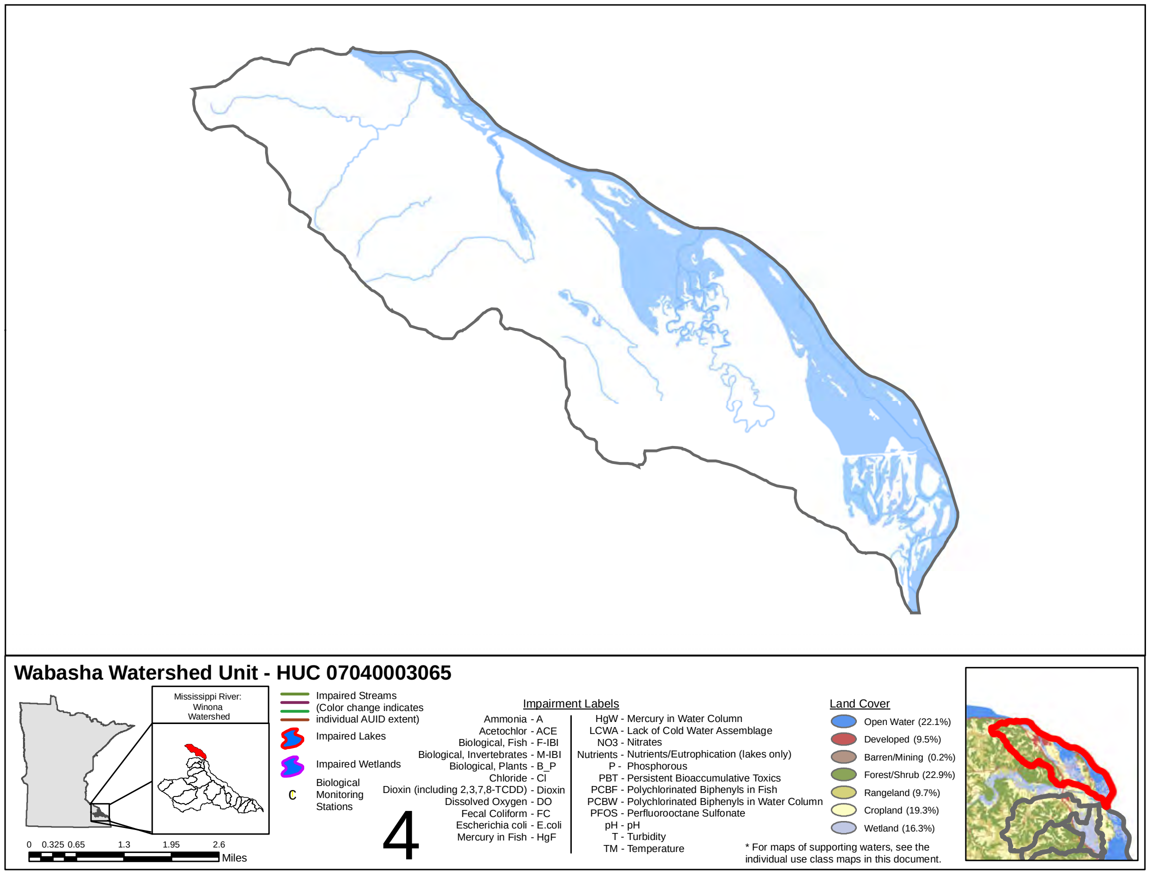

Figure 17. Currently listed impaired waters by parameter and land use characteristics in the Wabasha Watershed Unit.

Cooks Valley Watershed Unit HUC 07040003075

The Cooks Valley subwatershed lies in the northern region of the Mississippi River (Winona) watershed in southeastern Wabasha County, draining nearly 20 mi^2. Gorman Creek, its principal tributary, is a small spring fed stream. Designated as trout waters in its upper reaches, the stream emerges near Conception and follows CSAH 18 in a northeasterly direction before flowing southeast, where it loses its coldwater character and is later joined by Snake Creek. It enters the Mississippi River near Maloney Lake one mile north of Weaver. The subwatershed is predominately rural; its land use is divided between forest (34.1%), rangeland (31.1%) and cropland (24.3%). Due to its small drainage, MPCA did not establish a stream water chemistry station at the outlet of Gorman Creek. No assessed lakes are present within the subwatershed.

Table 1. Aquatic Life and Recreation assessments on stream reaches: Cooks Valley Watershed Unit.

					Aquatic Life Indicators:										
AUID ***Reach Name,*** *Reach Description*	**Reach Length (miles)**	**Use Class**	**Biological Station ID**	**Location of Biological Station**	Fish IBI	Invert IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides	Bacteria	**Aquatic Life**	**Aquatic Rec.**
07040003569 ***Gorman Creek,*** *T110 R10W S27, west line to Unnamed cr*	2.57	2B, 3C	10LM030	Downstream of 170th Ave (Lark Ln), 1.5 mi. SW of Kellogg	NA	NA	IF	IF	–	IF	–	–	–	IF*	NA

Abbreviations for Indicator Evaluations: – = No Data, **NA** = Not Assessed, **IF** = Insufficient Information, **MTS** = Meets criteria; **EXP** = Exceeds criteria, potential impairment; **EXS** = Exceeds criteria, potential severe impairment; **EX** = Exceeds criteria (Bacteria).

Abbreviations for Use Support Determinations: **NA** = Not Assessed, **IF** = Insufficient Information, **NS** = Non-Support, **FS** = Full Support

Key for Cell Shading: = existing impairment, listed prior to 2012 reporting cycle; = new impairment; = full support of designated use.

*Aquatic Life assessment and/or impairments have been deferred until the adoption of Tiered Aquatic Life Uses due to the AUID being predominantly (>50%) channelized or having biological data limited to a station occurring on a channelized portion of the stream.

Table 2. Non-assessed biological stations on channelized AUIDs: Dry Creek 11-HUC .

AUID ***Reach Name,*** *Reach Description*	**Reach length (miles)**	**Use Class**	**Biological Station ID**	**Location of Biological Station**	**Fish IBI**	**Invert IBI**
07040003569 ***Gorman Creek,*** *T110 R10W S27, west line to Unnamed cr*	2.57	2B, 3C	10LM030	Downstream of 170th Ave (Lark Ln), 1.5 mi. SW of Kellogg	Good	Fair

See Appendix 5.1 for clarification on the good/fair/poor thresholds and Appendix 5.2 and Appendix 5.3 for IBI results.

Table 3. Minnesota Stream Habitat Assessment (MSHA): Cooks Valley 11-HUC.

# Visits	Biological Station ID	Reach Name	Land Use (0-5)	Riparian (0-15)	Substrate (0-27)	Fish Cover (0-17)	Channel Morph. (0-36)	MSHA Score (0-100)	MSHA Rating
1	10LM030	Gorman Creek	1.5	8	11.2	12	20	52.7	Fair
		Average Habitat Results: *Cooks Valley 11 HUC*	**1.5**	**8**	**11.2**	**12**	**20**	**52.7**	**Fair**

Qualitative habitat ratings

= Good: MSHA score above the median of the least-disturbed sites (MSHA>66)

= Fair: MSHA score between the median of the least-disturbed sites and the median of the most-disturbed sites (45 < MSHA < 66)

= Poor: MSHA score below the median of the most-disturbed sites (MSHA<45)

Table 4. Channel Condition and Stability Assessment (CCSI): Cooks Valley 11 HUC.

# Visits	Biological Station ID	Stream Name	Upper Banks (4-43)	Lower Banks (5-46)	Substrate (3-37)	Channel Evolution (1-11)	CCSI Score (13-137)	CCSI Rating
1	10LM030	Gorman Creek	21	21	34	3	79	moderately unstable
		Average Stream Stability Results: *Cooks Valley 11 HUC*	**21**	**21**	**34**	**3**	**79**	**moderately unstable**

Qualitative channel stability scores and ratings (Higher scores indicate greater channel instability)

= stable: CCSI < 27 = fairly stable: 27 < CCSI < 45 = moderately unstable: 45 < CCSI < 80 = severely unstable: 80 < CCSI < 115 = extremely unstable: CCSI > 115

Summary

Due to the subwatershed's small size, limited water quality data was available for Gorman Creek. While biological monitoring visits occurred at a natural segment of Gorman Creek, a majority of the stream has been modified consistent with channelization (57.8%), thus an aquatic life use assessment was deferred. The MDNR considers Gorman Creek's upper coldwater reaches to be in good condition. The MPCA fish monitoring visit on the downstream warmwater results agreed with this, scoring slightly above the upper confidence interval. However, the community is beginning to demonstrate signs of stress, which is more evident in the poor macroinvertebrate results observed. The macroinvertebrate community was dominated by tolerant taxa which may be attributed to marginal habitat conditions observed at the biological station including: sedimentation, erosion, a lack of sufficient habitat for colonization and cattle access to the stream. A potential for turbidity impairment coincides with sedimentation issues seen during the CCSI survey, with an unconsolidated actively mobile bed and excess deposition. Nitrogen results from a single sample collected during the fish visit are low (2.7 mg/L) which does not explain the marginal M-IBI score. While additional monitoring could provide insight into the creek's thermal regime and help better define the appropriate use class, habitat improvements to reduce and sediment concerns would likely benefit the aquatic biology in the lower reaches of Gorman Creek.

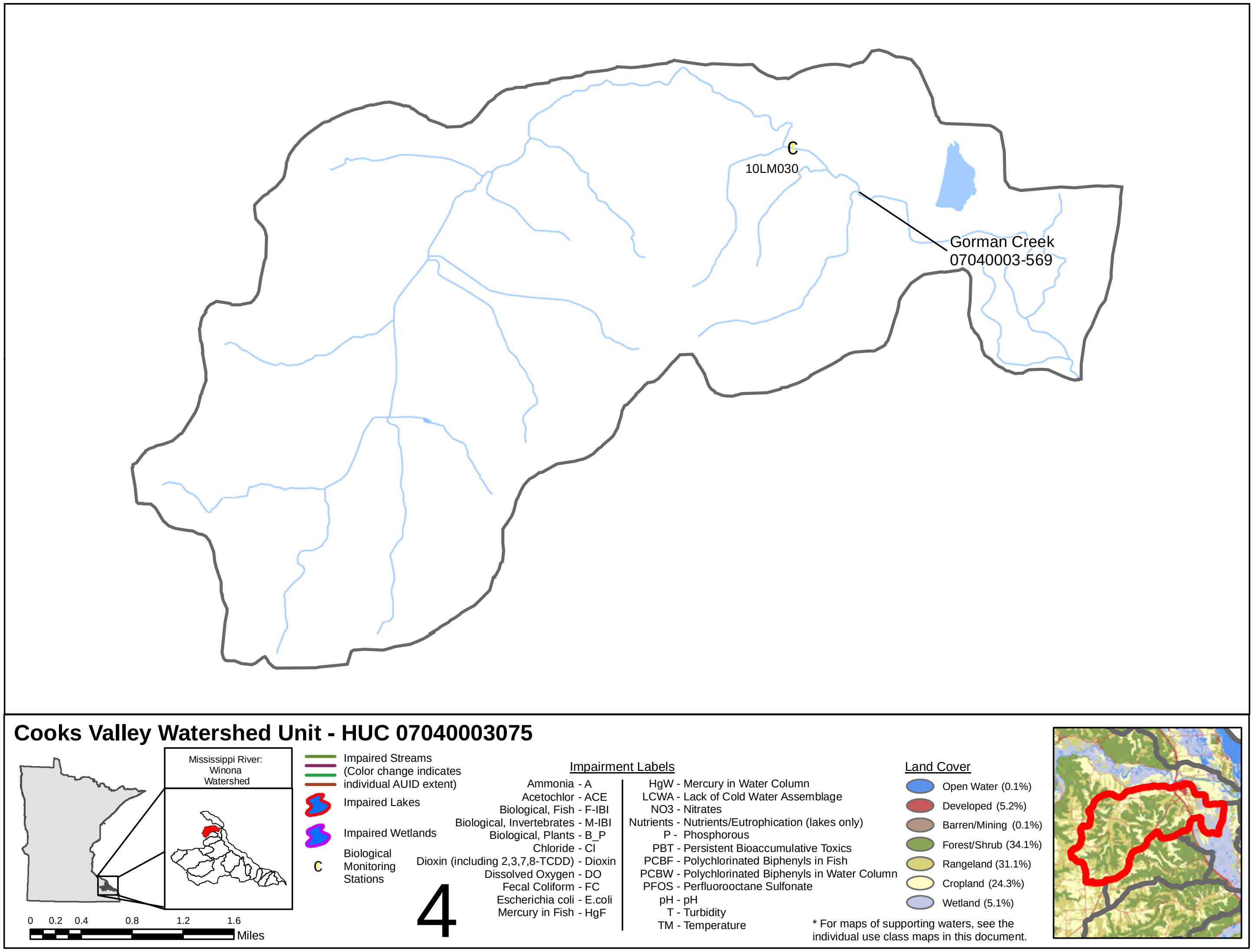

Figure 18. Currently listed impaired waters by parameter and land use characteristics in the Cooks Valley Watershed Unit.

Snake Creek Watershed Unit — HUC 07040003080

Snake Creek is a small subwatershed that flows to the Mississippi River after joining Gorman Creek. Draining only 10 mi^2 of Wabasha County, Snake Creek is nestled in a valley of rugged terrain amongst the bluffs of southeastern Minnesota. Springs, two miles south of Conception, are its headwaters which flow in a northeasterly direction following Township Road 152 through the Richard J. Dorer Memorial Hardwood State Forest to its confluence with Gorman Creek. Its landuse is equally divided between forested (50%) and agricultural uses (rangeland 24% and row crop 21%). Due to its small drainage, MPCA did not establish a stream water chemistry station at the outlet of Snake Creek. No lakes are present within the subwatershed.

Table 5. Aquatic Life and Recreation assessments on stream reaches: Snake Creek Watershed Unit.

AUID *Reach Name*, Reach Description	Reach Length (miles)	Use Class	Biological Station ID	Location of Biological Station	Aquatic Life Indicators: Fish IBI	Invert IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides	Bacteria	Aquatic Life	Aquatic Rec.
07040003557 ***Snake Creek,*** *Unnamed Cr to Unnamed Cr*	1.83	1B, 2A, 3B	03LM002	2 mi. upstream of Hwy 61, 10 mi NE of Plainview	MTS	MTS	IF	IF	–	IF	–	–	–	FS	NA

Abbreviations for Indicator Evaluations: – = No Data, **NA** = Not Assessed, **IF** = Insufficient Information, **MTS** = Meets criteria; **EXP** = Exceeds criteria, potential impairment; **EXS** = Exceeds criteria, potential severe impairment; **EX** = Exceeds criteria (Bacteria).
Abbreviations for Use Support Determinations: **NA** = Not Assessed, **IF** = Insufficient Information, **NS** = Non-Support, **FS** = Full Support
Key for Cell Shading: = existing impairment, listed prior to 2012 reporting cycle; = new impairment; = full support of designated use.

Table 6. Minnesota Stream Habitat Assessment (MSHA): Snake Creek 11-HUC.

# Visits	Biological Station ID	Reach Name	Land Use (0-5)	Riparian (0-15)	Substrate (0-27)	Fish Cover (0-17)	Channel Morph. (0-36)	MSHA Score	MSHA Rating
1	03LM002	Snake Creek	5	14	11.8	11	19	60.8	Fair
		Average Habitat Results: *Snake Creek 11 HUC*	**5**	**14**	**11.8**	**11**	**19**	**60.8**	**Fair**

Qualitative habitat ratings

- = Good: MSHA score above the median of the least-disturbed sites (MSHA>66)
- = Fair: MSHA score between the median of the least-disturbed sites and the median of the most-disturbed sites (45 < MSHA < 66)
- = Poor: MSHA score below the median of the most-disturbed sites (MSHA<45)

Table 7. Channel Condition and Stability Assessment (CCSI): Snake Creek 11 HUC.

# Visits	Biological Station ID	Stream Name	Upper Banks (4-43)	Lower Banks (5-46)	Substrate (3-37)	Channel Evolution (1-11)	CCSI Score (13-137)	CCSI Rating
1	03LM002	Snake Creek	9	30	30	3	72	moderately unstable
	Average Stream Stability Results: *Snake Creek 11 HUC*		**9**	**30**	**30**	**3**	**72**	moderately unstable

Qualitative channel stability scores and ratings (Higher scores indicate greater channel instability)

= stable: CCSI < 27 = fairly stable: 27 < CCSI < 45 = moderately unstable: 45 < CCSI < 80 = severely unstable: 80 < CCSI < 115 = extremely unstable: CCSI > 115

Summary

Limited water quality data was available for assessment for the Snake Creek subwatershed due to its small size. The lone biological station near the watershed's outlet resulted in fish and macroinvertebrates scores well above the upper confidence intervals for both indicators. A true coldwater signature was evident in the stream for both fish and invertebrates, notably coldwater obligate taxa including a fish community dominated by native brook trout. Habitat conditions show moderate signs of stress including an abundance of fine sediment, the presence of erosion and marginal instream habitat. These coincided with signs of geomorphologic instability evident in the lower banks and within the stream bed observed in CCSI results, including moderately diminishing sediment transport capacity, an unconsolidated and actively mobile stream bed and extensive deposition occurring at obstructions within the channel. Protective land use measures should be taken to maintain this high quality coldwater system.

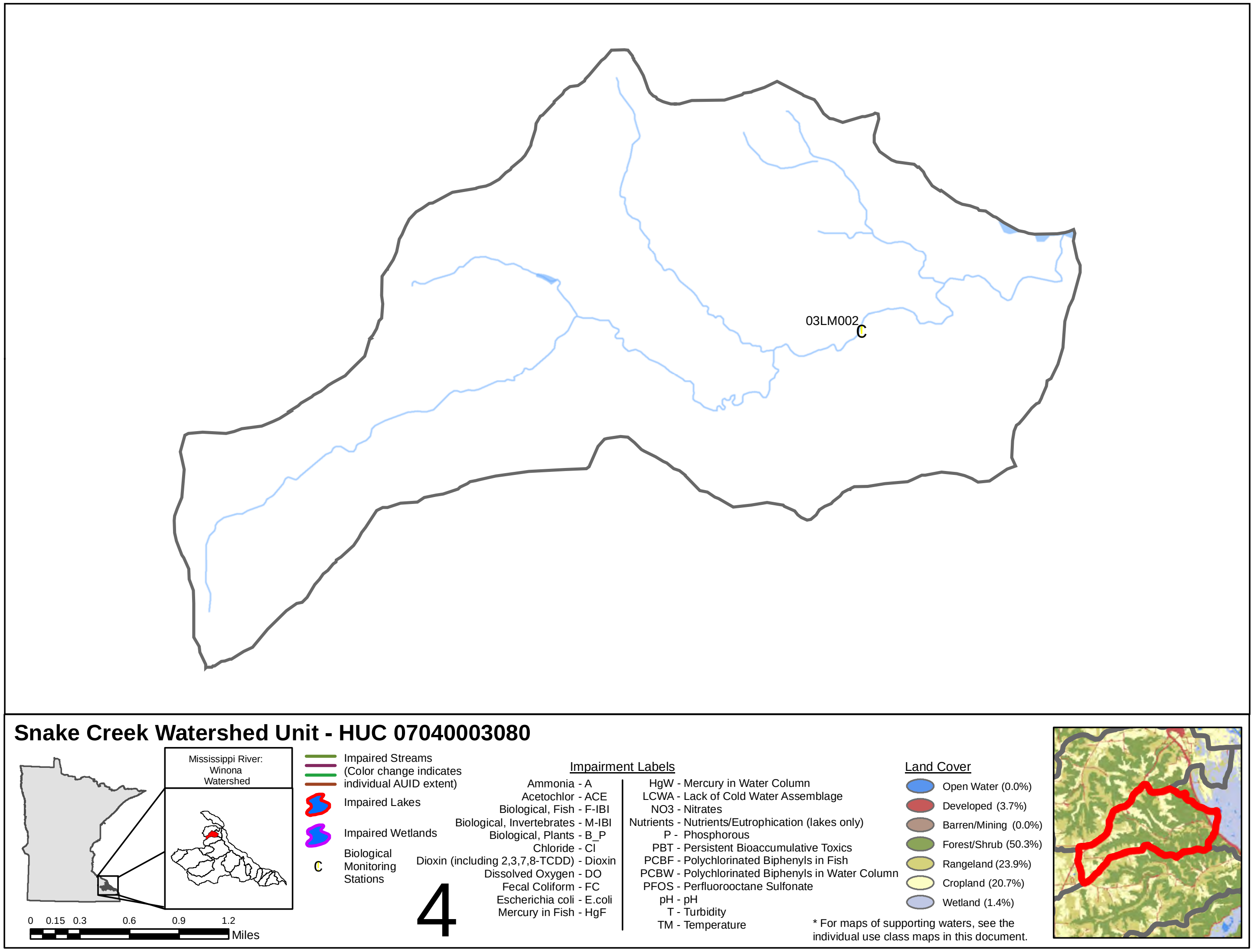

Figure 19. Currently listed impaired waters by parameter and land use characteristics in the Snake Creek Watershed Unit.

East Indian Watershed Unit HUC 07040003090

The East Indian subwatershed drains 21 mi^2 of rural southeastern Minnesota, linking a small portion of the southeastern boundary of Wabasha County to Winona County. Its principal outflow, East Indian Creek, is a designated trout stream, home to both brown trout and native brook trout. The creek begins three miles northeast of Plainview and flows in a northeasterly direction in the valley below CSAH 14. The creek empties into the Mississippi River approximately one mile north of Weaver in Maloney Lake. Landuse in the watershed is characterized by forest (39%), rangeland (37%) and cropland (21%). Due to its small drainage, MPCA did not establish a stream water chemistry station at the outlet of East Indian Creek, represented by MPCA biological station 10LM031. No lakes are present within the watershed.

Table 8. Aquatic Life and Recreation assessments on stream reaches: East Indian Watershed Unit.

AUID *Reach Name,* *Reach Description*	Reach Length (miles)	Use Class	Biological Station ID	Location of Biological Station	Aquatic Life Indicators: Fish IBI	Invert IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides	Bacteria	Aquatic Life	Aquatic Rec.
07040003573 ***East Indian Creek,*** *T109 R11W S36, west line to Mississippi R*	13.81	1B, 2A, 3B	04LM049 10LM031	1 mi. S of CSAH 14, 6 mi. NW of Plainview Downstream of private Rd S of CSAH 14, 6.5 mi. S of Kellogg	MTS	MTS	IF	EXP	–	IF	–	–	–	FS	NA

Abbreviations for Indicator Evaluations: **–** = No Data, **NA** = Not Assessed, **IF** = Insufficient Information, **MTS** = Meets criteria; **EXP** = Exceeds criteria, potential impairment; **EXS** = Exceeds criteria, potential severe impairment; **EX** = Exceeds criteria (Bacteria).

Abbreviations for Use Support Determinations: **NA** = Not Assessed, **IF** = Insufficient Information, **NS** = Non-Support, **FS** = Full Support

Key for Cell Shading: ☐ = existing impairment, listed prior to 2012 reporting cycle; ☐ = new impairment; ☐ = full support of designated use.

Table 9. Minnesota Stream Habitat Assessment (MSHA): East Indian 11-HUC.

# Visits	Biological Station ID	Reach Name	Land Use (0-5)	Riparian (0-15)	Substrate (0-27)	Fish Cover (0-17)	Channel Morph. (0-36)	MSHA Score	MSHA Rating
1	04LM049	East Indian Creek	5	10.5	14.5	13	25	68	Good
1	10LM031	East Indian Creek	0	6	13.6	11	23	53.6	Fair
		Average Habitat Results: *East Indian 11 HUC*	**2.5**	**8.3**	**14.1**	**12**	**24**	**60.8**	**Fair**

Qualitative habitat ratings

- ☐ = Good: MSHA score above the median of the least-disturbed sites (MSHA>66)
- ☐ = Fair: MSHA score between the median of the least-disturbed sites and the median of the most-disturbed sites (45 < MSHA < 66)
- ☐ = Poor: MSHA score below the median of the most-disturbed sites (MSHA<45)

Table 10. Channel Condition and Stability Assessment (CCSI): East Indian 11 HUC.

# Visits	Biological Station ID	Stream Name	Upper Banks (4-43)	Lower Banks (5-46)	Substrate (3-37)	Channel Evolution (1-11)	CCSI Score (13-137)	CCSI Rating
1	10LM031	East Indian Creek	15	19	16	3	53	moderately stable
Average Stream Stability Results: ***East Indian Watershed 11 HUC***			**15**	**19**	**16**	**3**	**53**	**moderately stable**

Qualitative channel stability scores and ratings (Higher scores indicate greater channel instability)

= stable: CCSI < 27 = fairly stable: 27 < CCSI < 45 = moderately unstable: 45 < CCSI < 80 = severely unstable: 80 < CCSI < 115 = extremely unstable: CCSI > 115

Summary

Limited water quality data was available for assessment for the East Indian Creek subwatershed due to its small size. Turbidity data collected from East Indian Creek was limited to one year of monitoring. While the results did suggest the potential for impairment for turbidity, gathering additional data was recommended for a more accurate analysis. Biological stations demonstrate full support for Aquatic Life Use based on both biological indicators. Fish scores were above biocriteria and were identical temporally across sampling years 2002-2010. The macroinvertebrate community in East Indian creek is reflective of a healthy coldwater community, despite a potential for decline in quality longitudinally as well as temporally. The upper reach (04LM049) had low diversity but was dominated by coldwater taxa, scoring above the upper confidence interval. The lower reach (10LM031) had a slightly elevated number of tolerant taxa, scoring just below the threshold, yet the presence of a strong coldwater community was adequate to consider the watershed supportive of the coldwater criteria. Habitat quality also decreased moving down the watershed which may be related to increasing human disturbance scores moving downstream. Lower scores at the downstream station may be attributed to a degraded riparian condition such as: open pasture, row crop agriculture, lack of shade and sedimentation concerns in the instream zone, embeddedness of coarse substrates and light erosion. Gradient also drastically decreases moving downstream from 20.31 m/km at the upstream station to 2.25 m/km. Nitrogen results from one-time grab samples during fish visits decreased moving downstream from 2.7 mg/L to 2 mg/L, and were low compared to other samples taken in the Mississippi River Winona watershed. Minnesota Trout Unlimited is planning a habitat improvement project on East Indian Creek in 2013 to control sediment issues and increase cover, and thereby the abundance of aquatic organisms.

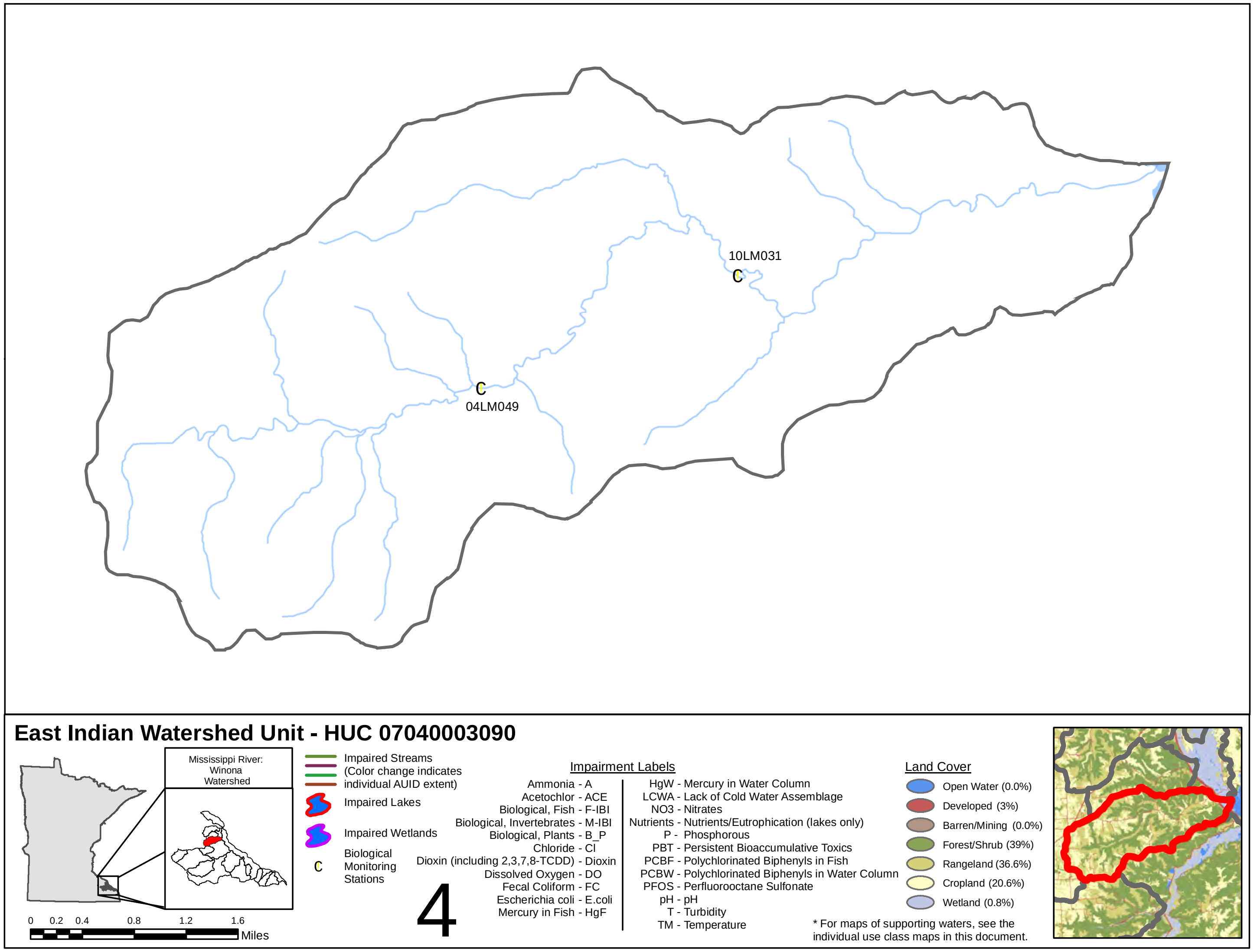

Figure 20. Currently listed impaired waters by parameter and land use characteristics in the East Indian Watershed Unit.

Mississippi River Direct Watershed Unit HUC 07040003100

Mississippi River Direct Watershed Unit is the smallest subwatershed in the Mississippi River (Winona) Watershed, covering only 7.5 mi^2 of Wabasha County, serving as a link to the Mississippi River for both the Snake and Gorman Creek subwatersheds. Due to its small nature, and wetland dominance (49%), no monitoring stations were placed within the watershed and no data was available for assessment. Figure 21 provides additional spatial context of the subwatershed.

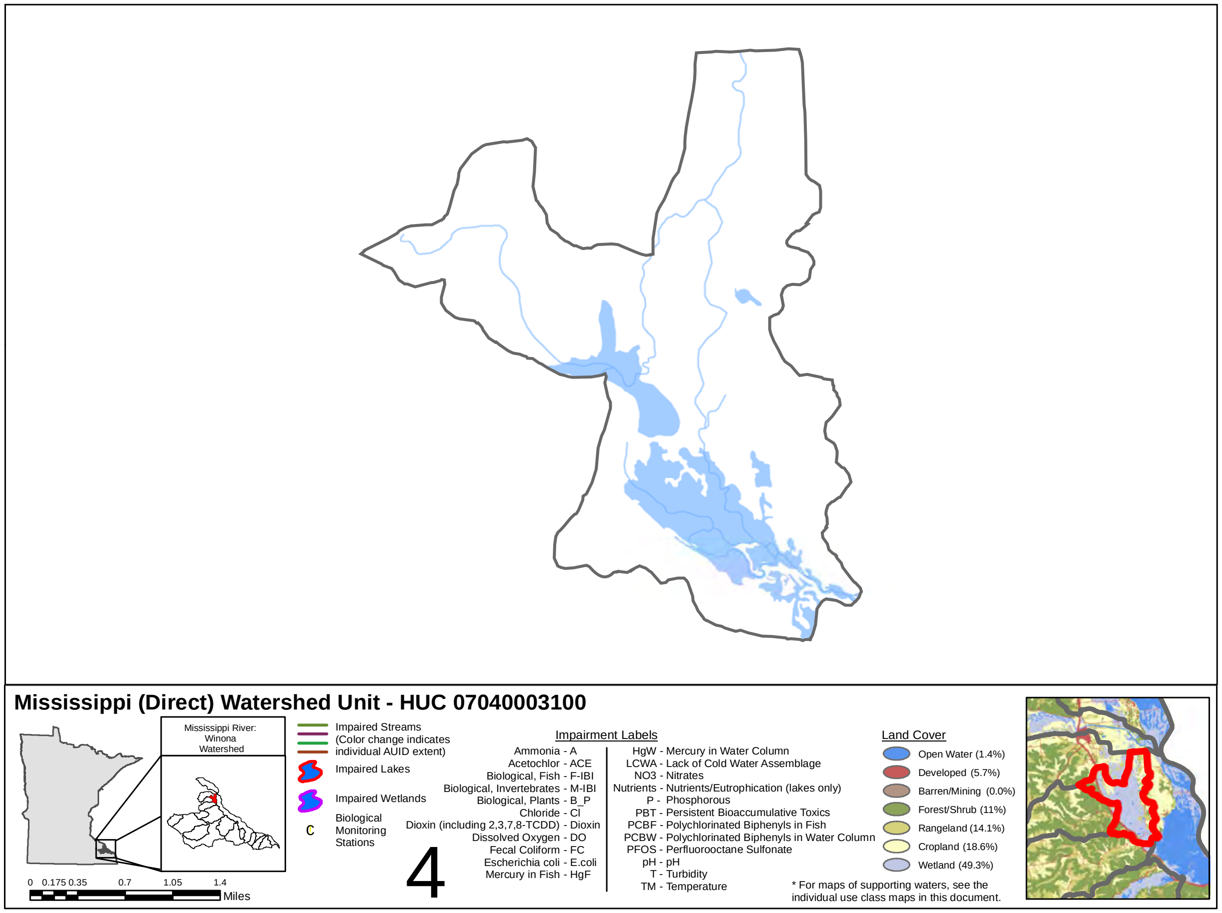

Figure 21. Currently listed impaired waters by parameter and land use characteristics in the Mississippi River Direct Watershed Unit.

Whitewater River, North Branch Watershed Unit HUC 07040003120

The Whitewater River's north branch subwatershed encompasses 80 mi^2 of northern Olmsted and southwestern Wabasha counties. Eighty percent of the subwatershed is managed for agricultural landuse (cropland 50% and rangeland 30%). Only five percent of the subwatershed's landscape remains forested. Ninety-five percent of the subwatershed's landscape is held in private ownership while the rest is owned by the state. The Whitewater River's North Branch begins two miles south of Viola and flows north; the stream is then fed by the Dry Creek Subwatershed from the west and continues east past Carley State Park. The North Branch is then joined by Logan Creek in Whitewater State Wildlife Management Area two miles northwest of Kingsley Corner, and ends by joining the Whitewater's south and middle forks in Elba. The subwatershed's outlet is represented by water quality station 10LM003. No lakes are present within the watershed.

Table 11. Aquatic Life and Recreation assessments on stream reaches: Whitewater River, North Branch Watershed Unit. Reaches are organized upstream to downstream in the table.

AUID *Reach Name,* *Reach Description*	Reach Length (miles)	Use Class	Biological Station ID	Location of Biological Station	Aquatic Life Indicators: Fish IBI	Invert IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides	Bacteria	Aquatic Life	Aquatic Rec.
07040003525 ***Whitewater River, North Fork,*** *Headwaters to T108 R12W S34, north line*	9.28	2B, 3C	04LM005	Downstream of Silver Creek Rd NE, 1 mi. S of Viola	MTS	EXP	IF	IF	–	IF	–	–	–	IF**	NA
07040003524 ***Whitewater River, North Fork,*** *T108 R12W S27, south line to T108 R12W S25, east line*	5.84	7	04LM135 04LM136	Downstream of Hwy 42, in Elgin @ CR 73 crossing, ~1.5 mi. E of Elgin	NA	NA	–	–	–	–	–	–	–	NA*	NA
07040003553 ***Whitewater River, North Fork,*** *T108 R11W S30, west line to Unnamed cr*	7.91	1B, 2A, 3B	10LM035 10LM010	Upstream of Twp Rd 244, 2.5 mi. E of Elgin 0.5 mi. upstream of CSAH 4, 3 mi. S of Plainview, in Carley State park	EXS	EXS	IF	EXS	–	IF	–	–	EX	NS	NS
07040003526 ***Unnamed Creek*** *Unnamed cr to N Fk Whitewater R*	3.61	7	10LM036	Downstream of CSAH 25, 2 mi. SE of Plainview	NA	NA	–	–	–	–	–	–	–	NA*	NA
07040003536 ***Logan Branch,*** *Headwaters to T107 R11W S4, east line*	10.67	2B, 3C	10LM011	0.25 mi. E of CSAH 10, 4.5 mi. S of Plainview	MTS	MTS	IF	EXS	–	IF	–	–	EX	NS	NS
07040003552 ***Logan Branch,*** Unnamed cr to N Fk Whitewater R	0.55	1B, 2A, 3B	04LM127	0.5 mi. S of 72nd St NE, in Whitewater State WMA, 6 mi. W of Elba	MTS	MTS	IF	IF	–	IF	–	–	--	FS	NS
07040003554 ***Whitewater River, North Fork,*** *Unnamed cr to M Fk Whitewater* **R**	11.37	1B, 2A, 3B	10LM003	Upstream of Elba Twp Rd 16, 2.5 mi. W of Elba	MTS	MTS	IF	EXP	MTS	MTS	MTS	MTS	EX	NS	NS

Abbreviations for Indicator Evaluations: – = No Data, **NA** = Not Assessed, **IF** = Insufficient Information, **MTS** = Meets criteria; **EXP** = Exceeds criteria, potential impairment; **EXS** = Exceeds criteria, potential severe impairment; **EX** = Exceeds criteria (Bacteria).
Abbreviations for Use Support Determinations: **NA** = Not Assessed, **IF** = Insufficient Information, **NS** = Non-Support, **FS** = Full Support
Key for Cell Shading: ☐ = existing impairment, listed prior to 2012 reporting cycle; ☐ = new impairment; ☐ = full support of designated use.
*Aquatic Life assessment and/or impairments have been deferred until the adoption of Tiered Aquatic Life Uses due to the AUID being predominantly (>50%) channelized or having biological data limited to a station occurring on a channelized portion of the stream.
**Aquatic Life assessment and/or impairments have been deferred until the adoption of Tiered Aquatic Life Uses due to the AUID being predominantly (>50%) channelized while the biological station occurred on a natural reach within the channelized AUID.

Table 12. Non-assessed biological stations on channelized AUIDs: Whitewater River, North Branch 11-HUC.

AUID ***Reach Name,*** *Reach Description*	**Reach length (miles)**	**Use Class**	**Biological Station ID**	**Location of Biological Station**	**Fish IBI**	**Invert IBI**
07040003525 ***Whitewater River, North Fork,*** *Headwaters to T108 R12W S34, north line*	9.28	2B, 3C	10EM059	Downstream of CSAH 2, 1 mi. S of Elgin	Good	Good
07040003524 ***Whitewater River, North Fork,*** *T108 R12W S27, south line to T108 R12W S25, east line*	5.84	7	04LM135 04LM136	Downstream of Hwy 42, in Elgin @ CR 73 crossing, ~1.5 mi. E of Elgin	Good	Poor(3)
07040003526 ***Unnamed Creek*** *Unnamed cr to N Fk Whitewater R*	5.80	7	10LM036	Downstream of CSAH 25, 2 mi. SE of Plainview	Good	Good

See Appendix 5.1 for clarification on the good/fair/poor thresholds and Appendix 5.2 and Appendix 5.3 for IBI results. Parentheses behind ratings indicate the quantity of site visits when >1, which may or may not occur in the same year.

Table 13. Minnesota Stream Habitat Assessment (MSHA): Whitewater River, North Branch 11-HUC.

# Visits	Biological Station ID	Reach Name	Land Use (0-5)	Riparian (0-15)	Substrate (0-27)	Fish Cover (0-17)	Channel Morph. (0-36)	MSHA Score (0-100)	MSHA Rating
2	04LM005	Whitewater River, North Fork	1	4.5	21.6	10	24.5	61.6	Fair
1	10EM059	Whitewater River, North Fork	0	9.5	10	6	16	41.5	Poor
2	04LM135	Whitewater River, North Fork	0	7.8	13.5	4	13	38.3	Poor
1	10LM035	Whitewater River, North Fork	0	13.5	15.1	14	25	67.6	Good
1	10LM010	Whitewater River, North Fork	5	12.5	21.1	12	33	83.6	Good
1	10LM036	Trib. To Whitewater River, North Fork	0	8	17.3	16	20	61.3	Fair
1	10LM011	Logan Branch	5	13	13.2	13	22	66.2	Good
1	04LM127	Logan Branch	2.5	12.5	22.2	13	27	77.2	Good
2	10LM003	Whitewater River, North Fork	3.9	11.3	22	13	34	84.1	Good
1	04LM136	Whitewater River, North Fork	0	5	16	5	20	46	Fair
		Average Habitat Results: *Whitewater River, North Branch 11 HUC*	**1.7**	**9.8**	**17.2**	**10.6**	**23.5**	**62.7**	**Fair**

Qualitative habitat ratings

- = Good: MSHA score above the median of the least-disturbed sites (MSHA>66)
- = Fair: MSHA score between the median of the least-disturbed sites and the median of the most-disturbed sites (45 < MSHA < 66)
- = Poor: MSHA score below the median of the most-disturbed sites (MSHA<45)

Table 14. Channel Condition and Stability Assessment (CCSI): Whitewater River, North Branch 11

# Visits	Biological Station ID	Stream Name	Upper Banks (4-43)	Lower Banks (5-46)	Substrate (3-37)	Channel Evolution (1-11)	CCSI Score (13-137)	CCSI Rating
1	10EM059	Whitewater River, North Fork	19	17	28	3	67	moderately unstable
1	04LM135	Whitewater River, North Fork	13	9	24	3	49	moderately unstable
1	10LM035	Whitewater River, North Fork	13	15	10	3	41	fairly stable
1	10LM010	Whitewater River, North Fork	11	17	8	3	39	fairly stable
1	10LM036	Trib. To Whitewater River, North Fork	22	15	10	3	50	moderately unstable
1	10LM011	Logan Branch	9	15	8	3	35	fairly stable
1	10LM003	Whitewater River, North Fork	11	13	6	1	31	fairly stable
		Average Stream Stability Results: *Whitewater River, North Branch 11 HUC*	**14**	**14.4**	**13.4**	**2.7**	**44.8**	**fairly stable**

Qualitative channel stability scores and ratings (Higher scores indicate greater channel instability)

= stable: CCSI < 27 = fairly stable: 27 < CCSI < 45 = moderately unstable: 45 < CCSI < 80 = severely unstable: 80 < CCSI < 115 = extremely unstable: CCSI > 115

Table 15. Outlet water chemistry results: Whitewater River, North Branch 11-HUC.

Station location:	**Whitewater River, North Branch, 0.1.5 mi. W of Twp Rd 16, 2.2 mi W of Elba**
STORET/EQuIS ID:	**S000-451**
Station #:	**10LM003**

Parameter	Units	# of Samples	Minimum	Maximum	Mean	Median	WQ Standard[1]	# of WQ Exceedances[2]
Ammonia-nitrogen	mg/L	10	<0.05	<0.05	<0.05	<0.05	0.04	0
Chloride	mg/L	10	16	18	17	17	230	0
Dissolved Oxygen (DO)	mg/L	42	5.8	14.0	10.1	10.4	5	3
Escherichia coli	MPN/100ml	21	9	7270	950	108	126/1260	4
Inorganic nitrogen (nitrate and nitrite)	mg/L	47	1.8	7.6	5.3	5.1		
Kjeldahl nitrogen	mg/L	10	0.3	0.8	0.5	0.4		
pH		17	8.1	9.6	8.4	8.4	6.5 - 9	0
Phosphorus	ug/L	47	0.05	2.5	0.27	0.13		
Specific Conductance	uS/cm	17	553	642	592	589		
Temperature, water	deg °C	52	9.1	21.5	16.7	17.3		
Total suspended solids	mg/L	47	2	2000	105	10	60	7
Total suspended volatile solids	mg/L	47	1	210	13	2		
Transparency tube	cm	61	1	>100	66	92	>20	
Sulfate	mg/L	10	12	15	14	14		
Hardness	mg/L	10	290	340	309	310		

[1]Total suspended solids and Transparency tube standards are surrogate standards derived from the turbidity standard of 25.
[2]Represents exceedances of individual maximum standard for E. coli (1260/100ml) or fecal coliform.
****Data found in the table above was compiled using the results from data collected at the outlet monitoring station in the Whitewater River, North Branch 11 HUC, a component of the IWM work conducted between May and September in 2010 and 2011. This specific data does not necessarily reflect all data that was used to assess the AUID.**

Summary

Assessable stream water quality data uphold existing impairments for both bacteria and turbidity across much of the North Branch Whitewater subwatershed. In contrast, biological condition varies; upper reaches show more variability in Macroinvertebrate Index of Biotic Integrity (MIBI) score, which is likely associated with a higher proportion of channelized streams, agricultural landuse and limited habitat. Closer to the mouth, the riparian area becomes predominately forested, and habitat improves resulting in higher MIBI scores. In contrast, fish impairment is localized to the central region. This may be attributed to thermal transition from warm to coldwater as well as poor habitat and anthropogenic stressors. Fish community results in the upper warm and lower cold reaches of the subwatershed are the best seen across the Whitewater, despite evident anthropogenic stress in the headwaters, and warrant additional protection. Temporal results appear consistent across years sampled (2004 and 2010). Nitrogen levels are highest in the upper reaches of the North Branch Whitewater River (04LM005: 15mg/L at upstream most biological station) and decrease moving down the subwatershed (4.8 mg/L at 10LM003). It is likely that decreasing levels observed are a result of increased flow from springs in the watershed rather than a result of improved condition. Nitrate levels are likely negatively impacting macroinvertebrate communities. Feedlots are also prevalent in the watershed; several large feedlots in the central region may also be contributing to observed bacterial and biotic impairments. CCSI results show in increasing trend in stability moving downstream in the watershed consistent with increasing levels of gradient seen in the downstream reaches. Human disturbance percentages in the subwatershed are consistently above 50%. The lowest disturbances were seen on biological stations on Logan Branch, while the highest levels of disturbance were seen on the North Branch of the Whitewater River at biological station 04LM136. MSHA scores are fair to good across all stations except the Class 7 (limited resource value water) reach but do not show any longitudinal relationships. Lower scores were predominately related to sedimentation concerns.

The invertebrate and fish communities in the upper reaches of the watershed show some coldwater characteristics, despite having a warmwater designation; this is supported by coldwater temperatures. Streams that are transitional between cold and warmwater can have community characteristics of both stream types, resulting in an imperfect fit for IBI classification and calculation. Thus monitoring has presented MIBI scores that are somewhat variable when compared to associated land use, habitat and water quality conditions. A change in classification from warm to coldwater in the upper reaches would result in more impairment results throughout the watershed. Downstream, improved riparian zones and instream habitat is reflected in a healthier coldwater community more indicative of coldwater streams in this region. Additional monitoring is recommended to better distinguish thermal character across the North Branch Whitewater's reaches to better classify the stream. Macroinvertebrate communities would also likely benefit from measures to control nitrogen in the watershed.

North Branch Whitewater

07040003525, *Headwaters to T108R12W S34 north line*
Biological results from the warmwater headwaters segment of the North Branch Whitewater River were not assessed due to a majority of the reach (55.9%) being modified consistent with channelization. Despite this, fish communities perform above thresholds for equivalent natural streams. Brown trout were sampled at the downstream reach which indicates potential disparities in use class designation. Average July temperatures of 14.8 C further indicate coldwater potential. Historical MDNR surveys indicate that this reach could be an important coldwater feeder. Additional thermal monitoring would better classify the thermal regime of this headwater system and designate the appropriate use class. Habitat results follow fish IBI score patterns, decreasing moving downstream, contrary to observed macroinvertebrate results which improved and elevated above standards moving downstream. Low invertebrate scores may be impacted by high nitrate levels observed during the biological visit (15 mg/L).

07040003524, *T108 R12WS27, south line to T108 R12W S25, east line*
The next downstream biological sample was not assessed because the AUID is a channelized Class 7 (limited resource value waters) reach, thus biocriteria are not applicable. Despite this designation, fish IBI scores are above the upper confidence interval for equivalent natural streams. Two macroinvertebrate visits demonstrated decreasing quality well below lower confidence limits for equivalent natural streams when comparing the 2004 and 2010 visits. Habitat conditions are homogenous at the site (100% run) with predominately fine (clay/sand) substrates and little instream cover. The Class 7 use designation should be reconsidered as a wastewater discharger is no longer contributing effluent to the North Fork at this reach.

07040003553, *T108 R11W S30, west line to unnamed creek*
Downstream of the Class 7 AUID and Dry Creek's confluence with the North Branch Whitewater River, use class designation changes from warm to coldwater. Current E. coli data supports previous fecal listing (2002) based on greater than 10% individual exceedances and current turbidity data also

supports previous listing (2002). E. coli and turbidity data corroborate current impairments for aquatic life based on fish and invertebrate results from 2010 monitoring. Upstream site (immediately below the Class 7 reach) scores are below the threshold and within lower the confidence interval, while the downstream site scores above the threshold and within the upper confidence interval, demonstrating localized impairment upstream. The fish community at the upstream site shows strong signals of degradation due to increased water temperature. Although some coldwater species are still present (including trout), warmwater and tolerant fish species are abundant and populations are highly skewed (dominated by individuals of one or two species). July average instream temperatures were around 20° C for both sites indicating thermal stress. Macroinvertebrates performed poorly at both stations (below lower confidence intervals) and communities are only marginally characteristic of coldwater systems. Although both stations have very good habitat availability, there is a lot of fine sediment accumulating on hard substrates in areas of low velocity. This area is likely a transitional zone between warm and coldwater use classes and will require additional information to determine appropriate classification.

07040003554, *Unnamed Cr to M Fk Whitewater R*

The North Branch Whitewater River's cold character becomes more evident after Logan Branch's confluence. While current turbidity and E. coli exceedances support previously listed impairments for aquatic life and recreation, fish, invertebrates, chloride and ammonia results all meet their respective standards. Samples for both biological indicators perform well above upper confidence limits and are characteristic of healthy coldwater communities. The fish community is nearly ideal for a large coldwater stream; trout, sculpin, and coldwater sensitive taxa were present and abundant. High Dissolved Oxygen (DO) levels observed at this station were noted but IBI scores above biocriteria suggest that no additional follow up monitoring is necessary. Habitat is also exceptional at the station, showing only minor concerns regarding fine sediment and bank erosion.

Logan Branch, **07040003536,** *Headwater to T107 R11W S4, east line*, **07040003552,** *Unnamed cr to N Fk Whitewater R*

Logan Branch enters the North Branch Whitewater River in the downstream reaches of the watershed. This reach was previously listed as impaired due to high levels of fecal coliform and turbidity. Recent E. coli and turbidity data support previous listings. Its headwaters are warmwater and transition to coldwater downstream of 10LM011 after being joined by spring fed tributaries. Both fish and invertebrates performed well above standards at both stations. Results are in agreement with good habitat conditions observed. However, sedimentation and abundance of fine sediments at the upper reach are a concern and may be linked to agricultural land use upstream. The high quality resource of Logan Branch is likely supporting coldwater communities observed in the downstream reaches of the North Branch Whitewater River.

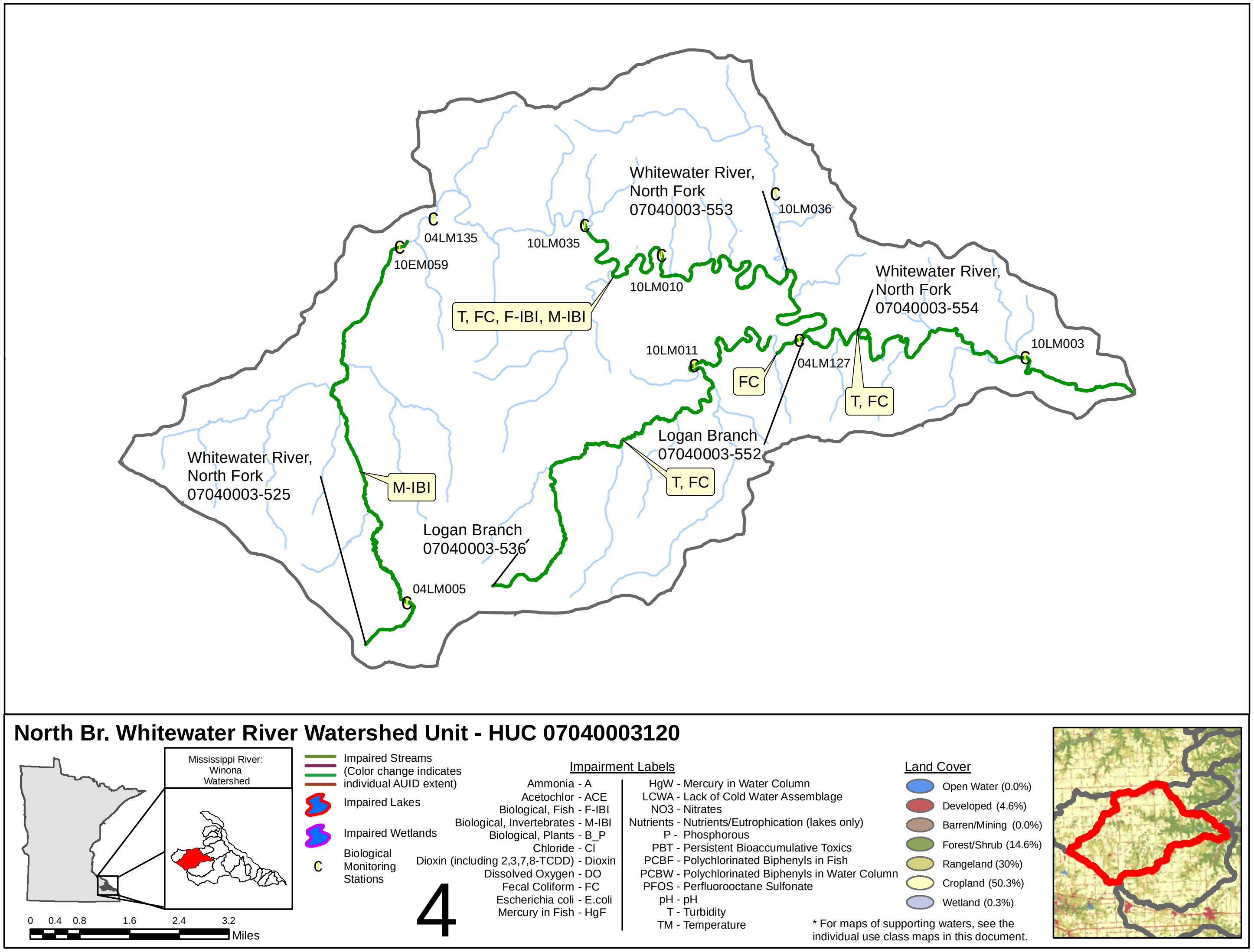

Figure 22. Currently listed impaired waters by parameter and land use characteristics in the Whitewater River, North Branch Watershed Unit.

Whitewater River, Middle Branch Watershed Unit HUC 07040003130

Centrally located in the heart of the Mississippi River (Winona) watershed, the Middle Branch of the Whitewater subwatershed is predominately rural in character. Over 80% of its land use is tied to agricultural production (cropland 54% and rangeland 28%). The upper 12 miles of the Middle Fork, extending from the headwaters to Crow Spring, is classified as a warmwater habitat. The 13 mile downstream AUID extending from Crow Spring to the South Fork of the Whitewater River is classified as a coldwater habitat**.** The Middle Branch Whitewater River originates in eastern Olmsted county one mile northeast of Eyota and flows in a northeasterly direction. The river flows through Whitewater State Park where it is joined by Trout Run and converges with the Whitewater's north and south branches near Elba in western Winona County. The subwatershed's outlet is represented by water quality station 10LM002 on the Whitewater River, Middle Branch. No lakes are present within the watershed.

Table 16. Aquatic Life and Recreation assessments on stream reaches: Whitewater River, Middle Branch Watershed Unit. Reaches are organized upstream to downstream in the table.

AUID *Reach Name,* *Reach Description*	Reach Length (miles)	Use Class	Biological Station ID	Location of Biological Station	Aquatic Life Indicators: Fish IBI	Invert IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides	Bacteria	Aquatic Life	Aquatic Rec.
07040003515 ***Whitewater River, Middle Fork,*** *Headwaters to T107 R11W S34, east line*	9.56	2B, 3C	10LM008	Upstream of CSAH 10, 3.5 mi. N of Dover	EXP	EXS	IF	EXS	–	IF	–	–	EX	NS	NS
07040003F18 ***Whitewater River, Middle Fork,*** *T107 R11W S35, west line to Crow Spring*	1.56	1B, 2A, 3B	04LM035	Upstream of CR 107 NE, 4 mi. NW of St. Charles	MTS	MTS	IF	IF	–	IF	–	–	IF	FS	IF
07040003610 ***Crow Spring (Middle Fork Whitewater River Tributary),*** *T106 R11W S10, west line to Unnamed cr*	2.26	1B, 2A, 3B	04LM128	Downstream of CSAH 39 (10th St SE), 5 mi. NE of Eyota	MTS	EXP	IF	IF	–	IF	–	–	–	IF**	NA
07040003611 ***Crow Spring (Middle Fork Whitewater River Tributary),*** *Unnamed cr to M Fk Whitewater R*	2.03	1B, 2A, 3B	10LM009	Upstream of CSAH 9, 4.5 mi. NW of St Charles	MTS	EXS	IF	IF	–	IF	–	–	EX	NS	IF
07040003F19 ***Whitewater River, Middle Fork,*** *Crow Spring to N Fk Whitewater R*	11.39	1B, 2A, 3B	10LM037 10LM007 10LM002	Upstream of CR 107 NE, 5 mi. NW of St. Charles Downstream of unnamed road in Whitewater State Park, 5.5 mi. N of St Charles Downstream of Hwy 74, 8 mi. N of St. Charles	MTS	EXP	IF	EXS	MTS	EXP	MTS	MTS	EX	NS	NS
07040003576 ***Trout Run - Whitewater Park,*** *T107 R10W S29, south line to Whitewater R*	1.89	1B, 2A, 3B	04LM101	0.5 mi. E of Hwy 74, in Whitewater State Park, 1 mi. S of Elba	MTS	MTS	IF	IF	–	IF	–	–	–	FS	NA

Abbreviations for Indicator Evaluations: – = No Data, **NA** = Not Assessed, **IF** = Insufficient Information, **MTS** = Meets criteria; **EXP** = Exceeds criteria, potential impairment; **EXS** = Exceeds criteria, potential severe impairment; **EX** = Exceeds criteria (Bacteria).
Abbreviations for Use Support Determinations: **NA** = Not Assessed, **IF** = Insufficient Information, **NS** = Non-Support, **FS** = Full Support
Key for Cell Shading: = existing impairment, listed prior to 2012 reporting cycle; = new impairment; = full support of designated use.
**Aquatic Life assessment and/or impairments have been deferred until the adoption of Tiered Aquatic Life Uses due to the AUID being predominantly (>50%) channelized while the biological station occurred on a natural reach within the channelized AUID.

Table 17. Minnesota Stream Habitat Assessment (MSHA): Whitewater River, Middle Branch 11-HUC.

# Visits	Biological Station ID	Reach Name	Land Use (0-5)	Riparian (0-15)	Substrate (0-27)	Fish Cover (0-17)	Channel Morph. (0-36)	MSHA Score (0-100)	MSHA Rating
1	10LM008	Whitewater River, Middle Fork	0	4	7.8	12	14	37.8	Poor
1	04LM035	Whitewater River, Middle Fork	5	14	21.2	8	21	69.2	Good
1	04LM128	Crow Spring	0	4	19.6	7	23	53.6	Fair
1	10LM009	Crow Spring	3	11	13	12	19	58	Fair
1	10LM037	Whitewater River, Middle Fork	2.5	9.5	19.6	13	33	77.6	Good
2	10LM007	Whitewater River, Middle Fork	5	11.8	24.2	12	35	88.0	Good
1	04LM101	Trout Creek	5	12	18.2	13	33	81.2	Good
2	10LM002	Whitewater River, Middle Fork	5	12.3	20.9	12	29.5	79.6	Good
Average Habitat Results: *Whitewater River, Middle Branch 11 HUC*			**3.2**	**9.8**	**18.1**	**11.1**	**25.9**	**68.1**	**Good**

Qualitative habitat ratings
= Good: MSHA score above the median of the least-disturbed sites (MSHA>66)
= Fair: MSHA score between the median of the least-disturbed sites and the median of the most-disturbed sites (45 < MSHA < 66)
= Poor: MSHA score below the median of the most-disturbed sites (MSHA<45)

Table 18. Channel Condition and Stability Assessment (CCSI): Whitewater River, Middle Branch 11 HUC.

# Visits	Biological Station ID	Stream Name	Upper Banks (4-43)	Lower Banks (5-46)	Substrate (3-37)	Channel Evolution (1-11)	CCSI Score (13-137)	CCSI Rating
1	10LM008	Whitewater River, Middle Fork	27	17	20	3	67	moderately unstable
1	10LM009	Crow Spring	15	15	11	3	43	fairly stable
1	10LM037	Whitewater River, Middle Fork	12	11	6	1	30	fairly stable
1	10LM007	Whitewater River, Middle Fork	10	13	6	1	30	fairly stable
1	10LM002	Whitewater River, Middle Fork	11	17	16	1	45	moderately unstable
Average Stream Stability Results: *Whitewater River, Middle Branch 11 HUC*			**15**	**14.6**	**11.8**	**1.8**	**43**	**fairly stable**

Qualitative channel stability scores and ratings (Higher scores indicate greater channel instability)
= stable: CCSI < 27 = fairly stable: 27 < CCSI < 45 = moderately unstable: 45 < CCSI < 80 = severely unstable: 80 < CCSI < 115 = extremely unstable: CCSI > 115

Table 19. Outlet water chemistry results: Whitewater River, Middle Branch 11-HUC.

Station location:	Whitewater River, Middle Branch, At MN 74 in Elba							
STORET/EQuIS ID:	S001-825							
Station #:	10LM002							
Parameter	**Units**	**# of Samples**	**Minimum**	**Maximum**	**Mean**	**Median**	**WQ Standard[1]**	**# of WQ Exceedances[2]**
Ammonia-nitrogen	mg/L	10	<0.05	<0.05	<0.05	<0.05		
Chloride	mg/L	10	15	17	15	15	230	0
Dissolved Oxygen (DO)	mg/L	17	8.5	14.1	10.8	11.2	5	0
Escherichia coli	MPN/100ml	24	11	9060	876	86	1260	7
Inorganic nitrogen (nitrate and nitrite)	mg/L	10	5.5	7.6	6.5	6.5		
Kjeldahl nitrogen	mg/L	10	<0.03	1.0	0.5	0.4		
pH		17	7.9	9.6	8.5	8.4	6.5 - 9	1
Phosphorus	ug/L	10	0.03	0.22	0.07	0.05		
Specific Conductance	uS/cm	17	532	607	565	562		
Temperature, water	deg °C	21	12.9	20.1	17.7	17.5		
Total suspended solids	mg/L	13	1	60	11	4	60	
Total volatile solids	mg/L	10	1	7	2	1		
Transparency tube	100 cm	52	20	>100	89	100	>20	0
Sulfate	mg/L	10	14	16	15	16		
Hardness	mg/L	10	288	330	299	300		

[1]Total suspended solids and Transparency tube standards are surrogate standards derived from the turbidity standard of 25.
[2]Represents exceedances of individual maximum standard for E. coli (1260/100ml) or fecal coliform.
****Data found in the table above was compiled using the results from data collected at the outlet monitoring station in the Whitewater River, Middle Branch 11 HUC, a component of the IWM work conducted between May and September in 2010 and 2011. This specific data does not necessarily reflect all data that was used to assess the AUID.**

Summary

Assessable stream water quality data were available on four AUIDs of the Middle Fork White Water River totaling 25 miles. The headwaters reach of the Middle Branch is universally degraded, exhibiting the worst condition for invertebrates, fish, E. coli, habitat and morphological condition observed within the subwatershed. It is reflective of the poor conditions in the adjacent landscape including intense agricultural landuse. Recently assessed data confirms the existing turbidity impairment (2008). High nitrate levels were also observed across the watershed ranging from 5.6 mg/L to 9.4 mg/L. Nitrogen levels increase moving downstream on the Middle Fork Whitewater with highest levels observed in the central part of the subwatershed, including the Crow Spring tributary and downstream of its confluence to just before Trout Creek's confluence. High nitrates prompted a drinking water use impairment in the downstream segment of the Middle Fork and likely contribute stress to invertebrate communities across the watershed. A high DO reading of 14.1 mg/L at the intensive water chemistry station in Elba may indicate potential nutrient enrichment concerns; additional continuous DO monitoring is recommended to better understand diurnal DO flux.

Contrary to the impairments observed in upstream reaches of the Middle Fork, fish communities in the remainder of the watershed were excellent, exhibiting some of the highest IBI scores observed in the entire Mississippi River (Winona) watershed. Habitat quality was also very good across the remainder of the Middle Branch and sites were noted to be fairly stable morphologically. Measures should be taken to maintain the high quality of the coldwater fishery of the Middle Branch. Additional thermal investigations could provide a clearer picture to true thermal condition or thermal degradation in the watershed.

Middle Branch Whitewater River

07040003515, *Headwaters to T107 R11W S34, east line*

This section of the headwaters of the Middle Fork Whitewater River was classified as coldwater, but was changed to warmwater after talks with MDNR staff who described the thermal regime as being a transitional zone best represented by warmwater standards. This AUID is severely degraded compared to downstream reaches; an assessment of non-support was made for both aquatic recreation and aquatic life uses due to high E. coli and turbidity levels and poor biological communities, dominated by tolerant taxa. Station 10LM008, lacks a riparian zone and has very little instream habitat resulting in scores well below the threshold. Stressors to the biological community include adverse habitat conditions including cattle access to stream, bank erosion, dominance of silt substrates and severely embedded coarse substrates.

07040003F18, *T107 R11W S35, west line to Crow Spring*

This segment is a split from retired parent AUID (07040003-514); previous impairments on this AUID were not carried forward to this segment as listing data was from stations located on the portion of the AUID associated with 07040003-F19. The split is related to a proposed use class change from coldwater to warmwater (2B). The southern headwater fish IBI has been applied to data for assessment. Fish and invertebrate data indicate supporting conditions for aquatic life benefiting from an intact riparian zone and diverse habitat. The fish community is well balanced and includes sufficient numbers of individuals and taxa of sensitive species. Tolerant individuals and taxa appear considerably less than at the upstream station. The macroinvertebrate community is relatively healthy with some indications of coldwater influence; however, quantities of potentially tolerant midges may indicate stress.

07040003F19, *Crow Spring to N Fk Whitewater R*

The existing fecal coliform, nitrate, and turbidity impairments from the now-retired parent AUID (07040003-514) were carried forward to this AUID (07040003-F19) as original listing data for turbidity (transparency tube), nitrate and fecal coliform both came from stations on this AUID. Macroinvertebrate, bacteria and turbidity results show impaired condition moving down the Middle Branch despite excellent fish communities. The invertebrate community reflects what appears to be a subtle change in temperature regime. The community shows strong, healthy coldwater characteristics at the upper (10LM037) and lower (10LM002) reaches, with a warmwater signal in the middle reaches (10LM007). The upper and lower site score above the coldwater threshold, while the middle reach scores below the threshold. If scored using warmwater criteria, the middle reach would score well above the threshold, as it has a very diverse and abundant Ephemeroptera, Plecoptera and Trichoptera (EPT) community. The increase in diversity can indicate a degrading coldwater condition, but the excellent fish IBI scores (79-90) suggest otherwise. The macroinvertebrate community at this station had a large number of tolerant taxa (snails, Diptera) and lacks the quantity of coldwater taxa expected, indicating stress. Relatively high levels of nitrogen were also recorded during the fish visit (8.6 mg/L) and may be potentially stressing invertebrate biota as habitat conditions are not likely causing stress.

Crow Spring – 07040003610, *T106 R11W S10, west line to unnamed cr ,* **07040003611,** *Unnamed cr to Middle Fk Whitewater R*

Crow Spring enters the Middle Branch Whitewater River between AUIDs 07040003-F18 and 07040003-F19. Biological assessments for the upstream reach of Crow Spring were deferred due to a majority of the reach (55%) being modified consistent with channelization. The downstream reach was assessed as non-supporting of aquatic life based on low invertebrate IBI scores. The invertebrate community degrades moving downstream on Cold Spring; while the community includes coldwater taxa, it lacks sufficient EPT and sensitive taxa. Large quantities of snails were also sampled indicating a stressed community. High nitrogen levels (10 mg/L) were measured during the fish visit at both stations and may indicate a potential stressor. Pasture in the riparian zone, lack of adequate shade and instream cover, erosion and sedimentation may also be stressing the upstream macroinvertebrate community. The predominance of fine sediments, lack of complex channel development and light embeddedness of coarse substrates may be influencing the macroinvertebrate community at the downstream station. In contrast, the fish IBI performs well above upper confidence intervals at both stations. Fish communities of Crow Spring are considered nearly ideal for small cold headwater streams dominated by brook trout, sculpin and brown trout, and have undeniably benefitted from habitat improvement projects evident throughout the reach.

Trout Run – 07040003576, *T107 R10W S29, south line to Whitewater R*

Trout run enters the Middle Branch Whitewater River near its downstream reaches and is a model example of a healthy coldwater system in the Whitewater River drainage, reflective both of natural landuse and little anthropogenic stress observed in the watershed. Biological visits at 04LM101 in 2004 indicated support of aquatic life use based on both fish and invertebrate assemblages. Both assemblages show a characteristic coldwater signature; slimy sculpin, brook and brown trout and are supported by an excellent habitat condition (MSHA = 81.2) with only minor sedimentation and erosion issues observed. Extra protection measures are warranted for Trout Run to maintain its high quality.

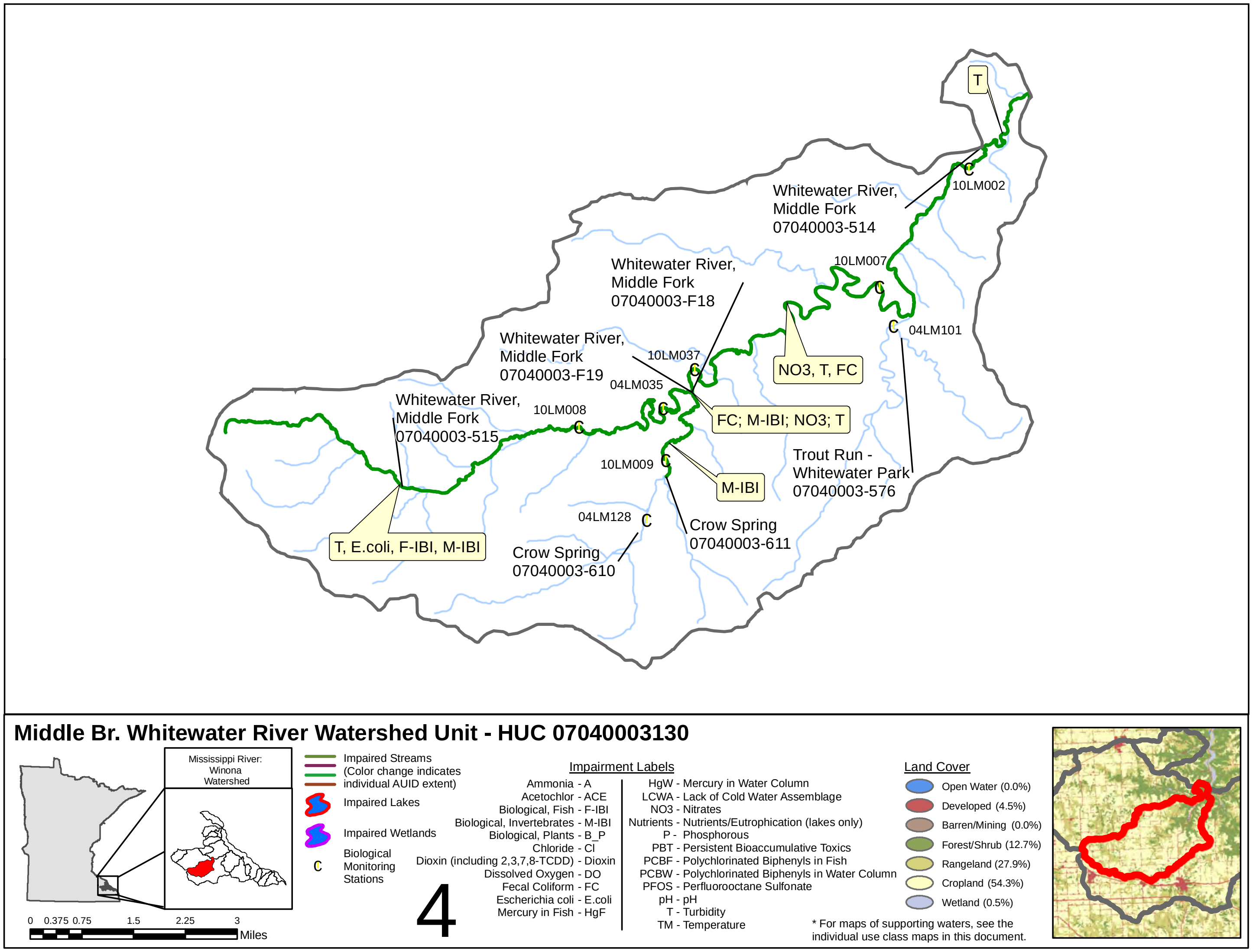

Figure 23. Currently listed impaired waters by parameter and land use characteristics in the Whitewater River, Middle Branch Watershed Unit.

Dry Creek Watershed Unit HUC 07040003110

The Dry Creek Subwatershed drains 24 mi^2 of rural farmland (73% cropland and 19% rangeland) in the headwaters of the North Branch of the Whitewater River. Dry Creek starts 56 miles northeast of Rochester, near the border of Olmstead and southeastern Wabasha counties. It flows in a northeasterly direction, then parallels CSAH 25 before entering the community of Elgin where it joins the Whitewater River's north branch. Due to its small drainage, MPCA did not establish a stream water chemistry station at the outlet of Dry Creek. No lakes are present within the watershed.

Table 20. Aquatic Life and Recreation assessments on stream reaches: Dry Creek Watershed Unit.

AUID *Reach Name,* *Reach Description*	Reach Length (miles)	Use Class	Biological Station ID	Location of Biological Station	Aquatic Life Indicators: Fish IBI	Invert IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides	Bacteria	Aquatic Life	Aquatic Rec.
07040003567 ***Dry Creek,*** *T108 R13W S35, south line to N Fk Whitewater R*	7.38	2C	10LM034	Downstream of CSAH 2 (4th Ave NW), 0.5 mi. N of Elgin	NA	NA	–	–	–	–	–	–	–	NA*	NA

Abbreviations for Indicator Evaluations: – = No Data, **NA** = Not Assessed, **IF** = Insufficient Information, **MTS** = Meets criteria; **EXP** = Exceeds criteria, potential impairment; **EXS** = Exceeds criteria, potential severe impairment; **EX** = Exceeds criteria (Bacteria).

Abbreviations for Use Support Determinations: **NA** = Not Assessed, **IF** = Insufficient Information, **NS** = Non-Support, **FS** = Full Support

Key for Cell Shading: ☐ = existing impairment, listed prior to 2012 reporting cycle; ☐ = new impairment; ☐ = full support of designated use.

*Aquatic Life assessment and/or impairments have been deferred until the adoption of Tiered Aquatic Life Uses due to the AUID being predominantly (>50%) channelized or having biological data limited to a station occurring on a channelized portion of the stream.

Table 21. Non-assessed biological stations on channelized AUIDs: Dry Creek 11-HUC .

AUID *Reach Name,* *Reach Description*	Reach length (miles)	Use Class	Biological Station ID	Location of Biological Station	Fish IBI	Invert IBI
07040003567 ***Dry Creek,*** *T108 R13W S35, south line to N Fk Whitewater R*	7.38	2C	10LM034	Downstream of CSAH 2 (4th Ave NW), 0.5 mi. N of Elgin	Good	Poor

See Appendix 5.1 for clarification on the good/fair/poor thresholds and Appendix 5.2 and Appendix 5.3 for IBI results.

Table 22. Minnesota Stream Habitat Assessment (MSHA): Dry Creek 11-HUC .

# Visits	Biological Station ID	Reach Name	Land Use (0-5)	Riparian (0-15)	Substrate (0-27)	Fish Cover (0-17)	Channel Morph. (0-36)	MSHA Score	MSHA Rating
1	10LM034	Dry Creek	2.5	9.5	12	11	8	43	Poor
		Average Habitat Results: Dry Creek *11 HUC*	**2.5**	**9.5**	**12**	**11**	**8**	**43**	**Poor**

Qualitative habitat ratings
- = Good: MSHA score above the median of the least-disturbed sites (MSHA>66)
- = Fair MSHA score between the median of the least-disturbed sites and the median of the most-disturbed sites (45 < MSHA < 66)
- = Poor: MSHA score below the median of the most-disturbed sites (MSHA<45)

Table 23. Channel Condition and Stability Assessment (CCSI): Dry Creek 11 HUC.

# Visits	Biological Station ID	Stream Name	Upper Banks (4-43)	Lower Banks (5-46)	Substrate (3-37)	Channel Evolution (1-11)	CCSI Score (13-137)	CCSI Rating
1	10LM034	Dry Creek	10	16	24	3	53	moderately unstable
		Average Stream Stability Results: Dry Creek *11 HUC*	**10**	**16**	**24**	**3**	**53**	**moderately unstable**

Qualitative channel stability scores and ratings (Higher scores indicate greater channel instability)

= stable: CCSI < 27 = fairly stable: 27 < CCSI < 45 = moderately unstable: 45 < CCSI < 80 = severely unstable: 80 < CCSI < 115 = extremely unstable: CCSI > 115

Summary

Dry Creek is a warmwater headwaters stream feeding the North Branch of the Whitewater River. Channelization has occurred over a majority of its length, thus preventing an assessment for aquatic life use. Biological results were marginal when compared to thresholds of natural streams of equivalent size. This may be linked to poor aquatic habitat, likely attributed to channelization including dominance of fine substrates, lack of channel development, embeddedness of coarse substrates and lack habitat for macroinvertebrate colonization. Habitat conditions are also consistent with high levels of human disturbance and the low gradient observed at the station (1.24). Potential for high nitrate levels, as indicated from a one-time nitrogen sample of 7.6 mg/L during the fish monitoring visit, may also be contributing to lackluster biological communities. While fish meet the modified thresholds for channelized streams, invertebrates perform poorly.

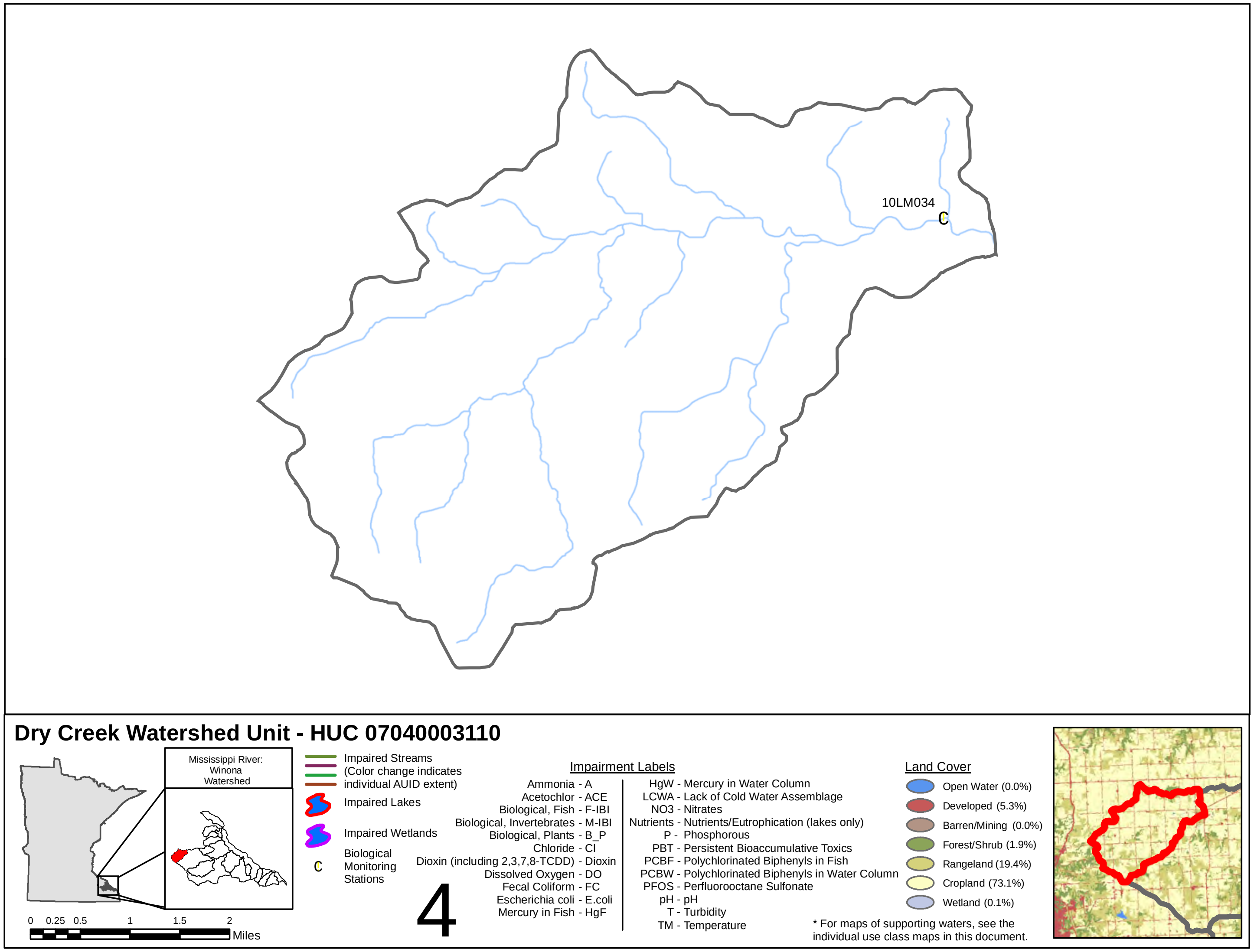

Figure 24. Currently listed impaired waters by parameter and land use characteristics in the Dry Creek Watershed Unit.

Whitewater River, South Branch Watershed Unit HUC 07040003140

The South Branch Whitewater Subwatershed stretches across western Olmsted county and eastern Winona county. The watershed's landuse is predominately agricultural at nearly 80% (49% cropland and 28% rangeland). In 1996, the South Branch supported roughly 110 feedlots producing a total of 700 tons of manure per day. As a result, the South Branch has the highest amount of manure per acre of cropland per year (6.6 tons/acre/year) when compared to other subwatersheds in the basin (Whitewater River Feedlot Analysis, 1996). In addition, 70% of the urban population of the Whitewater is located in the South Branch subwatershed in the rapidly growing communities of St. Charles, Dover and Eyota (Whitewater River Watershed Project, 2009). Thirteen percent of the watershed remains forested. The lower 12 mile AUID of the South Branch Whitewater is classified as a coldwater habitat while the upstream portion is classified as a warmwater habitat. The river begins northwest of Eyota and follows US Hwy 14 past Dover and St. Charles. From St. Charles the south branch flows northeast flowing through the 27,000 acre Whitewater State Wildlife Management Area. The river continues north merging with the North and Middle branches of the Whitewater in Elba. The watershed's outlet is represented by water quality station 10LM004 on the Whitewater River, South Branch. No lakes are present within the watershed.

Table 24. Aquatic Life and Recreation assessments on stream reaches: Whitewater River, South Branch Watershed Unit. Reaches are organized upstream to downstream in the table.

AUID *Reach Name,* *Reach Description*	Reach Length (miles)	Use Class	Biological Station ID	Location of Biological Station	Aquatic Life Indicators: Fish IBI	Invert IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides	Bacteria	Aquatic Life	Aquatic Rec.
07040003F16 ***Whitewater River, South Fork,*** *Headwaters to St Charles Twp Rd 7*	22.16	2B, 3C	10LM018 04LM020 10LM014	Upstream of CSAH 32, 2 mi. W of Dover Adjacent to Twp Rd 17, 0.5 mi. NE of St Charles Upstream of CR 119, 2.5 mi. NE of St Charles	EXP	EXP	IF	EXP	MTS	MTS	MTS	–	EX	NS	NS
07040003F15 ***Unnamed creek,*** *Unnamed cr to Unnamed cr*	0.74	2B, 3C	10LM019	Downstream of 7th St SW, 0.5 mi. S of Dover	NA	NA	–	–	–	–	–	–	–	NA*	NA
07040003F14 ***Unnamed creek,*** *Unnamed cr to S Fk Whitewater R*	0.87	2B, 3C	10LM015	Upstream of St Charles Twp Rd 18 (Green Acres Dr), 3 mi. NE of St Charles	NA	NA	–	–	–	–	–	–	–	NA*	NA
07040003F17 ***Whitewater River, South Fork,*** *St Charles Twp Rd 7 to T106 R10W S2, east line*	0.88	2B, 3C	10LM016	Downstream of St Charles Twp Rd 7, 5 mi. NE of St Charles	MTS	EXP	IF	IF	–	IF	–	–	–	NS	NA
07040003512 ***Whitewater River, South Fork,*** *T106 R10W S1, west line to N Fk Whitewater R*	12.08	1B, 2A, 3B	04LM068 04LM102 10LM012 10LM004	0.5 mi. E of St Charles Twp Rd 7, in Whitewater WMA, 6 mi. NE of St Charles Downstream of CR 112, 2 mi. W of Altura Downstream of CSAH 112, 2.5 mi. W of Altura Downstream of CSAH 26, 1.5 mi. E of Elba	MTS	EXP	EXP	EXS	MTS	MTS	MTS	MTS	EX	NS	NS
07040003F11 ***Unnamed creek (Kieffer Valley),*** *T107 R10W S11, east line to S Fk Whitewater R*	0.87	1B, 2A, 3B	10LM013	Downstream of CSAH 37, 1.5 mi. NW of Altura	MTS	MTS	IF	IF	–	IF	–	–	–	FS	NA

Abbreviations for Indicator Evaluations: – = No Data, **NA** = Not Assessed, **IF** = Insufficient Information, **MTS** = Meets criteria; **EXP** = Exceeds criteria, potential impairment; **EXS** = Exceeds criteria, potential severe impairment; **EX** = Exceeds criteria (Bacteria).
Abbreviations for Use Support Determinations: **NA** = Not Assessed, **IF** = Insufficient Information, **NS** = Non-Support, **FS** = Full Support
Key for Cell Shading: ☐ = existing impairment, listed prior to 2012 reporting cycle; ☐ = new impairment; ☐ = full support of designated use.
*Aquatic Life assessment and/or impairments have been deferred until the adoption of Tiered Aquatic Life Uses due to the AUID being predominantly (>50%) channelized or having biological data limited to a station occurring on a channelized portion of the stream.

Table 25. Non-assessed biological stations on channelized AUIDs: Whitewater River, South Branch 11-HUC.

AUID ***Reach Name,*** *Reach Description*	Reach length (miles)	Use Class	Biological Station ID	Location of Biological Station	Fish IBI	Invert IBI
07040003F14 ***Unnamed creek,*** *Unnamed cr to S Fk Whitewater R*	0.87	2B, 3C	10LM015	Upstream of St Charles Twp Rd 18 (Green Acres Dr), 3 mi. NE of St Charles	Poor	--
07040003F15 ***Unnamed creek,*** *Unnamed cr to Unnamed cr*	0.74	2B, 3C	10LM019	Downstream of 7th St SW, 0.5 mi. S of Dover	Good	Good

See Appendix 5.1 for clarification on the good/fair/poor thresholds and Appendix 5.2 and Appendix 5.3 for IBI results.

Table 26. Minnesota Stream Habitat Assessment (MSHA): Whitewater River, South Branch 11-HUC.

# Visits	Biological Station ID	Reach Name	Land Use (0-5)	Riparian (0-15)	Substrate (0-27)	Fish Cover (0-17)	Channel Morph. (0-36)	MSHA Score (0-100)	MSHA Rating
1	10LM018	Whitewater River, South Fork	5	9	11.6	7	16	48.6	Fair
1	10LM019	Trib. To Whitewater River, South Fork	0	11.5	13.4	5	14	43.9	Poor
2	04LM020	Whitewater River, South Fork	0	9.8	18.3	10.5	14.5	53.0	Fair
1	10LM014	Whitewater River, South Fork	0	5	18.2	11	10	44.2	Poor
1	10LM015	Trib. To Whitewater River, South Fork	5	15	4	5	4	33	Poor
1	10LM016	Whitewater River, South Fork	3.8	14.5	17.1	11	33	79.4	Good
1	04LM068	Whitewater River, South Fork	5	13.5	23.2	12	31	84.7	Good
1	04LM102	Whitewater River, South Fork	2.5	11.5	20.9	12	28	74.9	Good
1	10LM012	Whitewater River, South Fork	5	13	21.4	17	28	84.4	Good
2	10LM013	Kieffer Valley Creek	4.4	14	19.2	13	28.5	79.1	Good
1	10LM004	Whitewater River, South Fork	5	10.5	16.1	12	25	68.6	Good
Average Habitat Results: *Whitewater River, South Branch 11 HUC*			**3.2**	**11.6**	**16.7**	**10.5**	**21.1**	**63.1**	**Fair**

Qualitative habitat ratings

- = Good: MSHA score above the median of the least-disturbed sites (MSHA>66)
- = Fair MSHA score between the median of the least-disturbed sites and the median of the most-disturbed sites (45 < MSHA < 66)
- = Poor: MSHA score below the median of the most-disturbed sites (MSHA<45)

Table 27. Channel Condition and Stability Assessment (CCSI): Whitewater River, South Branch 11 HUC.

# Visits	Biological Station ID	Stream Name	Upper Banks (4-43)	Lower Banks (5-46)	Substrate (3-37)	Channel Evolution (1-11)	CCSI Score (13-137)	CCSI Rating
1	10LM018	Whitewater River, South Fork	33	27	16	7	83	severely unstable
2	10LM019	Trib. To Whitewater River, South Fork	31.5	30	13.5	5	80	severely unstable
1	10LM014	Whitewater River, South Fork	20	15	17	5	57	moderately unstable
1	10LM016	Whitewater River, South Fork	20	15	10	3	48	moderately unstable
1	10LM012	Whitewater River, South Fork	16	20	13	3	52	moderately unstable
1	10LM013	Kieffer Valley Creek	11	19	10	3	43	fairly stable
1	10LM004	Whitewater River, South Fork	11	13	24	3	51	moderately unstable
Average Stream Stability Results: *Whitewater River. South Branch 11 HUC*			**20.4**	**19.9**	**14.8**	**4.1**	**59.1**	**moderately unstable**

Qualitative channel stability scores and ratings (Higher scores indicate greater channel instability)

= stable: CCSI < 27 = fairly stable: 27 < CCSI < 45 = moderately unstable: 45 < CCSI < 80 = severely unstable: 80 < CCSI < 115 = extremely unstable: CCSI > 115

Table 28. Outlet water chemistry results: Whitewater River, South Branch 11-HUC.

Station location:	**Whitewater River, South Branch, At CSAH 26, 1 mi E of Elba**							
STORET/EQuIS ID:	**S001-743**							
Station #:	**10LM004**							
Parameter	**Units**	**# of Samples**	**Minimum**	**Maximum**	**Mean**	**Median**	**WQ Standard[1]**	**# of WQ Exceedances[2]**
Ammonia-nitrogen	mg/L	11	<0.05	<0.05	<0.05	<0.05		
Chloride	mg/L	11	21	26	24	24	230	0
Dissolved Oxygen (DO)	mg/L	17	8.1	13.1	10.7	10.8	5	0
Escherichia coli	MPN/100ml	13	23	2400	433	81	1260	2
Inorganic nitrogen (nitrate and nitrite)	mg/L	11	5.8	8.0	6.6	6.5		
Kjeldahl nitrogen	mg/L	11	0.3	1.2	0.5	0.4		
pH		17	7.9	9.3	8.4	8.4	6.5 - 9	1
Phosphorus	ug/L	11	0.06	0.23	0.12	0.11		
Specific Conductance	uS/cm	17	503	644	599	605		
Temperature, water	deg °C	17	12.1	19.4	16.4	16.6		
Total suspended solids	mg/L	11	1	78	13	4	60	
Total volatile solids	mg/L	11	1	9	2	2		
Transparency tube	Cm	17	20	>100	81	100	>20	0
Sulfate	mg/L	10	12	15	14	15		
Hardness	mg/L	11	260	330	304	310		

[1]Total suspended solids and Transparency tube standards are surrogate standards derived from the turbidity standard of 25.
[2]Represents exceedances of individual maximum standard for E. coli (1260/100ml) or fecal coliform.
****Data found in the table above was compiled using the results from data collected at the outlet monitoring station in the Whitewater River, South Branch 11 HUC, a component of the IWM work conducted between May and September in 2010 and 2011. This specific data does not necessarily reflect all data that was used to assess the AUID.**

Summary

Assessable stream water quality data were available for 35 miles of the South Fork Whitewater River across three AUIDs. The entire South Fork Whitewater River was previously listed as impaired for aquatic recreation (fecal coliform) and aquatic life (turbidity), and recent monitoring supports previous listings. Dissolved Oxygen (DO) data was insufficient to complete an assessment of the South Fork Whitewater AUID. Exceedances were observed within the coldwater portion; however, the numbers of exceedances were below the assessment threshold for the minimum number of samples. Also a high DO reading of 13.1 mg/L was observed at the intensive water chemistry station east of Elba, potentially indicating nutrient enrichment concerns. Additional continuous DO monitoring is recommended to determine whether or not impairment exists. High bacteria levels were identified within a small unnamed stream which flows into the South Fork Whitewater River just west of St. Charles and may potentially be stressing the South Branch Whitewater. Additional monitoring to identify whether E. coli levels are approaching the standard is recommended. High nitrate levels, ranging from 6.9 mg/L to 11mg/L, were seen across the South Branch, decreasing somewhat in the subwatershed's lower reaches; however, it is likely that decreasing levels are a result of increased flow from springs in the lower region of the watershed rather than a result of improved condition. Nitrogen levels are likely stressing biota and warrant additional investigation.

The South Branch's headwaters are degraded, consistent with high levels of anthropogenic stress associated with agricultural landuse. Biological impairments were apparent across the lower reaches of the South Fork's warmwater section for both indicators and are likely stressed by mediocre habitat conditions, consistent with anthropogenic influence. Downstream on the warmwater reach, an AUID was split to better define a transitional thermal zone of the South Branch Whitewater River from warmwater (2B) to coldwater (2A). Invertebrates generally perform poorly moving down the South Branch with some disparities in condition on the downstream-most AUID, while fish communities consistently exceeded biocriteria consistent with improving habitat conditions observed moving downstream. Additional monitoring is recommended to better understand the thermal transitional zone between the Whitewater's warm and coldwater AUIDs.

The Whitewater Joint Powers Board conducted the South Branch Bacteria Reduction Project TMDL from 2005-2009 to address the aquatic recreational use impairment. While strides were made in addressing an extremely complex pollution control problem impacting both surface and groundwater, it was apparent that a more targeted approach for placement of BMPs is needed that primarily focuses on bacteria reduction. Efforts are also needed to address failing septic systems and winter manure storage options to reduce bacteria levels within the watershed (Whitewater River Watershed Project, 2009).

South Branch Whitewater River

07040003F16, *Headwater to St Charles Twp Rd 7*

The headwaters of the South Branch Whitewater River is classified as warmwater. The existing aquatic recreation (fecal coliform) and aquatic life (turbidity) impairments from the now-retired, parent AUID carry-forward to this child AUID. Current E. coli data confirms existing aquatic recreation impairment due to six of six E. coli measurements exceeding the geometric mean and the occurrence of greater than 10% individual exceedances. Recent assessments added both fish and macroinvertebrate to the aquatic life impairment. The biological community degrades moving down the reach; while the biota at the upstream station (10LM018) and unassessed tributary to the Whitewater (10LM019) both maintain scores above the threshold and meet aquatic life use standards. The presence of abundant coldwater taxa in these reaches show signs of coldwater influence, despite warmwater designation. The biological community degrades moving down the reach demonstrating signs of stress for both indicators. Poor IBI scores reflect an abundance of tolerant taxa and decreasing numbers of sensitive taxa, despite a relatively diverse EPT community for macroinvertebrates. Poor IBI scores are consistent with mediocre habitat conditions observed in the reach including excess sedimentation, bank erosion, lack of riparian cover and poor channel development, all consistent with anthropogenic stress present in the watershed. Nitrogen levels were consistently high across the reach ranging from 10-11mg/L respectively and may also be stressing the biota.

The Whitewater River Regional Wastewater Treatment plant is a permitted wastewater facility located a few miles upstream of sire10LM014. Recently nitrate monitoring was added to its permit, and additional monitoring of this facility may be warranted to ensure it is not contributing to the biotic impairment downstream. While chloride samples meet standards, a majority of the monitoring occurred during the summer months. Additional monitoring may be warranted if runoff from road salt is a concern as the reach is adjacent to CSAH 14.

07040003F17*, St Charles Twp Rd 7 to T106 R10W S2, east line*

This AUID is the result of a recent AUID split to better define a transitional thermal zone of the South Branch Whitewater River. This short AUID is transitional from upstream warmwater AUID (07040003F16) to downstream coldwater AUID (0704003512). This AUID has a proposed use class change from warmwater to coldwater (2A), and southern coldwater fish IBI has been applied to data for assessment. The existing fecal coliform and turbidity impairments from the now retired parent AUID carry forward to this child AUID. Recent assessments also included degraded communities of invertebrates, resulting in a designation of impaired aquatic life use. The upper reach of the coldwater portion of the watershed shows influence from the warmwater reach, with relatively few coldwater invertebrate taxa present, falling below the threshold yet maintaining a very healthy and abundant EPT community. The macroinvertebrate community does not have a strong coldwater signature (10LM016). This may indicate that this is a transitional cool to coldwater community or may be a result of stress from high N (12 mg/L) and P (0.238 mg/L). Contrary to invertebrate results, the fish IBI results were above biocriteria and in agreement with coldwater criteria and excellent habitat conditions observed at the station. Additional monitoring is recommended to further determine the use classification along this AUID.

07040003512, *T106 R10W S1, west line to N Fk Whitewater R*

The downstream reach for the South Branch Whitewater River is classified coldwater. Existing impairments for drinking water (nitrates), aquatic recreation (fecal coliform) and aquatic life (turbidity) were reaffirmed by recent data collected. Macroinvertebrates were added to the aquatic life impairment during this round of assessment. Despite DO exceedances and high fluctuating values, further review and discussion determined that the AUID is not currently impaired due to DO at the location of sampling; however, algal presence and exceedances being just under 10% of total samples warranted additional continuous DO monitoring. Invertebrate impairments are isolated to the upstream stations (04LM068 and 04LM102) sampled in 2004. Downstream stations, (10LM012 and 10LM004) sampled in 2010, preform above upper confidence intervals demonstrating a healthy coldwater community. Disparities in condition may demonstrate temporal improvements in condition or may signal thermal disparities within the reach. Fish communities perform well above coldwater biocriteria across the AUID. Habitat conditions are also exceptional is this AUID. Relatively high levels of nitrogen (6.9 mg/L to 11 mg/L) exist across the reach but are likely not the only stressor impacting macroinvertebrates. Chloride levels and un-ionized ammonia are not elevated and are not likely stressors of biology in this system.

Kieffer Valley Creek, *07040003F11*, *T107 R11W S35, east line to S Fk Whitewater R*

Kieffer Valley Creek (10LM013), a coldwater stream which enters the South Branch Whitewater just prior to its confluence with its upper and middle branches, showed full support for aquatic life use based on fish and invertebrates. Biological communities were indicative of healthy coldwater communities and are supported by excellent habitat conditions within the reach.

Unnamed Creek, *07040003F14*, *unnamed cr to S Fk Whitewater R*

Unnamed Creek is a small warmwater stream in the central part of the subwatershed. Biology was not assessed as the reach is predominately modified consistent with channelization. The fish community was dominated by tolerant taxa, and the poor condition of the community is likely attributed to degraded habitat condition observed including: a homogenous channel condition (100% run), dominance of fine substrates and sparse in stream cover.

Unnamed Creek, *07040003F15*, *unnamed cr to unnamed cr*

Unnamed Creek is a small warmwater stream in the upper reaches of the South Branch Whitewater River Subwatershed. The stream was not assessed as it is has a predominantly modified stream channel consistent with channelization. Despite this, biology still met general warmwater use criteria. Habitat conditions are marginal, including a poor riparian zone, fine substrate dominant, lightly embedded coarse substrates and sparse habitat.

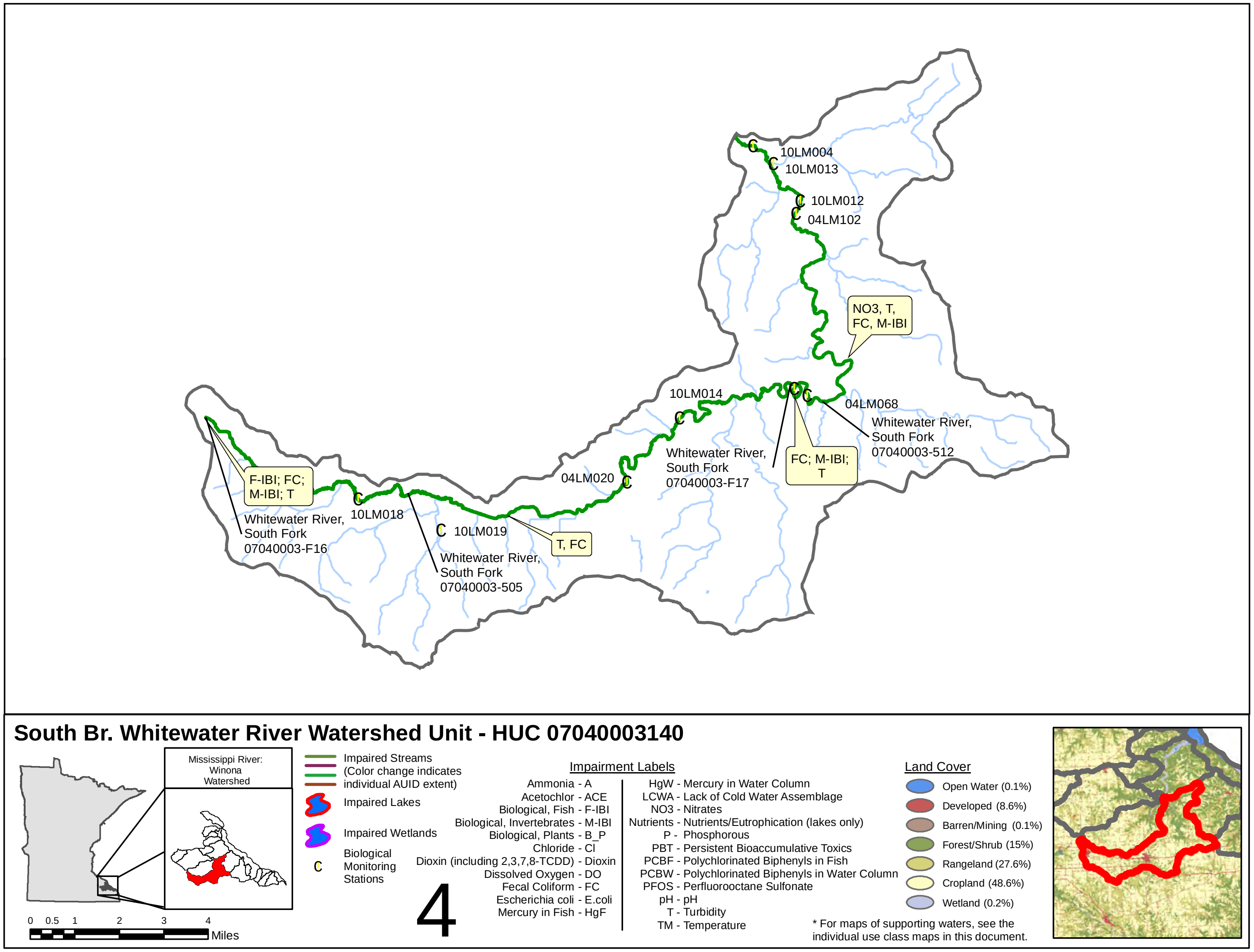

Figure 25. Currently listed impaired waters by parameter and land use characteristics in the Whitewater River, South Branch Watershed Unit.

Beaver Creek Watershed Unit

HUC 07040003150

The Beaver Creek subwatershed covers nearly 17 mi^2 of western Wabasha County and eastern Winona County. The small trout stream's headwaters lie two miles southeast of Plainview. Beaver Creek flows in an easterly direction through Whitewater State Wildlife Management Area before entering the Whitewater River. Its land use is evenly divided between forest (35%), cropland (31%) and rangeland (30%). Due to its small drainage area, the MPCA did not establish a stream water chemistry station at the outlet of Beaver Creek, represented by MPCA biological station 10LM033. No lakes are present within the watershed.

Table 29. Aquatic Life and Recreation assessments on stream reaches: Beaver Creek Watershed Unit.

AUID *Reach Name,* Reach Description	Reach Length (miles)	Use Class	Biological Station ID	Location of Biological Station	Aquatic Life Indicators: Fish IBI	Invert IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides	Bacteria	Aquatic Life	Aquatic Rec.
07040003566 ***Beaver Creek,*** *T108 R11W S24, west line to Unnamed cr*	6.6	1B, 2A, 3B	04LM104 10LM033	Adjacent to Whitewater Twp Rd 10, in Whitewater State WMA, 6 mi. E of Plainview Adjacent to CSAH 30, 7 mi. E of Plainview	MTS	EXP	IF	MTS	–	IF	–	–	–	NS	NA

Abbreviations for Indicator Evaluations: **–** = No Data, **NA** = Not Assessed, **IF** = Insufficient Information, **MTS** = Meets criteria; **EXP** = Exceeds criteria, potential impairment; **EXS** = Exceeds criteria, potential severe impairment; **EX** = Exceeds criteria (Bacteria).

Abbreviations for Use Support Determinations: **NA** = Not Assessed, **IF** = Insufficient Information, **NS** = Non-Support, **FS** = Full Support

Key for Cell Shading: = existing impairment, listed prior to 2012 reporting cycle; = new impairment; = full support of designated use.

Table 30. Minnesota Stream Habitat Assessment (MSHA): Beaver Creek 11-HUC.

# Visits	Biological Station ID	Reach Name	Land Use (0-5)	Riparian (0-15)	Substrate (0-27)	Fish Cover (0-17)	Channel Morph. (0-36)	MSHA Score (0-100)	MSHA Rating
1	04LM104	Beaver Creek	5	11	21.3	14	36	87.3	Good
1	10LM033	Beaver Creek	2.5	12	16.5	15	18	64	Fair
		Average Habitat Results: *Beaver Creek 11 HUC*	**3.8**	**11.5**	**18.9**	**14.5**	**27**	**75.7**	**Good**

Qualitative habitat ratings

- = Good: MSHA score above the median of the least-disturbed sites (MSHA>66)
- = Fair: MSHA score between the median of the least-disturbed sites and the median of the most-disturbed sites (45 < MSHA < 66)
- = Poor: MSHA score below the median of the most-disturbed sites (MSHA<45)

Table 31. Channel Condition and Stability Assessment (CCSI): Beaver Creek 11 HUC.

# Visits	Biological Station ID	Stream Name	Upper Banks (4-43)	Lower Banks (5-46)	Substrate (3-37)	Channel Evolution (1-11)	CCSI Score (13-137)	CCSI Rating
1	10LM033	Beaver Creek	10	11	24	1	46	moderately unstable
		Average Stream Stability Results: *Beaver Creek 11 HUC*	**10**	**11**	**24**	**1**	**46**	**moderately unstable**

Qualitative channel stability scores and ratings (Higher scores indicate greater channel instability)

= stable: CCSI < 27 = fairly stable: 27 < CCSI < 45 = moderately unstable: 45 < CCSI < 80 = severely unstable: 80 < CCSI < 115 = extremely unstable: CCSI > 115

Summary

Beaver Creek is a small coldwater stream, predominately natural in character (95%) that feeds the mainstem Whitewater River. The observed fish community was typical of a healthy small coldwater stream with low taxa richness dominated by coldwater obligates, including both brown trout and sculpin, and performed well above upper confidence limits at both stations. The stream was non-supporting of aquatic life use for macroinvertebrates even though turbidity and fish assessments show support. Macroinvertebrate quality increased moving downstream; 2004 visits in the upstream watershed were below lower confidence limits while 2010 visits near the watershed's outlet were above the threshold, indicating localized impairment in the upstream reaches of Beaver Creek. The macroinvertebrate community in the subwatershed's headwaters was dominated by tolerant taxa that are indicative of nutrient enrichment. One time grab samples collected during the fish monitoring visits in 2004 and 2010 indicated low levels of nitrogen. Habitat quality also decreases moving downstream in the subwatershed both spatially and overtime. Common sited problems include sedimentation of pools, embeddedness of coarse substrates and a dominance of fine substrates. However, Beaver Creek was determined to be fully supporting based on turbidity levels. Additional monitoring is recommended to determine the extent of impairment within the Beaver Creek system.

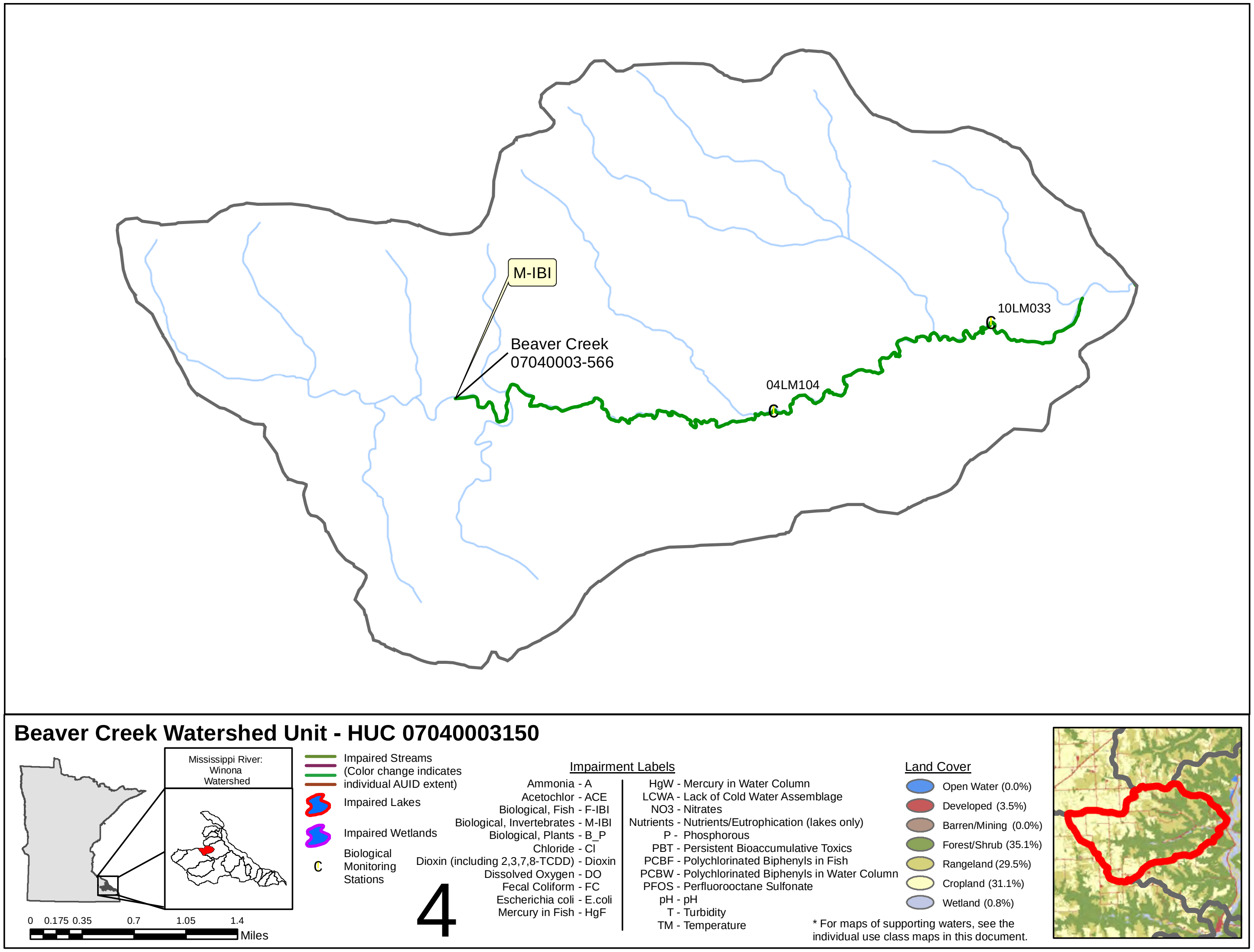

Figure 26. Currently listed impaired waters by parameter and land use characteristics in the Beaver Creek Watershed Unit.

Whitewater River Watershed Unit HUC 07040003160

The Whitewater River begins where its three branches converge near Elba. The coldwater river flows north following CR 74, moving through Whitewater State Wildlife Management area. Beaver Creek joins the Whitewater in the community of Beaver: here the river transitions to warmwater and turns northeast passing by the door pools and gaining the outflow of Trout Creek before discharging to Maloney Lake at Weaver Bottoms, approximately one mile south of Weaver. The watershed encompasses 52 mi^2 of northern Winona County and a small portion of southern Wabasha County. The watershed has historically been the subject of numerous flooding events, predominately the result of poorly managed agricultural landuse, which led to protection efforts in the Whitewater's riparian corridor in the early 20^{th} century and the current predominance of natural landuse observed in the watershed today (forested 50%, wetlands 7%). However, a third of the watershed's landuse is still managed for agricultural purposes (25% rangeland, 14% cropland). After record rains fell on the region, 2007 marked the watershed's largest flooding event in recent memory. The watershed's outlet is represented by water quality station 10LM001 on the Whitewater River. No lakes are present within the watershed.

Table 32. Aquatic Life and Recreation assessments on stream reaches: Whitewater River Watershed Unit. Reaches are organized upstream to downstream in the table.

AUID *Reach Name*, *Reach Description*	**Reach Length (miles)**	**Use Class**	**Biological Station ID**	**Location of Biological Station**	Aquatic Life Indicators: Fish IBI	Invert IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides	Bacteria	**Aquatic Life**	**Aquatic Rec.**
07040003537 ***Whitewater River,*** *S Fk Whitewater R to Beaver Cr*	6.08	1B, 2A, 3B	04LM103	Downstream to Hwy 74, 3.5 mi. NE of Elba	MTS	MTS	IF	EXS	MTS	MTS	MTS	–	–	NS	NA
07040003574 ***Trout Creek (Trout Valley Creek),*** *T108 R9W S20, east line to Whitewater R*	7.74	1B, 2A, 3B	04LM091 10EM171 10LM032	Downstream of southernmost crossing of CSAH 31, 4 mi. S of Weaver Upstream of Trout Dr, 11.5 mi. E of Plainview Downstream of CSAH 31, 10 mi. E of Plainview	MTS	MTS	IF	IF	–	IF	–	–	–	FS	NA
07040003539 ***Whitewater River,*** *T109 R10W S36, south line to Mississippi R*	4.72	2B, 3C	10LM001	Upstream of Hwy 61, 0.5 mi. SE of Weaver	NA	NA	IF	MTS	MTS	MTS	MTS	–	EX	NS*	NS
07040003609 **Unnamed Creek,** *Unnamed cr to Whitewater R*	2.16	3B, 3C	04LM105	1mi. upstream of Hwy 74, in Whitewater State Park, 3 mi. N of Elba	IF	IF	IF	IF	--	--	--	--	--	IF	NA

Abbreviations for Indicator Evaluations: **–** = No Data, **NA** = Not Assessed, **IF** = Insufficient Information, **MTS** = Meets criteria; **EXP** = Exceeds criteria, potential impairment; **EXS** = Exceeds criteria, potential severe impairment; **EX** = Exceeds criteria (Bacteria).

Abbreviations for Use Support Determinations: **NA** = Not Assessed, **IF** = Insufficient Information, **NS** = Non-Support, **FS** = Full Support

Key for Cell Shading: ☐ = existing impairment, listed prior to 2012 reporting cycle; ☐ = new impairment; ☐ = full support of designated use.

*Biological assessment and/or impairments have been deferred until the adoption of Tiered Aquatic Life Uses due to the AUID being predominantly (>50%) channelized or having biological data limited to a station occurring on a channelized portion of the stream.

Table 33. Non-assessed biological stations on channelized AUIDs: Whitewater River 11-HUC.

AUID ***Reach Name,*** *Reach Description*	Reach length (miles)	Use Class	Biological Station ID	Location of Biological Station	Fish IBI	Invert IBI
07040003539 ***Whitewater River,*** *T109 R10W S36, south line to Mississippi R*	4.72	2B, 3C	10LM001	Upstream of Hwy 61, 0.5 mi. SE of Weaver	Good	Poor

See Appendix 5.1 for clarification on the good/fair/poor thresholds and Appendix 5.2 and Appendix 5.3 for IBI results.

Table 34. Minnesota Stream Habitat Assessment (MSHA): Whitewater River 11-HUC.

# Visits	Biological Station ID	Reach Name	Land Use (0-5)	Riparian (0-15)	Substrate (0-27)	Fish Cover (0-17)	Channel Morph. (0-36)	MSHA Score (0-100)	MSHA Rating
1	04LM105	Unnamed Trib. To Whitewater River	5	12	20.6	12	33	82.6	Good
2	04LM103	Whitewater River	5	10.3	16.1	14	27.5	72.9	Good
2	04LM091	Trout Creek	5	12	20.8	13	30.5	81.3	Good
2	10EM171	Trout Creek	3.8	7.8	19.9	10.5	23.5	65.4	Fair
2	10LM032	Trout Creek	5	11.5	17.5	12	20	66.5	Good
1	10LM001	Whitewater River	5	11	14	7	11	48	Fair
Average Habitat Results: *Whitewater River 11 HUC*			**4.8**	**10.8**	**18.1**	**11.4**	**24.3**	**69.4**	**Good**

Qualitative habitat ratings

- = Good: MSHA score above the median of the least-disturbed sites (MSHA>66)
- = Fair: MSHA score between the median of the least-disturbed sites and the median of the most-disturbed sites (45 < MSHA < 66)
- = Poor: MSHA score below the median of the most-disturbed sites (MSHA<45)

Table 35. Channel Condition and Stability Assessment (CCSI): Whitewater River 11 HUC.

# Visits	Biological Station ID	Stream Name	Upper Banks (4-43)	Lower Banks (5-46)	Substrate (3-37)	Channel Evolution (1-11)	CCSI Score (13-137)	CCSI Rating
1	04LM103	Whitewater River	19	15	22	3	59	moderately unstable
1	10EM171	Trout Creek	19	23	16	3	61	moderately unstable
1	10LM032	Trout Creek	18	25	13	3	59	moderately unstable
1	10LM001	Whitewater River	11	9	28	3	51	moderately unstable
Average Stream Stability Results: *Whitewater River 11 HUC*			**16.8**	**18**	**19.8**	**3**	**57.5**	**moderately unstable**

Qualitative channel stability scores and ratings (Higher scores indicate greater channel instability)

= stable: CCSI < 27 = fairly stable: 27 < CCSI < 45 = moderately unstable: 45 < CCSI < 80 = severely unstable: 80 < CCSI < 115 = extremely unstable: CCSI > 115

Table 36. Outlet water chemistry results: Whitewater River 11-HUC.

Station location:	**Whitewater River, At CSAH 23, 0.5 mi SE of Weaver**							
STORET/EQuIS ID:	**S001-767**							
Station #:	**10LM001**							
Parameter	**Units**	**# of Samples**	**Minimum**	**Maximum**	**Mean**	**Median**	**WQ Standard[1]**	**# of WQ Exceedances[2]**
Ammonia-nitrogen	mg/L	10	<0.05	<0.05				
Chloride	mg/L	10	12	17	16	16	230	
Dissolved Oxygen (DO)	mg/L	17	7.4	10.4	8.8	9.0	5	0
Escherichia coli	MPN/100ml	13	50	2400	448	310	1260	1
Inorganic nitrogen (nitrate and nitrite)	mg/L	11	4.0	6.0	4.7	4.5		
Kjeldahl nitrogen	mg/L	10	0.4	1.4	0.7	0.5		
pH		17	7.7	9.3	8.3	8.3	6.5 - 9	1
Phosphorus	ug/L	10	0.07	0.30	0.14	0.11		
Specific Conductance	uS/cm	17	542	616	573	572		
Temperature, water	deg °C	17	11.5	21.4	17.5	18.8		
Total suspended solids	mg/L	10	13	190	49	30		1
Total volatile solids	mg/L	10	1	17	5	4		
Transparency tube	Cm	18	20	>100	54	54	>20	0
Sulfate	mg/L	10	11	14	13	14		
Hardness	mg/L	10	290	330	299	300		

[1]Total suspended solids and Transparency tube standards are surrogate standards derived from the turbidity standard of 25.

[2]Represents exceedances of individual maximum standard for E. coli (1260/100ml) or fecal coliform.

****Data found in the table above was compiled using the results from data collected at the outlet monitoring station in the Whitewater River 11 HUC, a component of the IWM work conducted between May and September in 2010 and 2011. This specific data does not necessarily reflect all data that was used to assess the AUID.**

Summary

All three of the Whitewater's upstream branches are impaired by both bacteria and turbidity and are conduits for high levels of nitrogen. Scattered biological impairments were predominantly observed in macroinvertebrate communities in upstream reaches. Despite upstream impairments, conditions improve somewhat moving into the mainstem Whitewater River watershed. While the Whitewater River continues to retain its aquatic life impairment for turbidity, recent data indicate conditions have improved in its downstream reach. However, lingering upstream turbidity impairments prevent downstream AUID delisting. Nitrate levels continue to decrease moving down the Whitewater likely contributing to healthy biological communities observed across this watershed. An aquatic recreational use impairment (E. coli) persists in the downstream AUID. The Whitewater River's listing for aquatic consumption from 1998 should be revisited as 2010 data suggests improving condition now meeting guidelines. Better management of sediments and livestock is needed to reduce non-point source pollution in the watershed and bring the watershed to full attainment of aquatic life and recreational uses.

Whitewater River

07040003537, *S Fk Whitewater R to Beaver cr*
The upper reach of the Whitewater River is a large coldwater stream draining 267 mi^2. This AUID was previously listed due to turbidity in 2006 and recent data supports this; however, the reach was identified to be fully supporting of chloride, fish and macroinvertebrates. Drinking water use criteria for nitrogen (NO_2/NO_3) are currently being met. Macroinvertebrates show temporal improvement from 2004 to 2010 (04LM103), scores from data collected in 2004 fell just below the threshold, while scores from 2010 fall above threshold, indicating a potentially improved condition and a healthy coldwater community. Fish Index of Biotic Integrity (IBI) scores are consistently above standards across sampling years. The fish community is representative of a large coldwater stream with sufficient quantities of sensitive and coldwater taxa, despite increased taxa richness due to its size and it transitional use from coldwater to warmwater (downstream AUID: [0704003539] is warmwater).

07040003539, *T109 R10W S36, south line to Mississippi R*
The downstream most reach of the Whitewater River has both aquatic recreation (E. coli) and aquatic life (turbidity) use impairments. While recent monitoring data for turbidity (2010 and 2011) suggests improving condition, several upstream turbidity impairments imply elevated turbidity levels persist within the watershed and do not warrant actions being taken to delist this AUID. Two of three E. coli geometric mean exceedances of existing data provide strong evidence that aquatic recreational use is not being met. Biota were not assessed for this portion of the Whitewater River as the biological station was located on a predominately channelized reach (10LM001). Despite this, biological data meet general warmwater use criteria for southern rivers for fish. Invertebrates at 10LM001 reflect a very different thermal regime compared to communities on the upstream AUID, with significantly decreased diversity and scores well below the warmwater threshold, likely due to a lack of suitable habitat and not discrepancies in use class. Un-ionized ammonia data and chloride data also demonstrate supporting conditions within the AUID.

Trout Creek, 07040003574, *T108 R9W S20, east line to Whitewater R*
Trout Creek enters the Whitewater River approximately one mile from its confluence with the Mississippi River. The coldwater stream meets aquatic life use standards for turbidity as well as biology. Biological data across the Trout Creek AUID is robust, represented well spatially and temporally: visits occurred on three stations (04LM091, 10EM171 and 10LM032) over two years (2004 & 2010). Good to excellent habitat scores across stations can be

linked to intact riparian buffer zones and little to no signs of sedimentation and erosion (MSHA ranges 60.7 - 84.8). Coldwater taxa present at all reaches (brown and brook trout) but were not abundant at all sampling events. Trout Creek has a very healthy coldwater macroinvertebrate community throughout its watershed. Thermal regime demonstrates potential warming moving downstream on the AUID, 2010 average July temperatures increase 4° C when comparing temperature logger results from upstream (12.9° C) to downstream (17.1° C). Despite warming trends, fish IBI scores tend to increase moving down Trout Creek. Stream thermal character should continue to be monitored to insure the streams coldwater integrity is maintained.

Unnamed trib. to Whitewater River, 07040003609, *Unnamed cr to Whitewater R*
The unnamed tributary to the Whitewater River is located in the upper portion of the Whitewater watershed. Insufficient information was available to assess for aquatic life on this AUID. Despite lack of anthropogenic stress, excellent habitat and apparent natural conditions at the station and within its upstream watershed, results from a 2004 biological visit (04LM105) show a disproportionate distribution of individuals and few intolerant taxa during the fish visit, and an invert assemblage that indicates some potential for coldwater use. The unnamed tributary to the Whitewater, (04LM105), had a score below the threshold in 2004, but above the threshold in 2010. The data from 2010 show an increase in sensitive coldwater taxa, suggesting the potential for a change in use designation. MDNR staff indicated that waterfowl pools downstream may be limiting fish migration. However, it is difficult to determine if the failure to meet biocriteria is a result of marginal thermal condition or stressors. Additional monitoring is needed to make a more informed assessment of biological condition and to determine correct use classification.

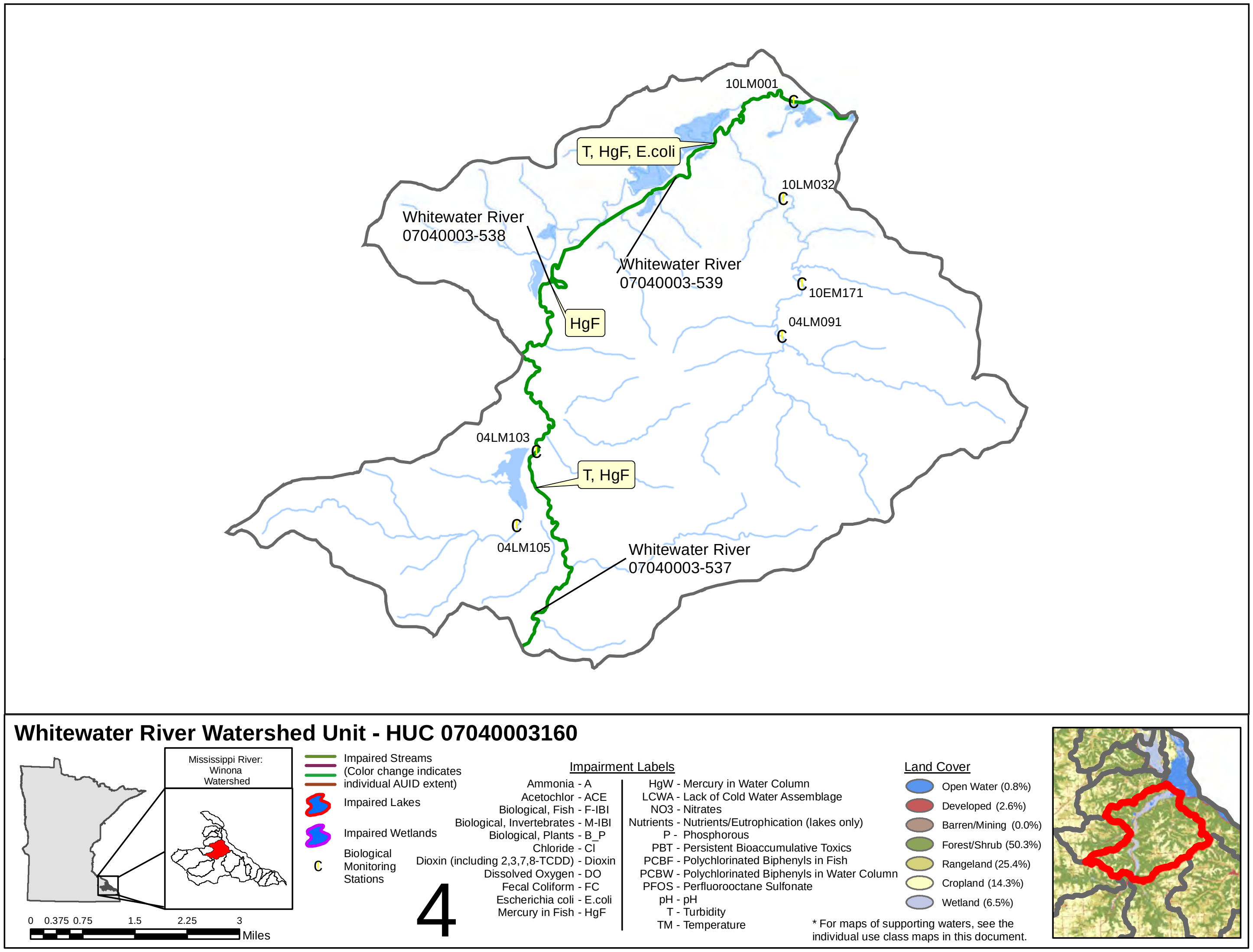

Figure 27. Currently listed impaired waters by parameter and land use characteristics in the Whitewater River Watershed Unit.

Rollingstone Creek Watershed Unit HUC 07040003180

The Rollingstone Creek Subwatershed joins three tributaries - Bear, Speltz, and Rollingstone Creeks before emptying directly to the Mississippi River. The watershed drains 51 mi^2 of Winona County. Rollingstone Creek emerges from the southern reaches of the watershed, just north of Bethany, flowing in a northeasterly direction. The creek abruptly turns east just south of the town of Rollingstone where it is joined by Bear Creek. Speltz Creek joins the Rollingstone one mile east of Rollingstone from the north before discharging to the Mississippi River after flowing through Minnesota City. The watershed is dominated by agricultural landuse (rangeland 40% and cropland 19%); however, 37% of its current landuse is forest. The watershed's outlet is represented by water quality station 10LM005 on Rollingstone Creek. No lakes are present within the watershed.

Table 37. Aquatic Life and Recreation assessments on stream reaches: Rollingstone Creek Watershed Unit. Reaches are organized upstream to downstream in the table.

					Aquatic Life Indicators:										
AUID ***Reach Name,*** *Reach Description*	**Reach Length (miles)**	**Use Class**	**Biological Station ID**	**Location of Biological Station**	Fish IBI	Invert IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides	Bacteria	**Aquatic Life**	**Aquatic Rec.**
07040003534 ***Rollingstone Creek (Rupprecht Creek),*** *T107 R9W S35, west line to Unnamed cr*	4.71	1B, 2A, 3B	10LM022	Upstream of Norton Twp Rd 3 (Horseshoe Rd), 3 mi. SW of Rollingstone	MTS	MTS	IF	IF	–	IF	–	–	–	FS	NA
07040003581 ***Bear Creek,*** *Unnamed cr to Rollingstone cr*	4.37	1B, 2A, 3B	10LM023	Upstream of CSAH 27, 2.5 mi. SW of Rollingstone	EXP	EXS	IF	IF	–	IF	–	–	–	NS	NA
07040003533 ***Rollingstone Creek,*** *Unnamed cr to Garvin Bk*	10.96	1B, 2A, 3B	10LM020 10LM005	Upstream of Rollingstone Twp Rd 11 (Stoos Rd), 0.5 S of Rollingstone Upstream of Rollingstone Twp Rd 7, 1 mi. W of Minnesota City	MTS	MTS	IF	EXS	MTS	MTS	MTS	–	EX	NS	NS
07040003555 ***Speltz Creek,*** *Preston Valley Cr to Rollingstone Cr*	2.99	1B, 2A, 3B	10LM021	Upstream of Rollingstone Twp Rd 12 in Rollingstone	NA	NA	IF	EXP	–	IF	–	–	–	IF*	NA

Abbreviations for Indicator Evaluations: – = No Data, **NA** = Not Assessed, **IF** = Insufficient Information, **MTS** = Meets criteria; **EXP** = Exceeds criteria, potential impairment; **EXS** = Exceeds criteria, potential severe impairment; **EX** = Exceeds criteria (Bacteria).

Abbreviations for Use Support Determinations: **NA** = Not Assessed, **IF** = Insufficient Information, **NS** = Non-Support, **FS** = Full Support

Key for Cell Shading: = existing impairment, listed prior to 2012 reporting cycle; = new impairment; = full support of designated use.

*Aquatic Life assessment and/or impairments have been deferred until the adoption of Tiered Aquatic Life Uses due to the AUID being predominantly (>50%) channelized or having biological data limited to a station occurring on a channelized portion of the stream.

Table 38. Non-assessed biological stations on channelized AUIDs: Rollingstone Creek 11-HUC.

AUID *Reach Name,* *Reach Description*	Reach length (miles)	Use Class	Biological Station ID	Location of Biological Station	Fish IBI	Invert IBI
07040003555 ***Speltz Creek,*** *Preston Valley Cr to Rollingstone Cr*	2.99	1B, 2A, 3B	10LM021	Upstream of Rollingstone Twp Rd 12, in Rollingstone	Fair	Fair

See Appendix 5.1 for clarification on the good/fair/poor thresholds and Appendix 5.2 and Appendix 5.3 for IBI results.

Table 39. Minnesota Stream Habitat Assessment (MSHA): Rollingstone Creek 11-HUC.

# Visits	Biological Station ID	Reach Name	Land Use (0-5)	Riparian (0-15)	Substrate (0-27)	Fish Cover (0-17)	Channel Morph. (0-36)	MSHA Score (0-100)	MSHA Rating
1	10LM022	Rollingstone Creek	2	10.5	8.4	12	16	48.9	Fair
1	10LM023	Bear Creek	2.5	11.5	17.6	15	28	74.6	Good
1	10LM020	Rollingstone Creek	4.3	13	9	11	18	55.3	Fair
1	10LM021	Speltz Creek	4	13.5	10	13	20	60.5	Fair
1	10LM005	Rollingstone Creek	5	12	14	11	21	63	Fair
		Average Habitat Results: *Rollingstone 11 HUC*	**3.6**	**12.1**	**11.8**	**12.4**	**20.6**	**60.4**	**Fair**

Qualitative habitat ratings
- = Good: MSHA score above the median of the least-disturbed sites (MSHA>66)
- = Fair: MSHA score between the median of the least-disturbed sites and the median of the most-disturbed sites (45 < MSHA < 66)
- = Poor: MSHA score below the median of the most-disturbed sites (MSHA<45)

Table 40. Channel Condition and Stability Assessment (CCSI): Rollingstone Creek 11 HUC.

# Visits	Biological Station ID	Stream Name	Upper Banks (4-43)	Lower Banks (5-46)	Substrate (3-37)	Channel Evolution (1-11)	CCSI Score (13-137)	CCSI Rating
1	10LM022	Rollingstone Creek	24	5	24	1	54	moderately unstable
1	10LM023	Bear Creek	32	22	30	6	90	severely unstable
1	10LM020	Rollingstone Creek	25	18	34	5	82	severely unstable
1	10LM021	Speltz Creek	28	25	26	7	86	severely unstable
1	10LM005	Rollingstone Creek	23	20	24	3	70	moderately unstable
		Average Stream Stability Results: *Rollingstone Creek 11 HUC*	**26.4**	**18**	**27.6**	**4.4**	**76.4**	**moderately unstable**

Qualitative channel stability scores and ratings (Higher scores indicate greater channel instability)

= stable: CCSI < 27 = fairly stable: 27 < CCSI < 45 = moderately unstable: 45 < CCSI < 80 = severely unstable: 80 < CCSI < 115 = extremely unstable: CCSI > 115

Table 41. Outlet water chemistry results: Rollingstone Creek 11-HUC.

Station location:	**Rollingstone Creek, At Middle Valley Road Bridge, 1.5 mi NW of MN City**							
STORET/EQuIS ID:	**S001-532**							
Station #:	**10LM005**							
Parameter	**Units**	**# of Samples**	**Minimum**	**Maximum**	**Mean**	**Median**	**WQ Standard[1]**	**# of WQ Exceedances[2]**
Ammonia-nitrogen	mg/L	10	<0.05	0.09	0.06	0.05	0.04	4
Chloride	mg/L	10	10	16	12	12	230	0
Dissolved Oxygen (DO)	mg/L	17	7.6	10.6	9.3	9.3	5	0
Escherichia coli	MPN/100ml	13	440	2400	1645	1600	1260	9
Inorganic nitrogen (nitrate and nitrite)	mg/L	30	0.9	2.7	2.1	2.1		
Kjeldahl nitrogen	mg/L	10	0.4	1.0	0.7	0.6		
pH		16	7.9	9.3	8.3	8.3	6.5 - 9	0
Phosphorus	ug/L	30	0.08	2.6	0.3	0.2		
Specific Conductance	uS/cm	17	533	597	561	559		
Temperature, water	deg °C	17	12.9	19.5	16.6	17.3		
Total suspended solids	mg/L	30	10	1800	136	40	60	8
Total volatile solids	mg/L	30	2	210	15	5		
Transparency tube	Cm	77	1	100	39	34	>20	13
Sulfate	mg/L	10	11	13	12	12		
Hardness	mg/L	10	280	330	311	310		

[1]Total suspended solids and Transparency tube standards are surrogate standards derived from the turbidity standard of 25.

[2]Represents exceedances of individual maximum standard for E. coli (1260/100ml) or fecal coliform.

****Data found in the table above was compiled using the results from data collected at the outlet monitoring station in the Rollingstone Creek 11 HUC, a component of the IWM work conducted between May and September in 2010 and 2011. This specific data does not necessarily reflect all data that was used to assess the AUID.**

Summary

Rollingstone Creek, 0704003534 T108 R9W S36, *west line to Preston Valley Cr***, 07040003533** *unnamed cr to Garvin bk*

Assessable stream water quality data were available for two AUIDs of Rollingstone Creek. These coldwater AUIDs extend southwest from Garvin Brook for approximately 16 miles. The downstream AUID was previously listed as impaired due to turbidity (2008) and aquatic recreational use (2008) due to fecal coliform exceedances. Recent turbidity and E. coli data support these listings with no indications of improvement. Additionally, nitrate/nitrite data were determined to be insufficient to complete a drinking water assessment; however, levels were still within drinking water criteria.

Despite chemical impairments, biological communities are demonstrating resilience but may be on the cusp of impairment if current coldwater use designations are accurate. Fish IBI scores were above the impairment threshold at all visits indicating healthy communities: the best results were seen at the upstream-most station (10LM022) where the fish community demonstrated a clear coldwater signature (brown trout and sculpin). Temperatures increase moving downstream suggesting some warming; fish assemblages demonstrate a similar trend transitioning from cold to coolwater assemblages moving downstream, inferring degradation in the watershed. In contrast, invertebrate communities slightly improve moving down the watershed and are reflective of coldwater communities. Habitat conditions also improve moving down the watershed. Fine sediments (sand and silt) dominate substrates at all stations; coarse substrates were only observed at the upstream most station but were severely embedded. Channel development lacks complexity across stations but slightly improves moving down the watershed. Poor conditions on feeder tributary, Bear Creek, are also likely contributing to downstream degradation observed in Rollingstone Creek. Additional thermal monitoring would provide a clearer picture of thermal regime across Rollingstone Creek. Work could also be done to improve habitat and control sediment across the watershed.

Speltz Creek, 07040003579, *T108 R9W S36, west line to Preston Valley Cr***, 07040003555,** *Preston Valley cr to Rollingstone cr*

Turbidity data for Speltz Creek pointed to several transparency tube exceedances; however, several of these exceedances coincided with high precipitation events. As a result, Speltz Creek was not listed as impaired for turbidity. Biological data was not assessed for Speltz Creek as the biological station was predominately channelized within the reach. Biological results were near or below thresholds for equivalent natural streams. The fish community sampled was more indicative of a warmwater community rather than coldwater, demonstrating signs of stress. Station habitat lacks coarse substrate and is dominated by fine sediment. Channel morphology lacks complexity and stability. Moderately sized upstream cattle operations may be contributing to downstream biological condition. Speltz Creek is degraded but has potential for improvement and would likely benefit from habitat improvement and channel stabilization efforts to control sediment.

Bear Creek, 07040003581, *Unnamed cr to Rollingstone cr*

Aquatic life use for Bear Creek was determined to be impaired based on low fish and invert IBI scores. The fish community lacks native coldwater taxa and percent of sensitive fish individuals found is considered low for a cold headwater stream. A poor invert score corroborates fish results and also shows signs of stress. Coldwater invertebrate taxa are present on Bear Creek, but the lack of an intact riparian zone and presence of unstable channel is preventing the establishment of additional intolerant Ephemeroptera, Plecoptera and Trichoptera (EPT) taxa. Differences between samples collected in 2010 and 2012 on Bear Creek suggest a further degrading condition. A good habitat score (MSHA = 74.6) appears inflated judging by pictures and the 2012 site visit (MSHA = 57.25) and do not reflect degraded condition observed. The biological station occurs within an open pasture, substrates are dominated by sand, little instream cover is present and shade is lacking in the upstream portion of reach. Severe recent degradation has been observed along this reach within the last 20 years by MDNR staff. Additional investigation of upstream moderately sized livestock operation may be helpful in determining potential stressors. Bear Creek would likely benefit from habitat improvement that would control sedimentation and improve refuge for coldwater taxa.

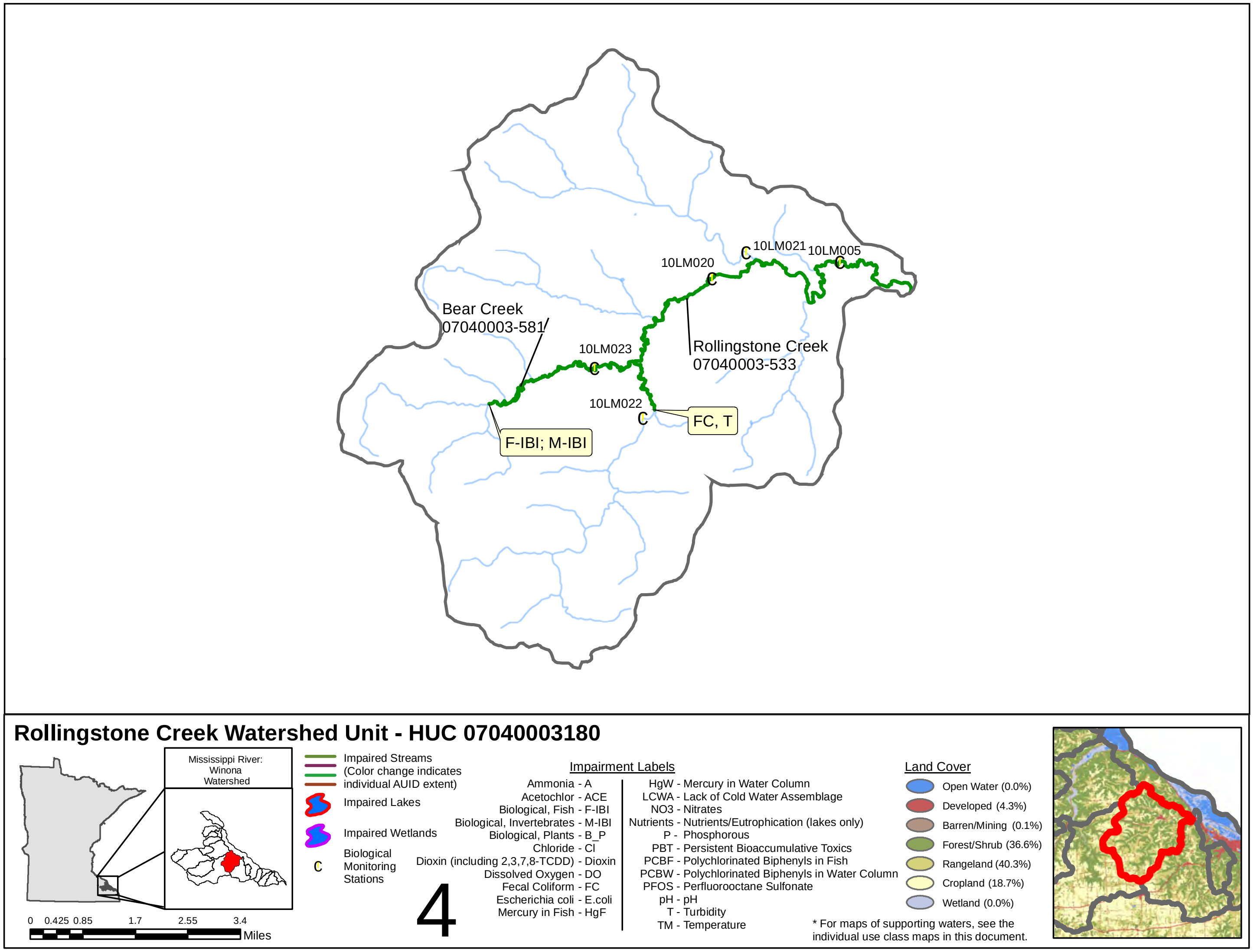

Figure 28. Currently listed impaired waters by parameter and land use characteristics in the Rollingstone Creek Watershed Unit.

Garvin Brook Watershed Unit HUC 07040003190

Garvin Brook is a small direct tributary to the Mississippi River draining 49 mi^2 of Winona County. Garvin Brook flows north beginning just east of Lewiston and follows US Hwy 14 until it reaches Stockton where it is joined by Stockton Valley Creek and continues north sharing the valley with CSAH 23, merging with Mississippi River just North of Minnesota City. While greater than 50% of the watershed is utilized for agricultural landuse, more than a third remains forested (36%). The watershed's outlet is represented by water quality station 10LM006 on Garvin Brook. No lakes are present within the watershed.

Table 42. Aquatic Life and Recreation assessments on stream reaches: Garvin Brook Watershed Unit. Reaches are organized upstream to downstream in the table.

					Aquatic Life Indicators:										
AUID ***Reach Name,*** *Reach Description*	**Reach Length (miles)**	**Use Class**	**Biological Station ID**	**Location of Biological Station**	Fish IBI	Invert IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides	Bacteria	**Aquatic Life**	**Aquatic Rec.**
07040003542 ***Garvin Brook,*** *T106 R8W S17, west line to Rollingstone cr*	15.18	1B, 2A, 3B	04LM099 10LM006	Adjacent to Twp Rd 12, in Farmer's Community Park, 5 mi. SW of Winona Upstream of private drive W of CSAH 23, 1 mi. SW of Minnesota City	MTS	MTS	IF	EXS	MTS	EXP	MTS	MTS	EX	NS	NS
07040003559 ***Stockton Valley Creek,*** *T106 R8W S23, south line to Garvin Bk*	7.45	1B, 2A, 3B	10LM024 10LM025	Downstream of CSAH 23, 0.5 mi. SW of Stockton Downstream of Twp Rd 14, 1.5 mi. S of Stockton	MTS	MTS	IF	MTS	–	–	–	–	–	NS	NA

Abbreviations for Indicator Evaluations: – = No Data, **NA** = Not Assessed, **IF** = Insufficient Information, **MTS** = Meets criteria; **EXP** = Exceeds criteria, potential impairment; **EXS** = Exceeds criteria, potential severe impairment; **EX** = Exceeds criteria (Bacteria).
Abbreviations for Use Support Determinations: **NA** = Not Assessed, **IF** = Insufficient Information, **NS** = Non-Support, **FS** = Full Support
Key for Cell Shading: = existing impairment, listed prior to 2012 reporting cycle; = new impairment; = full support of designated use.

Table 43. Non-assessed biological stations on channelized AUIDs: Garvin Brook 11-HUC.

AUID ***Reach Name,*** *Reach Description*	**Reach length (miles)**	**Use Class**	**Biological Station ID**	**Location of Biological Station**	**Fish IBI**	**Invert IBI**
07040003542 ***Garvin Brook,*** *T106 R8W S17, west line to Rollingstone cr*	10.96	1B, 2A, 3B	10LM024	Downstream of CSAH 23, 0.5 mi. SW of Stockton	Good	Good

See Appendix 5.1 for clarification on the good/fair/poor thresholds and Appendix 5.2 and Appendix 5.3 for IBI results.

Table 44. Minnesota Stream Habitat Assessment (MSHA): Garvin Brook 11-HUC.

# Visits	Biological Station ID	Reach Name	Land Use (0-5)	Riparian (0-15)	Substrate (0-27)	Fish Cover (0-17)	Channel Morph. (0-36)	MSHA Score (0-100)	MSHA Rating
1	04LM099	Garvin Brook	2.5	12.5	22	14	31	82	Good
1	10LM025	Stockton Valley Creek	2.5	9	20.8	14	27	73.3	Good
1	10LM024	Garvin Brook	3.5	12.5	16.2	16	25	73.2	Good
1	10LM006	Garvin Brook	4	10.5	20.5	12	24	71	Good
		Average Habitat Results: *Garvin Brook 11 HUC*	**3.125**	**11.125**	**19.875**	**14**	**26.75**	**74.875**	**Good**

Qualitative habitat ratings

- = Good: MSHA score above the median of the least-disturbed sites (MSHA>66)
- = Fair: MSHA score between the median of the least-disturbed sites and the median of the most-disturbed sites (45 < MSHA < 66)
- = Poor: MSHA score below the median of the most-disturbed sites (MSHA<45)

Table 45. Channel Condition and Stability Assessment (CCSI): Garvin Brook 11 HUC.

# Visits	Biological Station ID	Stream Name	Upper Banks (4-43)	Lower Banks (5-46)	Substrate (3-37)	Channel Evolution (1-11)	CCSI Score (13-137)	CCSI Rating
1	10LM025	Stockton Valley Creek	32	22	24	3	81	severely unstable
1	10LM024	Garvin Brook	27	21	32	5	85	severely unstable
1	10LM006	Garvin Brook	13	13	22	3	51	moderately unstable
		Average Stream Stability Results: *Garvin Brook 11 HUC*	**24**	**18.7**	**26**	**3.7**	**72.3**	**moderately unstable**

Qualitative channel stability scores and ratings (Higher scores indicate greater channel instability)

= stable: CCSI < 27 = fairly stable: 27 < CCSI < 45 = moderately unstable: 45 < CCSI < 80 = severely unstable: 80 < CCSI < 115 = extremely unstable: CCSI > 115

Table 46. Outlet water chemistry results: Garvin Brook 11-HUC.

Station location:	**Garvin Brook, At CSAH 23, 1 mi. SW of Minnesota City**							
STORET/EQuIS ID:	**S000-827**							
Station #:	**10LM006**							
Parameter	**Units**	**# of Samples**	**Minimum**	**Maximum**	**Mean**	**Median**	**WQ Standard[1]**	**# of WQ Exceedances[2]**
Ammonia-nitrogen	mg/L	10	<0.05	0.08	0.05	0.05	0.04	
Chloride	mg/L	10	12	17	13	13	230	0
Dissolved Oxygen (DO)	mg/L	17	7.7	10.9	9.6	9.7	5	0
Escherichia coli	MPN/100ml	120	1300	641	610	120	1260	1
Inorganic nitrogen (nitrate and nitrite)	mg/L	10	2.1	2.8	2.5	2.5		
Kjeldahl nitrogen	mg/L	10	0.3	0.6	0.4	0.4		
pH		17	7.6	9.3	8.3	8.3	6.5 - 9	1
Phosphorus	ug/L	10	0.05	0.09	0.07	0.07		
Specific Conductance	uS/cm	17	520	579	546	548		
Temperature, water	deg °C	17	12.9	19.4	16.9	17.1		
Total suspended solids	mg/L	10	3	14	8	7	60	
Total suspended volatile solids	mg/L	10	1.0	2.8	1.6	1.3		
Transparency tube	Cm	17	20	100	62	58	>20	0
Sulfate	mg/L	10	11	12	11	11		
Hardness	mg/L	10	283	310	296	300		

[1]Total suspended solids and Transparency tube standards are surrogate standards derived from the turbidity standard of 25.
[2]Represents exceedances of individual maximum standard for E. coli (1260/100ml) or fecal coliform.
****Data found in the table above was compiled using the results from data collected at the outlet monitoring station in the Garvin Brook 11 HUC, a component of the IWM work conducted between May and September in 2010 and 2011. This specific data does not necessarily reflect all data that was used to assess the AUID.**

Summary

Assessable stream water quality data were available for Garvin Brook extending approximately 16 miles southwest from Federal Highway 61. Garvin Brook was previously listed as impaired for aquatic life use (turbidity, ***07040003542*** in 1996 and ***07040003549*** in 2008) and aquatic recreation use (fecal coliform, ***0704003542*** in 1994 and ***07040003549*** in 2002). Recent E. coli data supports previous listing. A fecal impairment in Peterson Creek, a tributary to Garvin Brook, is likely contributing to Garvin Brook's impairment (See Figure 29). Recent continuous turbidity monitoring data suggests improved condition and could be considered for potential delisting for Garvin Brook.

In contrast with the existing turbidity impairment, both biological indicators demonstrated full support of aquatic life. Fish IBI scores decrease moving downstream on Garvin Brook and also show a decrease over time when comparing results from 2004 and 2010. Habitat scores also decrease moving downstream; however, all sites score very well. Sedimentation and erosion levels tend to increase moving downstream indicating that Garvin Brook may be losing stability moving down the watershed. While habitat and fish results tend to agree, invertebrate results demonstrate a different pattern. Surprisingly the best scoring invertebrate site was at the channelized reach followed by the upstream-most site. The lower station's biological results are not definitive due to the presence of elevated flows at the time of sampling; also the site is lower in gradient and in close proximity (<2 miles) to the confluence of the Mississippi River. The stream is likely transitioning from coldwater to coolwater resulting in a fish assemblage is more indicative of warmer thermal regime, demonstrating an influence of proximity to the Mississippi River. Additional monitoring may be useful in determining condition of the downstream-most biological station by determining the quality of the invertebrate community and better defining the thermal regime.

Stockton Valley Creek was listed as impaired for aquatic life (turbidity) and for aquatic recreational use (fecal coliform). A majority of the recent data supports the impairment listings; however, recent turbidity data does indicate a slight improvement in the water clarity of Stockton Valley Creek. Additional TSS monitoring is recommended to determine if turbidity is improving and provide information for potential delisting.

In disagreement with the existing turbidity impairment, both biological indicators demonstrated full support of aquatic life. Aquatic communities of Stockton Valley Creek are indicative of coldwater communities and preform very well (at or above upper confidence limits) across all biological visits. Habitat results are in agreement showing only light embeddedness of substrates and little bank erosion in the instream zone.

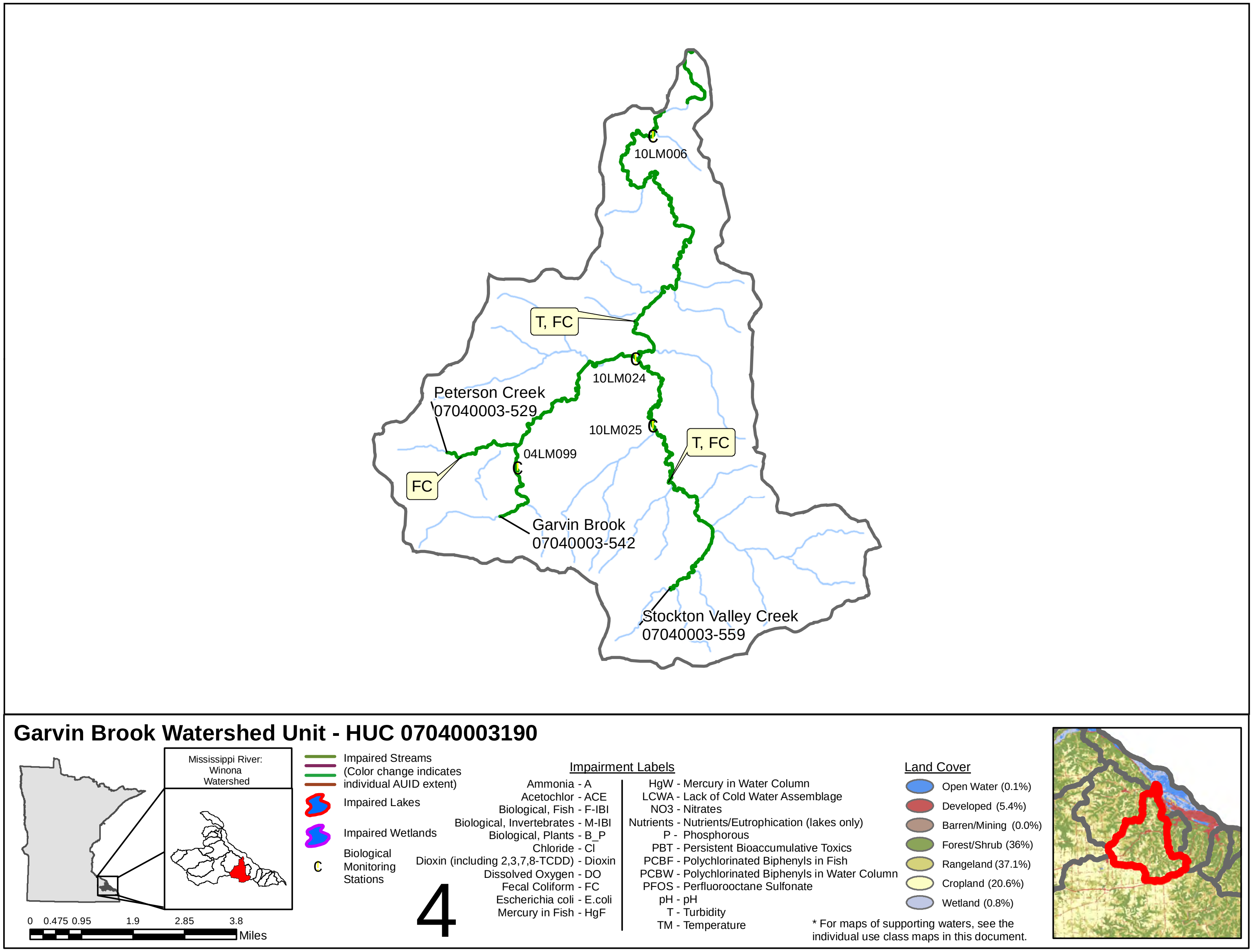

Figure 29. Currently listed impaired waters by parameter and land use characteristics in the Garvin Brook Watershed Unit.

Gilmore Creek Watershed Unit HUC 07040003210

Named for its principal tributary, Gilmore Creek Subwatershed drains 10 mi^2 of Winona County directly to the Mississippi River. This small trout stream emerges approximately two miles north of Wilson; it flows north following CSAH 21 to its outlet in Winona. Half of the watershed's landuse is forested, a third serves as pastureland for cattle and 12% is developed. Due to its small drainage, the MPCA did not establish a stream water chemistry station at the outlet of Gilmore Creek. While no lakes are present within the watershed, Gilmore Creek is a significant contribution to the catchment area for Lake Winona (Dakota Watershed Unit).

Table 47. Aquatic Life and Recreation assessments on stream reaches: Gilmore Creek Watershed Unit.

AUID *Reach Name,* *Reach Description*	Reach Length (miles)	Use Class	Biological Station ID	Location of Biological Station	Aquatic Life Indicators: Fish IBI	Invert IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides	Bacteria	Aquatic Life	Aquatic Rec.
07040003535 ***Gilmore Creek,*** *T106 R7W S6,South line to Boilers Lk (85-0010-00)*	4.99	1B, 2A, 3B	04LM100	Upstream of Gilmore Ave, in Winona	NA	NA	IF	MTS	–	IF	–	–	–	IF*	NA

Abbreviations for Indicator Evaluations: **–** = No Data, **NA** = Not Assessed, **IF** = Insufficient Information, **MTS** = Meets criteria; **EXP** = Exceeds criteria, potential impairment; **EXS** = Exceeds criteria, potential severe impairment; **EX** = Exceeds criteria (Bacteria).
Abbreviations for Use Support Determinations: **NA** = Not Assessed, **IF** = Insufficient Information, **NS** = Non-Support, **FS** = Full Support
Key for Cell Shading: = existing impairment, listed prior to 2012 reporting cycle; = new impairment; = full support of designated use.
*Aquatic Life assessment and/or impairments have been deferred until the adoption of Tiered Aquatic Life Uses due to the AUID being predominantly (>50%) channelized or having biological data limited to a station occurring on a channelized portion of the stream.

Table 48. Non-assessed biological stations on channelized AUIDs: Gilmore Creek 11-HUC.

AUID *Reach Name,* *Reach Description*	Reach length (miles)	Use Class	Biological Station ID	Location of Biological Station	Fish IBI	Invert IBI
07040003535 ***Gilmore Creek,*** *T106 R7W S6,South line to Boilers Lk (85-0010-00)*	4.99	1B, 2A, 3B	04LM100	Upstream of Gilmore Ave, in Winona	Good	Good

See Appendix 5.1 for clarification on the good/fair/poor thresholds and Appendix 5.2 and Appendix 5.3 for IBI results.

Table 49. Minnesota Stream Habitat Assessment (MSHA): Gilmore Creek 11-HUC.

# Visits	Biological Station ID	Reach Name	Land Use (0-5)	Riparian (0-15)	Substrate (0-27)	Fish Cover (0-17)	Channel Morph. (0-36)	MSHA Score (0-100)	MSHA Rating
2	04LM100	Gilmore Creek	3.1	10.5	13.1	8	11	45.7	Fair
		Average Habitat Results: *Gilmore Creek 11 HUC*	**3.1**	**10.5**	**13.1**	**8**	**11**	**45.7**	**Fair**

Qualitative habitat ratings

- = Good: MSHA score above the median of the least-disturbed sites (MSHA>66)
- = Fair: MSHA score between the median of the least-disturbed sites and the median of the most-disturbed sites (45 < MSHA < 66)
- = Poor: MSHA score below the median of the most-disturbed sites (MSHA<45)

Table 50. Channel Condition and Stability Assessment (CCSI): Gilmore Creek 11 HUC.

# Visits	Biological Station ID	Stream Name	Upper Banks (4-43)	Lower Banks (5-46)	Substrate (3-37)	Channel Evolution (1-11)	CCSI Score (13-137)	CCSI Rating
1	04LM100	Gilmore Creek	10	16	21	3	50	moderately unstable
		Average Stream Stability Results: *Gilmore Creek 11 HUC*	**10**	**16**	**21**	**3**	**50**	**moderately unstable**

Qualitative channel stability scores and ratings (Higher scores indicate greater channel instability)

= stable: CCSI < 27 = fairly stable: 27 < CCSI < 45 = moderately unstable: 45 < CCSI < 80 = severely unstable: 80 < CCSI < 115 = extremely unstable: CCSI > 115

Summary

While Gilmore Creek was determined to be fully supporting on turbidity, insufficient data from other parameters were available to make a sufficient aquatic life use assessment. Biological samples were collected within Gilmore Creek in 2004 and 2010; however, it was not assessed for biology due to the station occurring on a predominately channelized stream channel. Habitat conditions are typical of those observed in channelized stream reaches: channel development is homogenous (100% run), there is a lack of coarse substrates, sparse cover is present for biota and gradient is low. Despite these setbacks, the biology of Gilmore Creek performs exceptionally well. Fish results exceed upper confidence intervals for equivalent natural streams and macroinvertebrates also score above thresholds expected of equivalent natural systems and slightly improve over time. The biological community is typical of southern coldwater communities including both brown trout and sculpin. Biota of Gilmore Creek would likely benefit from stream habitat improvement within the basin. The Gilmore subwatershed serves as a majority of the catchment area for Lake Winona and is predominately undisturbed and not likely contributing significantly to Lake Winona’s nutrient impairment.

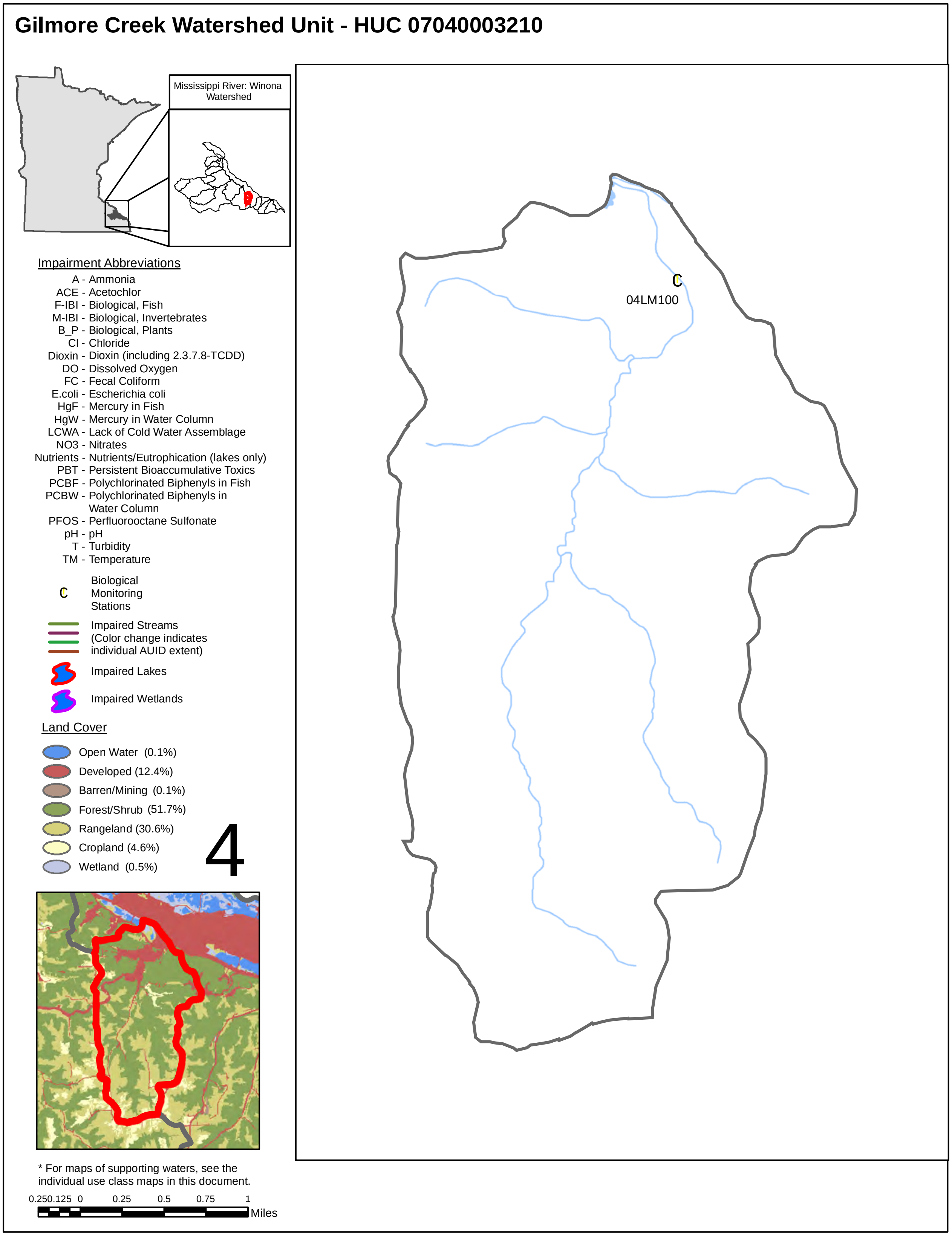

Figure 30. Currently listed impaired waters by parameter and land use characteristics in the Gilmore Creek Watershed Unit.

Pleasant Valley Watershed Unit HUC 07040003230

Pleasant Valley Subwatershed is another small watershed in the southern portion of the Mississippi River (Winona) drainage, adjacent to the Mississippi River, containing a mere 13 mi^2 of Winona County. The watershed is predominately forested (57%) with a third of its land managed as rangeland and 11% developed. Pleasant Valley Creek begins in its southern reaches flowing north, starting in Centerville, it follows CSAH 17 before veering north following Pleasant Valley Road. It drains to small lakes which drain to the Mississippi River approximately one mile southeast of Winona. Due to its small drainage, MPCA did not establish a stream water chemistry station at the outlet of Pleasant Valley Creek. No lakes are present within the watershed.

Table 51. Aquatic Life and Recreation assessments on stream reaches: Pleasant Valley Watershed Unit.

AUID *Reach Name,* *Reach Description*	Reach Length (miles)	Use Class	Biological Station ID	Location of Biological Station	Aquatic Life Indicators: Fish IBI	Invert IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides	Bacteria	Aquatic Life	Aquatic Rec.
07040003588 ***Pleasant Valley Creek,*** *T106 R7W S25, west line to T106 R7W S1, north line*	7.45	1B, 2A, 3B	04LM094	Upstream of CSAH 15 (Homer Rd), 1 mi. SE of Winona	NA	NA	–	MTS	–	–	–	–	–	IF*	NA

Abbreviations for Indicator Evaluations: **–** = No Data, **NA** = Not Assessed, **IF** = Insufficient Information, **MTS** = Meets criteria; **EXP** = Exceeds criteria, potential impairment; **EXS** = Exceeds criteria, potential severe impairment; **EX** = Exceeds criteria (Bacteria).
Abbreviations for Use Support Determinations: **NA** = Not Assessed, **IF** = Insufficient Information, **NS** = Non-Support, **FS** = Full Support
Key for Cell Shading: = existing impairment, listed prior to 2012 reporting cycle; = new impairment; = full support of designated use.
*Aquatic Life assessment and/or impairments have been deferred until the adoption of Tiered Aquatic Life Uses due to the AUID being predominantly (>50%) channelized or having biological data limited to a station occurring on a channelized portion of the stream.

Table 52. Non-assessed biological stations on channelized AUIDs: Pleasant Valley 11-HUC.

AUID **Reach Name,** *Reach Description*	Reach length (miles)	Use Class	Biological Station ID	Location of Biological Station	Fish IBI	Invert IBI
07040003588 **Pleasant Valley Creek,** *T106 R7W S25, west line to T106 R7W S1, north line*	7.45	1B, 2A, 3B	04LM094	Upstream of CSAH 15 (Homer Rd), 1 mi. SE of Winona	Fair	Good (4)

See Appendix 5.1 for clarification on the good/fair/poor thresholds and Appendix 5.2 and Appendix 5.3 for IBI results. Parentheses behind ratings indicate the quantity of site visits when >1, which may or may not occur in the same year.

Table 53. Minnesota Stream Habitat Assessment (MSHA): Pleasant Valley 11-HUC.

# Visits	Biological Station ID	Reach Name	Land Use (0-5)	Riparian (0-15)	Substrate (0-27)	Fish Cover (0-17)	Channel Morph. (0-36)	MSHA Score (0-100)	MSHA Rating
2	04LM094	Pleasant Valley Creek	3.5	9.8	17	7.5	8.5	46.3	Fair
		Average Habitat Results: Pleasant Valley *11 HUC*	**3.5**	**9.8**	**17**	**7.5**	**8.5**	**46.3**	**Fair**

Qualitative habitat ratings

= Good: MSHA score above the median of the least-disturbed sites (MSHA>66)

= Fair: MSHA score between the median of the least-disturbed sites and the median of the most-disturbed sites (45 < MSHA < 66)

= Poor: MSHA score below the median of the most-disturbed sites (MSHA<45)

Table 54. Channel Condition and Stability Assessment (CCSI): Pleasant Valley 11 HUC.

# Visits	Biological Station ID	Stream Name	Upper Banks (4-43)	Lower Banks (5-46)	Substrate (3-37)	Channel Evolution (1-11)	CCSI Score (13-137)	CCSI Rating
1	04LM094	Pleasant Valley Creek	21	15	26	7	69	moderately unstable
		Average Stream Stability Results: *Pleasant Valley 11 HUC*	**21**	**15**	**26**	**7**	**69**	**moderately unstable**

Qualitative channel stability scores and ratings (Higher scores indicate greater channel instability)

= stable: CCSI < 27 = fairly stable: 27 < CCSI < 45 = moderately unstable: 45 < CCSI < 80 = severely unstable: 80 < CCSI < 115 = extremely unstable: CCSI > 115

Summary

Pleasant Valley Creek was determined to be fully supporting of turbidity; however, insufficient data from other parameters were available to make a sufficient aquatic life use assessment. Pleasant Valley Creek was not assessed for biology due to the station occurring on a predominately channelized stream channel at the biological station. Biological communities perform poorly when compared to standards for natural stream channels of equivalent classes. While the fish community has improved over time between the 2004 and 2010 visits (fewer tolerant individuals), relative quantities of coldwater individuals are low, despite thermal conditions being suitable to their presence. Instream habitat at the biological station is homogenous, 95% run, and dominated by fine sediments with sparse cover present within the reach. The thermal potential for Pleasant Valley Creek suggests that the stream's biological communities would benefit from in-stream habitat restoration efforts.

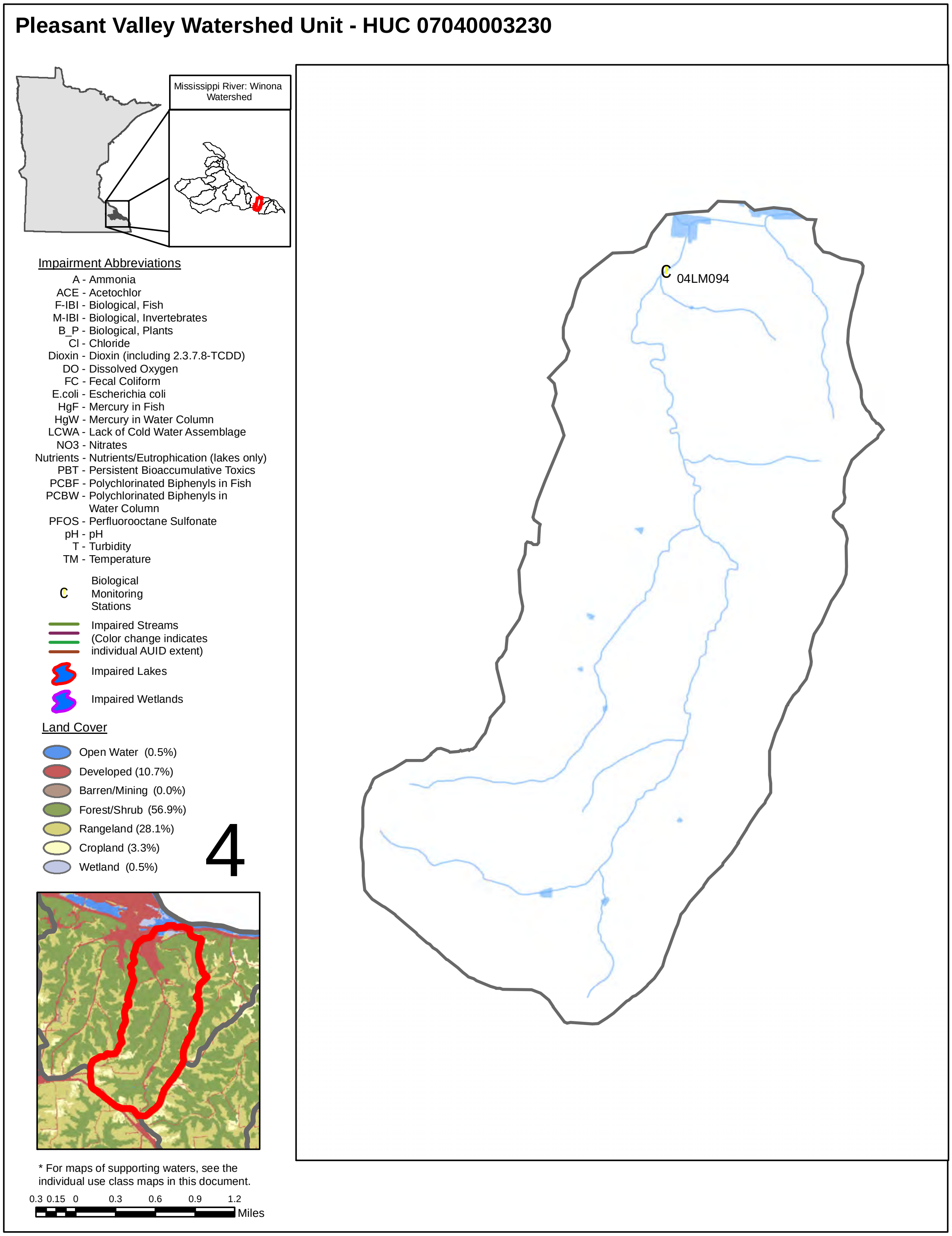

Figure 31. Currently listed impaired waters by parameter and land use characteristics in the Pleasant Valley Watershed Unit.

Cedar Creek Watershed Unit HUC 07040003250

Draining 18 mi^2 of Winona County, Cedar Creek Subwatershed lies in the southern expanse of the Mississippi River (Winona) Watershed. Cedar Creek begins on the north side of I90 near Witoka. Flowing northeast the creek follows CSAH 9 draining directly to the Mississippi River north of Lamoille. The watersheds landuse is predominately forested (53%) and rangeland (36%). Due to its small drainage, MPCA did not establish a stream water chemistry station at the outlet of Cedar Creek, but is represented by biological station 10LM027. No lakes are present within the watershed.

Table 55. Aquatic Life and Recreation assessments on stream reaches: Cedar Creek Watershed Unit.

AUID *Reach Name,* *Reach Description*	Reach Length (miles)	Use Class	Biological Station ID	Location of Biological Station	Aquatic Life Indicators: Fish IBI	Invert IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides	Bacteria	Aquatic Life	Aquatic Rec.
07040003591 ***Cedar Creek (Cedar Valley Creek)***, *Unnamed cr to Mississippi R*	11.7	1B, 2A, 3B	10LM027	Downstream of CSAH 9, 7 mi. SE of Winona	MTS	MTS	–	MTS	–	–	–	MTS	–	FS	NA

Abbreviations for Indicator Evaluations: – = No Data, **NA** = Not Assessed, **IF** = Insufficient Information, **MTS** = Meets criteria; **EXP** = Exceeds criteria, potential impairment; **EXS** = Exceeds criteria, potential severe impairment; **EX** = Exceeds criteria (Bacteria).
Abbreviations for Use Support Determinations: **NA** = Not Assessed, **IF** = Insufficient Information, **NS** = Non-Support, **FS** = Full Support
Key for Cell Shading: = existing impairment, listed prior to 2012 reporting cycle; = new impairment; = full support of designated use.

Table 56. Minnesota Stream Habitat Assessment (MSHA): Cedar Creek 11-HUC.

# Visits	Biological Station ID	Reach Name	Land Use (0-5)	Riparian (0-15)	Substrate (0-27)	Fish Cover (0-17)	Channel Morph. (0-36)	MSHA Score (0-100)	MSHA Rating
1	10LM027	Cedar Creek	5	11.5	18.4	11	31	76.9	Good
		Average Habitat Results: *Cedar Creek 11 HUC*	**5**	**11.5**	**18.4**	**11**	**31**	**76.9**	**Good**

Qualitative habitat ratings
- = Good: MSHA score above the median of the least-disturbed sites (MSHA>66)
- = Fair: MSHA score between the median of the least-disturbed sites and the median of the most-disturbed sites (45 < MSHA < 66)
- = Poor: MSHA score below the median of the most-disturbed sites (MSHA<45)

Table 57. Channel Condition and Stability Assessment (CCSI): Cedar Creek 11 HUC.

# Visits	Biological Station ID	Stream Name	Upper Banks (4-43)	Lower Banks (5-46)	Substrate (3-37)	Channel Evolution (1-11)	CCSI Score (13-137)	CCSI Rating
1	10LM027	Cedar Creek	29	18	12	7	66	moderately unstable
Average Stream Stability Results: Cedar Creek *11 HUC*			**29**	**18**	**12**	**7**	**66**	**moderately unstable**

Qualitative channel stability scores and ratings (Higher scores indicate greater channel instability)

= stable: CCSI < 27 = fairly stable: 27 < CCSI < 45 = moderately unstable: 45 < CCSI < 80 = severely unstable: 80 < CCSI < 115 = extremely unstable: CCSI > 115

Summary

Biological populations of Cedar Creek appear healthy and typical of small cold headwater systems, despite the absence of native trout and sculpin taxa. Habitat conditions reflect supporting turbidity condition and are near ideal with a habitat score that ranks amongst the highest of the entire HUC 8 watershed. A one-time water chemistry grab sample during the biological visit also indicate drastically lower levels of nitrogen 0.9 mg/L compared to results seen in the rest of the HUC 8 watershed.

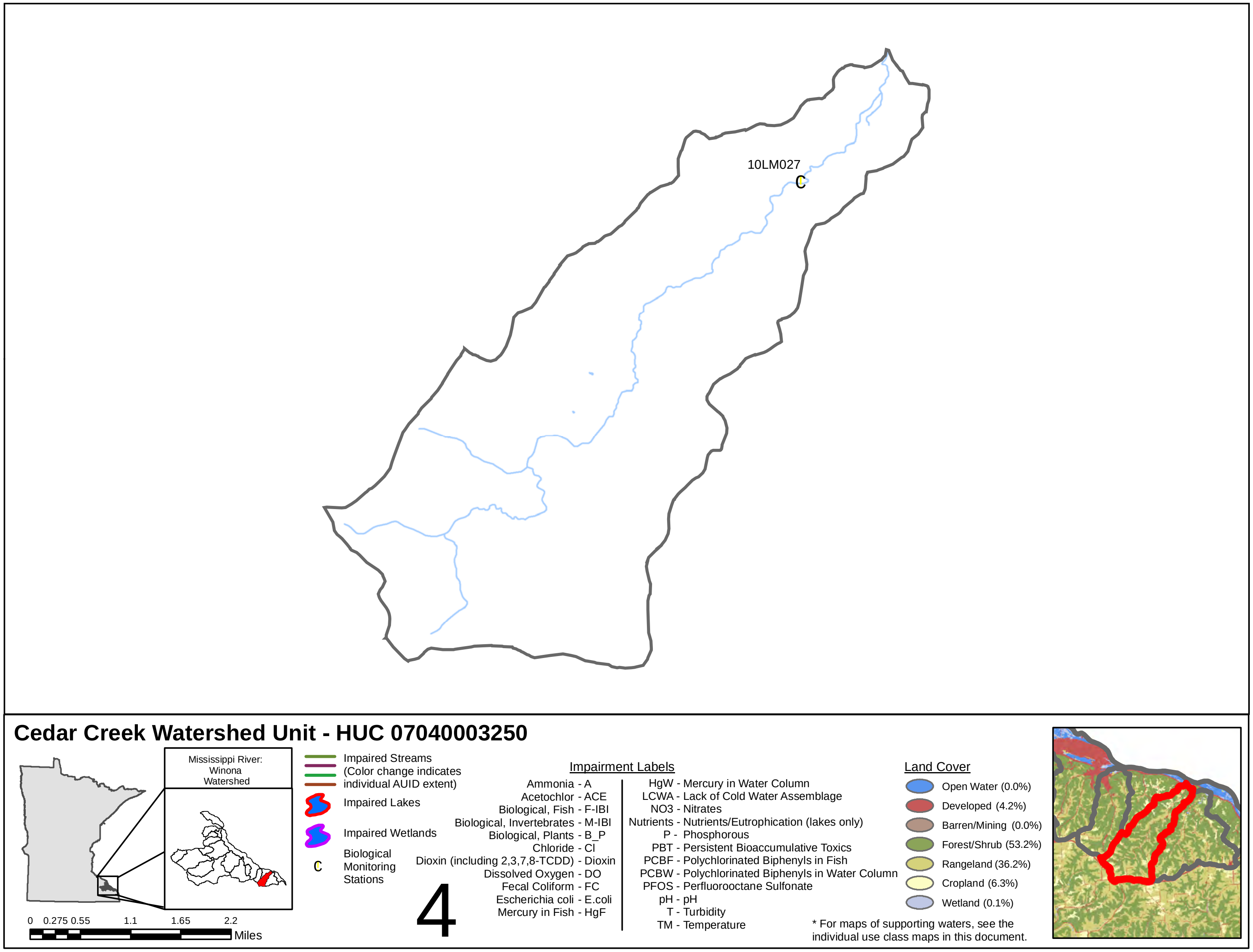

Figure 32. Currently listed impaired waters by parameter and land use characteristics in the Cedar Creek Watershed Unit.

Pickwick Valley Watershed Unit HUC 07040003270

Located in the southern region of the Mississippi River (Winona) major watershed, Pickwick Valley is the culmination of Big Trout and Little Trout Creeks, also referred to as Big Pickwick and Little Pickwick Creeks. The subwatershed's southernmost reaches begin on the north side of I90 between Ridgeway and Nodine. Its streams flow north draining 21 mi^2 of Winona County. Big Trout Creek follows CR 7 while Little Trout Creek follows Township Road 8. The tributaries converge near the town of Pickwick, home of the historic Pickwick Mill. Built in 1856, the Mill is one of the oldest water powered gristmills in southeastern Minnesota. Big Trout then follows Twp Road 9 and drains directly to the Mississippi River near Lamoille. The watershed is predominately forested (55.5%), a third is managed as rangeland (33.4%) and 6% is developed. Due to its small drainage, MPCA did not establish a stream water chemistry station at the outlet of Big Trout Creek. No lakes are present within the watershed.

Table 58. Aquatic Life and Recreation assessments on stream reaches: Pickwick Valley Watershed Unit. Reaches are organized upstream to downstream in the table.

AUID *Reach Name,* *Reach Description*	Reach Length (miles)	Use Class	Biological Station ID	Location of Biological Station	Aquatic Life Indicators: Fish IBI	Invert IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides	Bacteria	Aquatic Life	Aquatic Rec.
07040003592 ***Big Trout Creek (Pickwick Creek),*** *Unnamed cr to Mississippi R*	8.63	1B, 2A, 3B	10LM028 04LM092	Downstream of Homer Twp Rd 6 (Trout Creek Rd), 9 mi. SE of Winona Adjacent to CSAH 7, 1 mi. S of Lamoille	MTS	EXP	IF	MTS	–	IF	–	–	–	NS	NA
07040003593 ***Little Trout Creek (Little Pickwick Creek),*** *T106 R5W S32, east line to Big Trout Cr*	5.53	1B, 2A, 3B	10LM029	Upstream of Twp Rd 8, 9 mi. SE of Winona	MTS	MTS	IF	IF	–	IF	–	–	–	FS	NA

Abbreviations for Indicator Evaluations: – = No Data, **NA** = Not Assessed, **IF** = Insufficient Information, **MTS** = Meets criteria; **EXP** = Exceeds criteria, potential impairment; **EXS** = Exceeds criteria, potential severe impairment; **EX** = Exceeds criteria (Bacteria).

Abbreviations for Use Support Determinations: **NA** = Not Assessed, **IF** = Insufficient Information, **NS** = Non-Support, **FS** = Full Support

Key for Cell Shading: = existing impairment, listed prior to 2012 reporting cycle; = new impairment; = full support of designated use.

Table 59. Minnesota Stream Habitat Assessment (MSHA): Pickwick Valley 11-HUC.

# Visits	Biological Station ID	Reach Name	Land Use (0-5)	Riparian (0-15)	Substrate (0-27)	Fish Cover (0-17)	Channel Morph. (0-36)	MSHA Score (0-100)	MSHA Rating
1	04LM092	Big Trout Creek (Pickwick Creek)	5	12	13.7	8	15	53.7	Fair
1	10LM029	Little Trout Creek	5	9	21.5	13	26	74.5	Good
1	10LM028	Big Trout Creek (Pickwick Creek)	0	6	12	12	24	54	Fair
		Average Habitat Results: *Pickwick Valley 11 HUC*	**3.33**	**9**	**15.73**	**11**	**21.67**	**60.73**	**Fair**

Qualitative habitat ratings

= Good: MSHA score above the median of the least-disturbed sites (MSHA>66)

= Fair: MSHA score between the median of the least-disturbed sites and the median of the most-disturbed sites (45 < MSHA < 66)

= Poor: MSHA score below the median of the most-disturbed sites (MSHA<45)

Table 60. Channel Condition and Stability Assessment (CCSI): Pickwick Valley 11 HUC.

# Visits	Biological Station ID	Stream Name	Upper Banks (4-43)	Lower Banks (5-46)	Substrate (3-37)	Channel Evolution (1-11)	CCSI Score (13-137)	CCSI Rating
1	10LM029	Little Trout Creek	13	5	6	1	25	stable
1	10LM028	Big Trout Creek (Pickwick Creek)	14	10	13	1	38	fairly stable
	Average Stream Stability Results: *Pickwick Valley 11 HUC*		**13.5**	**7.5**	**9.5**	**1**	**31.5**	**fairly stable**

Qualitative channel stability scores and ratings (Higher scores indicate greater channel instability)

= stable: CCSI < 27 = fairly stable: 27 < CCSI < 45 = moderately unstable: 45 < CCSI < 80 = severely unstable: 80 < CCSI < 115 = extremely unstable: CCSI > 115

Summary

Biological impairment within the Big Trout Creek watershed appears to be isolated within the headwaters of Big Trout Creek. While fish results exceed upper confidence limits, with coldwater taxa such as brown trout and slimy sculpin, macroinvertebrates do not fare well. Invertebrate communities are dominated by large number of oligochaetes which indicates stress. The low habitat scores at the station may be attributed to pasture within the riparian zone and sedimentation of pools and severe embeddedness of coarse substrates in the instream zone. Big Trout Creek was determined to be fully supporting based on levels of turbidity. Several habitat improvement efforts have been completed near the biological station in recent years; MDNR believes the invertebrate community will improve over time as a result of these past efforts.

Downstream biological communities perform above standards for both indicators; however, habitat conditions appear worse than its upstream counterpart. Available habitat is much less diverse in nature, dominated by a single channel type (run), fine sediments, less cover and slower flows. While classified as a southern coldwater stream, the fish community is more diverse. Several warmwater species were present within the sample; the stream is demonstrating influence of warmer water temperature and/or proximity to Mississippi River. Water temperatures increase moving downstream but remain cold enough for coldwater obligate taxa. Additional monitoring could better define the thermal nature of Big Trout Creek prior to its confluence with the Mississippi River. Additional monitoring may also determine whether the small impoundment between these stations is influencing biological results.

Little Trout Creek met aquatic life use standards and performed exceptionally for both indicators and habitat scores. The stream supports a healthy coldwater biological community including both native brook trout and slimy sculpin (BCG tier 1 for fish). Additional investigation as to why Little Trout Creek preforms so well may better inform impairment on neighboring Big Trout Creek.

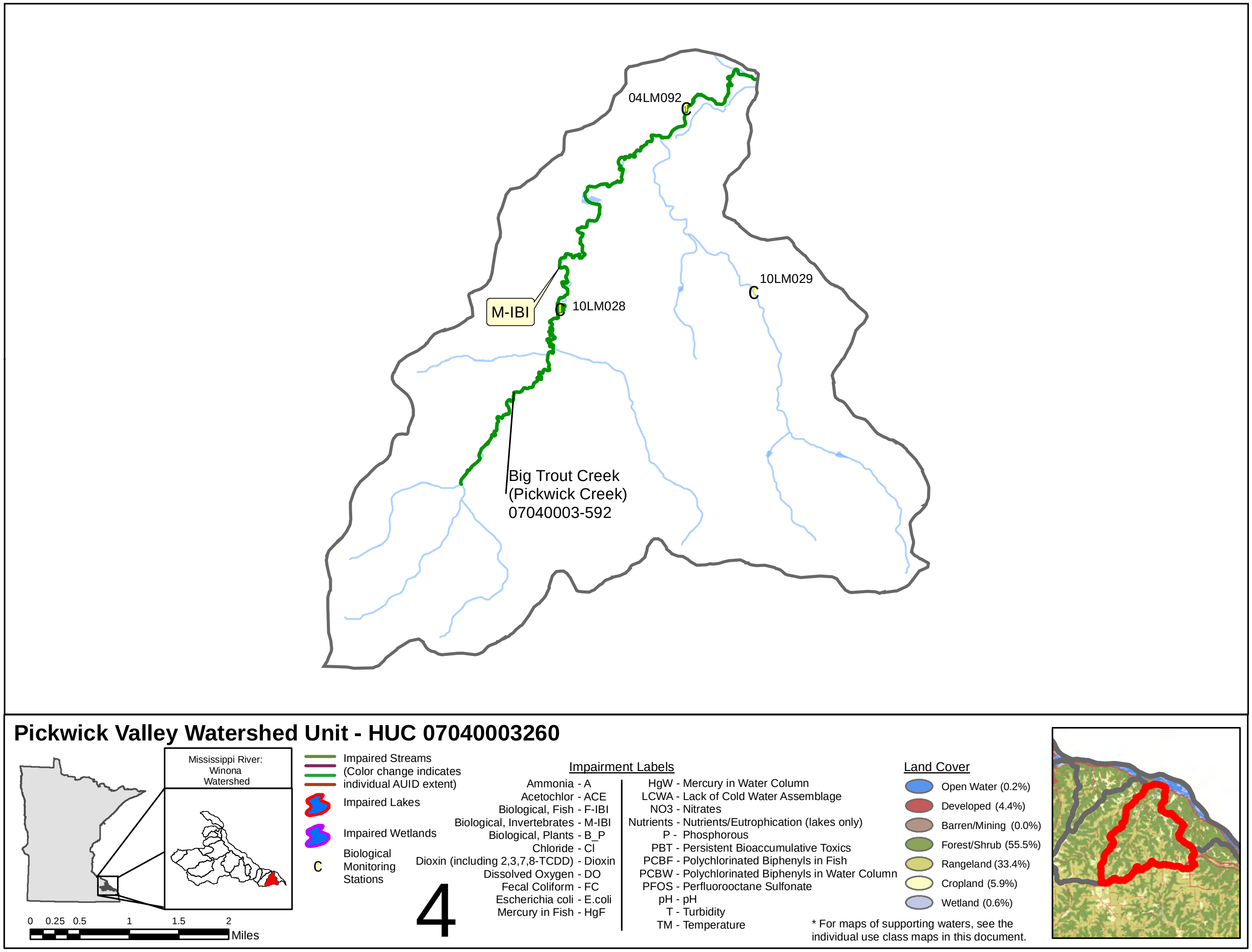

Figure 33. Currently listed impaired waters by parameter and land use characteristics in the Pickwick Valley Watershed Unit.

Dakota Valley Watershed Unit HUC 07040003270

Stretching over 94 mi^2 of picturesque bluff country of southeastern Minnesota, Dakota Valley is a long and narrow watershed spanning its eastern boundaries from southeastern Wabasha County to Winona County. Dakota Valley houses the only assessed lake within the Mississippi River (Winona) watershed, Lake Winona. It is not a true watershed, as it includes a flow-through section of the Mississippi River from the confluence of the Zumbro to Donehower, and several small tributaries that enter the Mississippi River directly including Burns Valley Creek near the subwatershed's southeastern boundary. The subwatershed's landuse is over nearly 60% natural (34% forest, 24% open water and 10% wetland), 19% agricultural (rangeland 14% and cropland 5%) and 13% developed, including the watershed's largest city, Winona. As aforementioned, the portion of the Mississippi River included in this subwatershed was not monitored in this study as it is a great river. The MPCA did not establish a stream water chemistry station within the watershed due to its nature as a flow-through section of the Mississippi River nor did the MPCA establish a stream chemistry station at the outlet of its largest tributary, Burns Valley Creek, due to its small drainage area.

Table 61. Aquatic Life and Recreation assessments on stream reaches: Dakota Valley Watershed Unit.

AUID *Reach Name*, *Reach Description*	Reach Length (miles)	Use Class	Biological Station ID	Location of Biological Station	Aquatic Life Indicators: Fish IBI	Invert IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides	Bacteria	Aquatic Life	Aquatic Rec.
07040003584 ***West Burns Valley Creek,*** *T106 R7W S16, west line to Burns Valley cr*	3.77	1B, 2A, 3B	03LM003	Downstream of Hwy 43, 2 mi. S of Winona	MTS	MTS	–	–	–	–	–	–	–	FS	NA

Abbreviations for Indicator Evaluations: – = No Data, **NA** = Not Assessed, **IF** = Insufficient Information, **MTS** = Meets criteria; **EXP** = Exceeds criteria, potential impairment; **EXS** = Exceeds criteria, potential severe impairment; **EX** = Exceeds criteria (Bacteria).
Abbreviations for Use Support Determinations: **NA** = Not Assessed, **IF** = Insufficient Information, **NS** = Non-Support, **FS** = Full Support
Key for Cell Shading: = existing impairment, listed prior to 2012 reporting cycle; = new impairment; = full support of designated use.

Table 62. Minnesota Stream Habitat Assessment (MSHA): Dakota Valley 11-HUC.

# Visits	Biological Station ID	Reach Name	Land Use (0-5)	Riparian (0-15)	Substrate (0-27)	Fish Cover (0-17)	Channel Morph. (0-36)	MSHA Score (0-100)	MSHA Rating
1	03LM003	West Burns Valley Creek	5	13	15	11	24	68	Good
		Average Habitat Results: *Dakota Valley 11 HUC*	**5**	**13**	**15**	**11**	**24**	**68**	**Good**

Qualitative habitat ratings
- = Good: MSHA score above the median of the least-disturbed sites (MSHA>66)
- = Fair: MSHA score between the median of the least-disturbed sites and the median of the most-disturbed sites (45 < MSHA < 66)
- = Poor: MSHA score below the median of the most-disturbed sites (MSHA<45)

Table 63. Channel Condition and Stability Assessment (CCSI): Dakota Valley 11 HUC.

# Visits	Biological Station ID	Stream Name	Upper Banks (4-43)	Lower Banks (5-46)	Substrate (3-37)	Channel Evolution (1-11)	CCSI Score (13-137)	CCSI Rating
1	03LM003	West Burns Valley Creek	12	9	6	1	28	fairly stable
Average Stream Stability Results: *Dakota Valley 11 HUC*			**12**	**9**	**6**	**1**	**28**	**fairly stable**

Qualitative channel stability scores and ratings (Higher scores indicate greater channel instability)

= stable: CCSI < 27 = fairly stable: 27 < CCSI < 45 = moderately unstable: 45 < CCSI < 80 = severely unstable: 80 < CCSI < 115 = extremely unstable: CCSI > 115

Table 64. Lake Water Aquatic Recreation Assessments: Dakota Valley 11-HUC.

Name	DOW#	Area (ha)	Trophic Status	% Littoral	Max. Depth (F)	Avg. Depth (F)	CLMP Trend	Mean TP (µg/L)	Mean Chl-a (µg/L)	Secchi Mean (F)	Support Status
Winona (South Bay)	85-0011-01	88	E	90	11.6	4.4	--	53	52	1	NS
Winona (North Bay)	85-0011-02	36	E	90	6.7	2.4	--	85	69	0.9	NS

Abbreviations: ↘ – Decreasing/Declining Trend; ↗ – Increasing/Improving Trends; NT – No Trend; **H** – Hypereutrophic; **E** – Eutrophic; **M** – Mesotrophic; **FS** – Full Support; **NS** – Non-Support; **IF** – Insufficient Information

Abbreviations for Use Support Determinations: **NA** = Not Assessed, **IF** = Insufficient Information, **NS** = Non-Support, **FS** = Full Support

Key for Cell Shading: = existing impairment, listed prior to 2012 reporting cycle; = new impairment; = full support of designated use.

Summary

Based on the North Central Hardwood Forest (NCHF) deep lake standards (Appendix 6.1), both basins of Lake Winona were determined to be non-supporting for aquatic recreational use due to excessive nutrients. A majority of the catchment area within the Gilmore Creek subwatershed is undisturbed, but both basins of the lake lie within, and receive external contributions from, a highly developed area in the city of Winona. This catchment area, characteristic within the immediate vicinity of Lake Winona, may be contributing to the excessive nutrient levels observed.

Limited stream water quality data was available within this subwatershed; however, sufficient data was available for an aquatic life use assessment on West Burns Valley Creek. Both fish and macroinvertebrate indicators demonstrate a healthy coldwater biological community typical of a headwaters system, including a population of native Brook Trout.

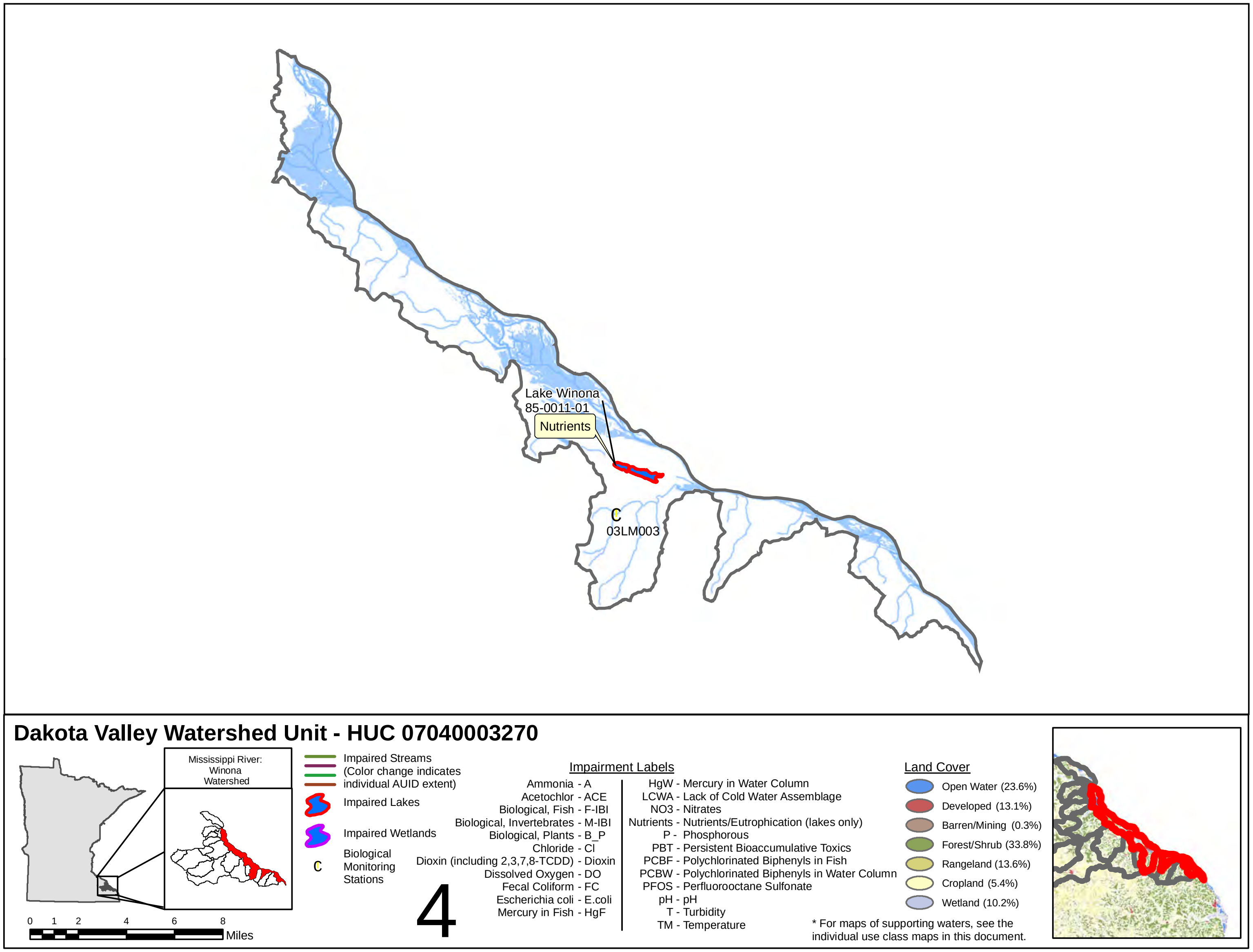

Figure 34. Currently listed impaired waters by parameter and land use characteristics in the Dakota Valley Watershed Unit.

VI. Watershed-wide results and discussion

Assessment results and data summaries are included below for the entire HUC-8 watershed unit of the Mississippi River (Winona) Watershed, grouped by sample type. Summaries are provided for load monitoring data results near the mouth of the river, aquatic life and recreational uses in streams and lakes throughout the watershed, and for aquatic consumption results at select river and lake locations along the watershed. Additionally, groundwater monitoring results and long-term monitoring trends are included where applicable.

Following the results are a series of graphics that provide an overall summary of assessment results by designated use, impaired waters, and fully supporting waters within the entire Mississippi River (Winona) Watershed.

Pollutant Load Monitoring

The Whitewater River is monitored on CSAH 30 near Beaver, Minnesota, approximately 10 river miles above the confluence with the Mississippi River. Many years of water quality data from throughout Minnesota combined with the previous analysis of Minnesota's ecoregion patterns, resulted in the development of three "River Nutrient Regions" (RNR), each with unique nutrient standards (MPCA, 2008). Of the state's 3 RNRs (North, Central, South), the Whitewater River's monitoring station is located within the Central RNR.

Annual flow weighed mean concentrations (FWMCs) were calculated and compared for years 2009-2011 (Figure 35, Figure 36, Figure 37 and Figure 38) and compared to the RNR standards (only TP and TSS draft standards are available for the Central RNR). It should be noted that while a FWMC exceeding given water quality standard is generally a good indicator that the water body is out of compliance with the RNR standard, the rule does not always hold true. Waters of the state are listed as impaired based on the percentage of individual samples exceeding the numeric standard, generally 10% and greater, over the most recent ten year period and not based on comparisons with FWMCs (MPCA, 2012). A river with a FWMC above a water quality standard, for example, would not be listed as impaired if less than 10% of the individual samples collected over the assessment period were above the standard.

Pollutant sources affecting rivers are often diverse and can be quite variable from one watershed to the next depending on land use, climate, soils, slopes, and other watershed factors. However, as a general rule, elevated levels of total suspended solids (TSS) and nitrate plus nitrite-nitrogen (nitrate-N) are generally regarded as "non-point" source derived pollutants originating from many small diffuse sources such as urban or agricultural runoff. Excess total phosphorus (TP) and dissolved orthophosphate (DOP) can be attributed to both "non-point" as well as "point" or end of pipe sources such as industrial or waste water treatment plants. Major "non-point" sources of phosphorus include dissolved phosphorus from fertilizers and phosphorus adsorbed to and transported with sediment during runoff.

Within a given watershed, pollutant sources and source contributions can also be quite variable from one runoff event to the next depending on factors such as: canopy development, soil saturation level, and precipitation type and intensity. Surface erosion and in-stream sediment concentrations, for example, will typically be much higher following high intensity rain events prior to canopy development rather than after low intensity post-canopy events where less surface runoff and more infiltration occur. Precipitation type and intensity influence the major course of storm runoff, routing water through several potential pathways including overland, shallow and deep groundwater, and/or tile flow. Runoff pathways along with other factors determine the type and levels of pollutants transported in runoff to receiving waters and help explain between-storm and temporal differences in

FWMCs and loads, barring differences in total runoff volume. During years when high intensity rain events provide the greatest proportion of total annual runoff, concentrations of TSS and TP tend to be higher and DOP and nitrate-N concentrations tend to be lower. In contrast, during years with high snow melt runoff and less intense rainfall events, TSS levels tend to be lower while TP, DOP, and nitrate-N levels tend to be elevated.

Total Suspended Solids

Water clarity refers to the transparency of water. Turbidity is a measure of the lack of transparency or "cloudiness" of water due to the presence of suspended and colloidal materials such as clay, silt, finely divided organic and inorganic matter, and plankton or other microscopic organisms. By definition, turbidity is caused primarily by suspension of particles that are smaller than one micron in diameter in the water column.

Analysis has shown a strong correlation to exist between the measures of TSS and turbidity. The greater the level of TSS, the murkier the water appears and the higher the measured turbidity. High turbidity results in reduced light penetration that harms beneficial aquatic species and favors undesirable algae species (MPCA and MSUM, 2009). An overabundance of algae can lead to increases in turbidity, further compounding the problem. Periods of high turbidity often occur when heavy rains fall on unprotected soils. Upon impact, raindrops dislodge soil particles and overland flow transports fine particles of silt and clay into rivers and streams (MPCA and MSUM, 2009).

Currently, the state of Minnesota’s TSS standards in the development phase and must be considered to be draft standards until approved. Within the Central RNR, the river would be considered impaired when greater than 10% of the individual samples exceed the TSS draft standard of 30 mg/L. (MPCA, 2011). From 2009 – 2011, 21%, 54%, and 68% of the samples exceeded the 30 mg/L draft standard, respectively. The computed FWMCs also exceeded the 30 mg/L draft standard as shown in Figure 35. TSS exceeded the draft standard during all rain events with the highest TSS concentration (4300 mg/L) occurring on during a September 2010 rain event having a peak flow in excess of 7000 cfs. This particular event had significant influence on the 2010 TSS FWMC.

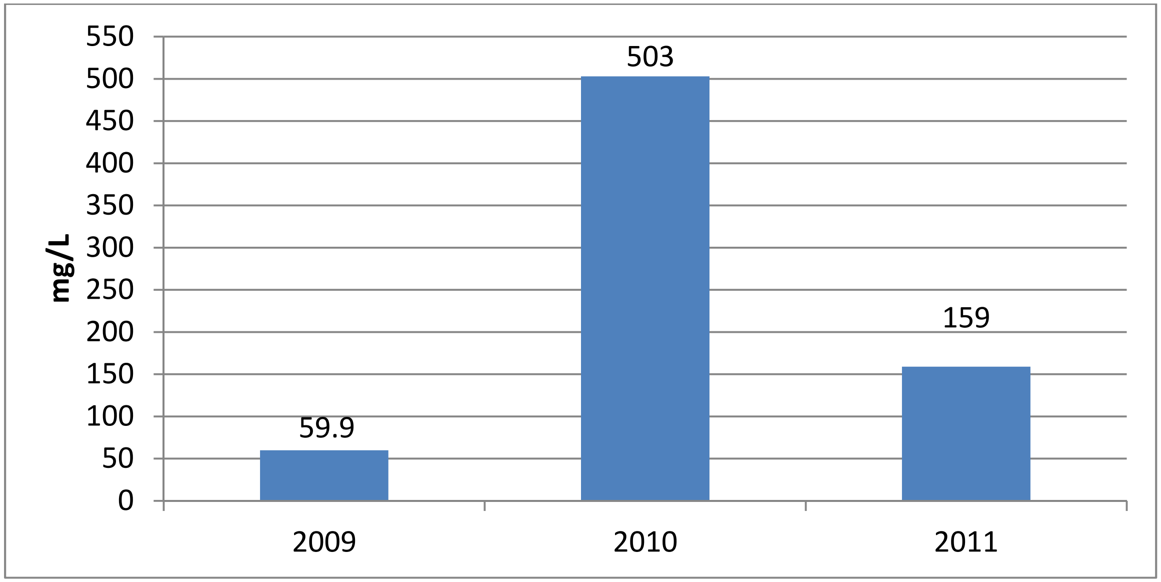

Figure 35. Total Suspended Solids (TSS) flow weighted mean concentrations in the Whitewater River.

Table 65. Annual pollutant loads by parameter calculated for the Whitewater River.

	2009	2010	2011
Parameter	**Mass (kg)**	**Mass (kg)**	**Mass (kg)**
Total Suspended Solids	8,425,941	104,055,520	35,420,018
Total Phosphorus	20,740	118,461	48,486
Ortho Phosphorus	12,218	52,256	28,005
Nitrate + Nitrite Nitrogen	742,095	1,157,109	1,408,305

Total Phosphorus

Nitrogen, phosphorus and potassium are essential macronutrients and are required for growth by all animals and plants. Lack of sufficient nutrient levels in surface water often restricts the growth of aquatic plant species (University of Missouri Extension, 1999). In freshwaters such as lakes and streams, phosphorus is typically the nutrient limiting growth; increasing the amount of phosphorus entering a stream or lake will increase the growth of aquatic plants and other organisms. Although phosphorus is a necessary nutrient, excessive levels overstimulate aquatic growth in lakes and streams resulting in reduced water quality. The progressive deterioration of water quality from overstimulation of nutrients is called eutrophication where, as nutrient concentrations increase, the surface water quality is degraded (University of Missouri Extension, 1999). Elevated levels of phosphorus in rivers and streams can result in: increased algae growth, reduced water clarity, reduced oxygen in the water, fish kills, altered fisheries, and toxins from cyanobacteria (blue green algae) which can affect human and animal health (University of Missouri Extension, 1999). In non-point source dominated watersheds, total phosphorus (TP) concentrations are strongly correlated with stream flow. During years of above average precipitation, TP loads are generally highest.

TP standards for Minnesota's rivers are also in development and must be considered draft standards until approved. Within the Central RNR, the TP draft standard is 0.100 mg/L as a summer average. Summer average violations of one or more "response" variables (pH, biological oxygen demand, dissolved oxygen flux, chlorophyll-a) must also occur along with the numeric TP violation for the water to be listed. In comparison of the data collected during from June through September from 2009 to 2011, TP exceedances occurred 37%, 58% and 65%, respectively. Figure 36 illustrates FWMCs greater than the draft standard in 2010 and 2011, albeit this includes all data throughout the year (not just summer values). Table 65 shows annual loads which exhibit similar traits as the FWMCs.

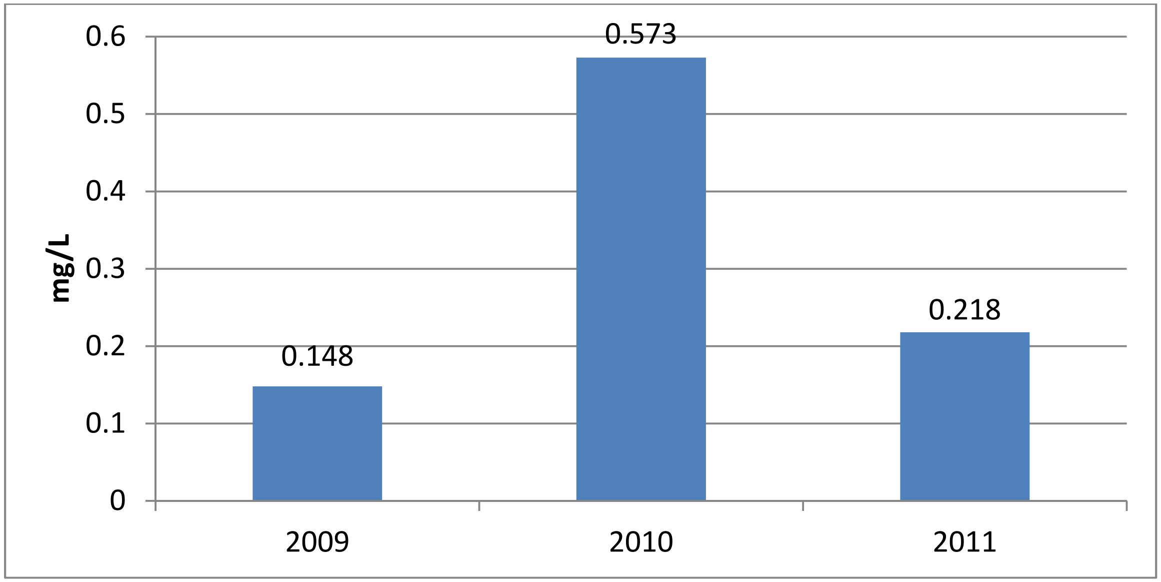

Figure 36. Total Phosphorus (TP) flow weighted mean concentrations for the Whitewater River.

Dissolved Orthophosphate

Dissolved Orthophosphate (DOP) is a water soluble form of phosphorus that is readily available for plant uptake (MPCA and MSUM, 2009). While orthophosphates occur naturally in the environment, river and stream concentrations may become elevated with additional inputs from waste water treatment plants, noncompliant septic systems, and fertilizers in urban and agricultural runoff. The DOP: TP ratio of FWMCs from the three years were 58%, 44%, and 58%, respectively. Figure 37 and Table 65 show similar trends between years as seen in TP and TSS. This is not uncommon due to the relationship between DOP, TP and TSS.

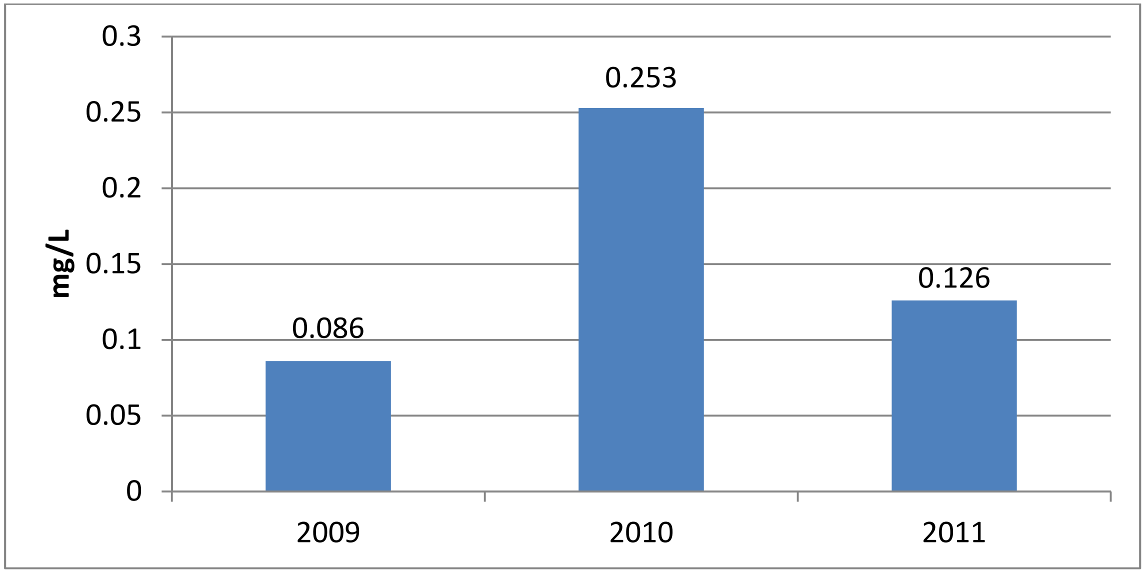

Figure 37. Dissolved Orthophosphate (DOP) flow weighted mean concentrations for the Whitewater River.

Nitrate plus nitrite-nitrogen

Nitrate and nitrite-nitrogen are inorganic forms of nitrogen present within the environment that are formed through the oxidation of ammonia-nitrogen by nitrifying bacteria (nitrification). Ammonia-nitrogen is found in fertilizers, septic systems, and animal waste. Once converted from ammonia-nitrogen to nitrate and nitrite-nitrogen, they too like phosphorus can stimulate excessive levels of some algae species in streams (MPCA, 2008). Because nitrate and nitrite-nitrogen are water soluble, transport to surface waters is enhanced through agricultural drainage. The ability of nitrite-N to be readily converted to nitrate-nitrogen is the basis for the combined laboratory analysis of nitrate plus nitrite-nitrogen, with nitrite-nitrogen typically making up a small proportion of the combined total concentration. These and other forms of nitrogen exist naturally in aquatic environments; however concentrations can vary drastically depending on season, biological activity, and anthropogenic inputs.

Nitrate-N can also be a common toxicant to aquatic organisms in Minnesota's surface waters with invertebrates appearing to be the most sensitive to nitrate toxicity. Draft nitrate-N standards have been proposed for the protection of aquatic life in lakes and streams. The draft acute value (maximum standard) for all Class 2 surface waters is 41 mg/L nitrate-N for a 1-day duration, and the draft chronic value for Class 2B (warm water) surface waters is 4.9 mg/L nitrate-N for a 4-day duration. In addition, a draft chronic value of 3.1 mg/L nitrate-N (4-day duration) was determined for protection of Class 2A (coldwater) surface waters (MPCA, 2010).

Figure 38 shows the nitrate-N FWMCs over the 3-year period for the Whitewater River monitoring site. The FWMC for all three years were well above the draft acute and chronic nitrate-N standards. During the study period all samples exceeded the Class 2A (coldwater) surface water nitrate-N draft standard. The majority of the highest concentrations during the study period were during low flow conditions. During low flow conditions groundwater is the primary water source and may be responsible for the elevated nitrate-N concentrations.

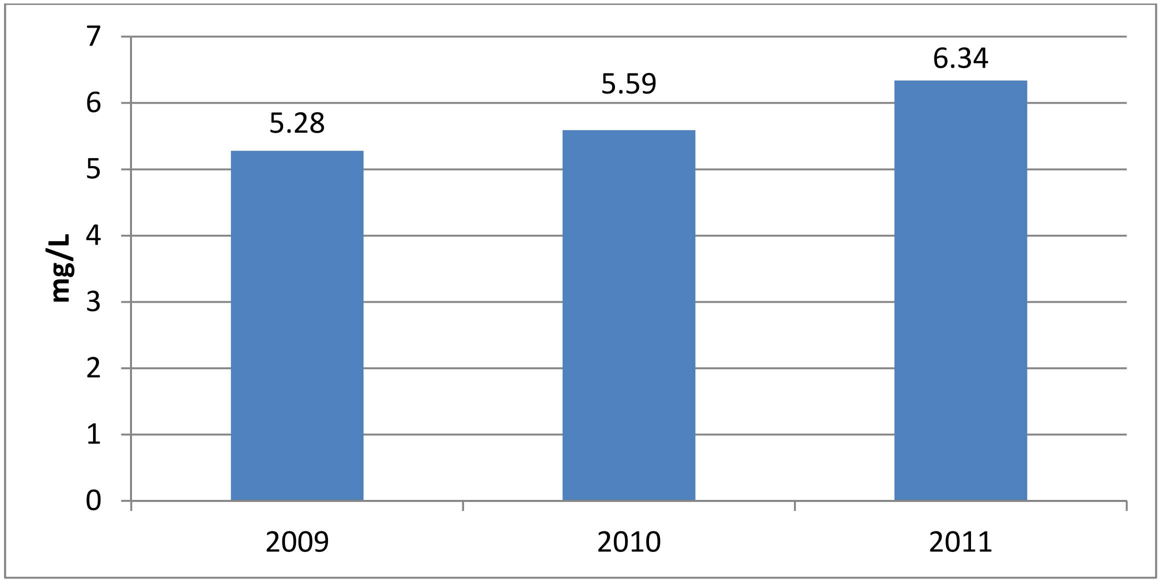

Figure 38. Nitrate + Nitrite Nitrogen (Nitrate-N) flow weighted mean concentrations for the Whitewater River.

Stream water quality

Twenty-eight of the 52 stream AUIDs were assessed (Table 66). Of the assessed streams, only 12 streams were considered to be fully supporting of aquatic life and no streams were fully supporting of aquatic recreation. Two AUIDs were not assessed due to their classification as limited resource waters. Twelve AUIDS were not assessed for aquatic biology because greater than 50% of the AUID is channelized or the biological station fell on a channelized stream reach on the AUID. Throughout the watersheds, 18 AUIDs are non-supporting of aquatic life and/or recreation. Of those AUIDs, 16 are non-supporting of aquatic life and 11 are non-supporting of aquatic recreation. Of those AUIDs, seven were non-supporting of aquatic life and two were non-supporting of aquatic recreation. The remaining nine AUIDs were non-supporting of both aquatic life and recreation. There are nine AUIDs with existing turbidity impairments and three additional reaches were recently listed as impaired due to turbidity. Recent data for Stockton Creek and several reaches of the Whitewater River did suggest improving water clarity. There were no DO impairments observed in any of the AUIDs within the Mississippi (Winona) watershed. There are six AUIDs that were previously listed as impaired for aquatic recreational use utilizing older fecal coliform data. Recent E. coli data support all of these impairments. In particular, results from the North and South Forks of the Whitewater River, Rollingstone Creek, Garvin Brook, and Stockton Valley Creek indicated that excessive bacteria levels are still present. Four AUIDs with sufficient data for assessment for pesticides met standards. Two AUIDs did not meet nitrate standards for drinking water. Low impairment rates can be explained more so by a lack of sufficient data to assess more AUIDs and not due to monitoring data meeting standards.

Table 66. Assessment summary for stream water quality in the Mississippi River (Winona) Watershed.

Watershed	Area (acres)	# Total AUIDs	# Assessed AUIDs	Supporting		Non-supporting		Insufficient Data for Aquatic Use Assessments
				# Aquatic Life	# Aquatic Recreation	# Aquatic Life	# Aquatic Recreation	
Mississippi River (Winona) **HUC 8**	**420,340**	**50**	**40**	**11**	**0**	**17**	**11**	**23**
Wabasha	14,916	0	0	–	–	–	–	–
Cooks Valley	12,664	2	2	–	–	–	–	2
Snake Creek	6,238	1	1	1	–	–	–	–
East Indian	13,161	1	1	1	–	–	–	–
Mississippi River Direct	4,781	0	0	–	–	–	–	–
Dry Creek	15,452	1	0	–	–	–	–	–
Whitewater River, North Branch	51,217	8	8	1	0	3	4	2
Whitewater River, Middle Branch	35,361	6	6	2	0	3	2	3
Whitewater River, South Branch	59,290	8	8	1	0	3	2	3
Beaver Creek	10,544	2	1	–	–	1	–	1
Whitewater River	33,381	4	3	1	–	2	1	1
Rollingstone Creek	32,294	6	4	1	–	2	1	3
Garvin Brook	31,244	4	2	0	–	2	1	2
Gilmore Creek	6,261	2	0	–	–	–	–	2
Pleasant Valley	8,580	2	0	–	–	–	–	2
Cedar Creek	11,335	1	1	1	–	–	–	–
Pickwick Valley	13,318	2	2	1	–	1	–	–
Dakota Valley	60,277	2	1	1	–	–	–	2

Biological monitoring

Of the waterways that were assessed for fish, 23 AUIDs met their respective thresholds for FIBI, while 4 failed general biocriteria. For those waterways that were not assessed for fish due to the reach or AUID being predominately channelized, 2 stations scored poorly, 2 stations scored fair, and 11 stations scored good. Invertebrates fared worse overall with only 17 meeting their respective MIBI thresholds and 10 failing biocriteria. For those waterways not assessed for invertebrates, three sites received poor ratings, seven had fair ratings and eight had good ratings.

Macroinvertebrates

The macroinvertebrate community in the Whitewater Watershed is largely reflective of the changing landscape from the headwaters to the mouth. The headwater streams primarily flow through agricultural uplands, and are mix of smaller designated coldwater and warmwater streams. Many of the stations sampled in these areas showed stresses related to a lack of riparian zone, dominant agricultural landuse, and in-stream habitat alteration. Some of the smaller order tributaries were located in densely forested areas; these streams had strong coldwater communities, and showed very little sign of impact. The larger tributaries and main stem, located further down the watershed, are associated with mixed landuse as the watershed transitions from agriculture to forests. The stations associated with the forested landscape tended towards higher M-IBI scores, and were more likely to score above the impairment threshold. The larger streams included warmwater, warm/cold transitional, and coldwater streams. The changes in water temperature regime are natural, and associated changes in community structure are to be expected. The presence of coldwater indicator taxa in streams designated as warmwater suggests that some of the warmwater streams are either strongly influenced by groundwater, are coldwater transitional systems, or are impaired coldwater streams. Warm/coldwater transitional streams occur throughout the state wherever coldwater and warmwater streams co-occur. The typical signature of a coldwater stream that is impaired due to unnatural warming is an increase in taxonomic richness, and/or a decrease in the abundance of obligate coldwater taxa. It can difficult to classify and asses streams of this nature, as they exist naturally as well as in response to impairment. The coldwater streams and the associated invertebrate communities in the watershed exhibit a range of conditions, from high quality, intact systems to streams showing an impact from altered riparian conditions and modified upstream landuse. The majority of streams sampled had sufficient flow and coarse substrates to be considered high-gradient while one third of the streams lacked the coarse substrates typical of high-gradient streams. The lack of coarse substrate can have a significant effect on taxonomic composition, especially when substrates have been altered unnaturally due to habitat loss or sedimentation.

Overall, 171 genera in 70 families of macroinvertebrates were collected in the Whitewater watershed. The most commonly sampled invertebrates in the coldwater streams were all taxa typically considered as coldwater indicators, including mayflies in the genus Baetis, sideswimmers, or scuds, in the genus Gammarus, and caddisflies in the genus Brachycentrus. In addition to being common in the coldwater streams, these taxa were common in many of the warmwater streams as well, suggesting a groundwater influence on many of the warmwater streams. The most common warmwater taxa include midges in the genus Polypedilum, snails in the genus Physa, and Baetis mayflies.

Fish

Fish communities in the watershed are most heavily impacted in the warm headwaters branches of the Whitewater River, especially the Middle and Southern branches. These regions are commonly stressed by agricultural landuse, homogenous instream habitat and a lacking riparian zone. Warm to coldwater transitional zones also challenged use designations for fish communities in the North Branch Whitewater River. Invertebrate communities appear to show more acute sensitivity to stress on the landscape within the Mississippi River Winona Watershed when compared to fish communities. This disparity in indicators is not a reason to put more stock in one indicator over another; rather it allows for a better understanding of whether impairments observed are a result of localized stress which fish are better equipped to flee from or if pollution is continuous in nature and limiting the establishment of a healthy fish community. This watershed has an abundance of high quality coldwater fisheries that deserve additional protection to maintain their integrity. High scores were seen not only in the sites least impacted by anthropogenic stress but also stations within the Whitewater's Northern and Middle Branches where macroinvertebrates did not perform as well. Stations with the best F-IBI scores were observed in regions with the greatest percentage of natural landuse in their subwatersheds, including Crow Spring, Trout Run, Little Trout Creek, and West Burns Valley Creek.

Historically, throughout the Lower Mississippi River Basin, there have been 126 different species of fish sampled. Forty-five of those species were sampled during monitoring efforts in the Mississippi River Winona Watershed utilized for this report. Some species were found at many sites in high densities, while other species were less dense, seen at few sites in limited quantities. No fish species were captured that are identified by the MDNR as endangered, threatened or species of special concern. No invasive fish species were sampled within the watershed. The most commonly found fish species in the watershed was the brown trout, sampled at 46 of 57 sites, totaling 3,327 individuals. Other species that were commonly found in the watershed included brook stickleback and white sucker; both were sampled at roughly 75% of the sites. A number of species were sampled at only one station and totaled only 1 individual: bigmouth buffalo, bowfin, mimic shiner, northern hogsucker, pumpkin seed, silver redhorse, spotfin shiner, spottail shiner, tadpole madtom, and walleye. In contrast the species with the highest density was white sucker, which were found at 43 stations and 4,865 individuals were sampled. Additional game species captured included brook trout (15 stations), rainbow trout (7 stations), largemouth bass (3 stations), northern pike (2 stations), smallmouth bass (2 stations) and sauger (2 stations). A complete list of species sampled, numbers of stations they were observed at and total numbers of individuals sampled at each station can be found in Appendix 7.

Lake water quality

The two basins of Lake Winona were the only lakes within the Mississippi (Winona) watershed that were monitored for aquatic recreational use. Currently, aquatic recreation standards are not in place for lakes within the Driftless Area ecoregion. Land uses within Lake Winona's catchment area were compared with other ecoregions to determine which standard should be utilized. The dominant land use for Winona Lake's catchment area was determined to be forest with a high percentage of urban development. The NCHF deep lake standard (Appendix 6.1) was determined to be more suitable and thus applied. Based on these standards, both basins of Lake Winona were determined to be non-supporting for aquatic recreation due to nutrient exceedances.

Table 67. Assessment summary for lake water chemistry in the Mississippi River (Winona) Watershed.

Watershed	Area (acres)	Total Lakes or Reservoirs	Lakes >10 Acres	Lake <10 Acres	Full Support	Non-support	Insufficient Data
Mississippi River (Winona) **HUC 8**	**420,340**	**2**	**2**	**0**	**0**	**2**	**0**
Wabasha	14,916	0	0	0	--	--	--
Cooks Valley	12,664	0	0	0	--	--	--
Snake Creek	6,238	0	0	0	--	--	--
East Indian	13,161	0	0	0	--	--	--
Mississippi River Direct	4,781	0	0	0	--	--	--
Dry Creek	15,452	0	0	0	--	--	--
Whitewater River, North Branch	51,217	0	0	0	--	--	--
Whitewater River, Middle Branch	35,361	0	0	0	--	--	--
Whitewater River, South Branch	59,290	0	0	0	--	--	--
Beaver Creek	10,544	0	0	0	--	--	--
Whitewater River	33,381	0	0	0	--	--	--
Rollingstone Creek	32,294	0	0	0	--	--	--
Garvin Brook	31,244	0	0	0	--	--	--
Gilmore Creek	6,261	0	0	0	--	--	--
Pleasant Valley	8,580	0	0	0	--	--	--
Cedar Creek	11,335	0	0	0	--	--	--
Pickwick Valley	13,318	0	0	0	--	--	--
Dakota Valley	60,277	2	2	0	0	2	0

Fish contaminant results

In this watershed, mercury has been measured in eight fish species, PCBs in five species, and PFCs in six species. A total of 165 fish were tested. Sample years ranged from 1981 to 2010. All samples were skin-on fillets (FILSK).

Table 69 is a summary of contaminant concentrations by waterway, fish species and year. "Total Fish" and "Samples" are shown because many of the results were from composite samples—multiple fish homogenized into a single sample. For example, the brown trout (BT) collected from Garvin Brook in 1981 was a single sample of five fish of similar lengths. The five fish were measured to get a mean length, but the individual lengths are not included in the fish contaminant database.

Mercury was measured in 80 fish samples. The highest mercury concentration was 0.35 mg/kg in a composite sample of two white sucker (WSU) collected from Whitewater River in 1992. Whitewater River is the only waterway among the three listed that is on the Impaired Waters List. The river was put on the list in 1998 because of mercury concentrations in WSU in 1992. WSU from 2010 show much lower mercury concentrations, indicating the Whitewater River is a likely candidate for delisting. Removing a waterbody from the impaired waters list, however, requires more than a single year of sampling after the sampling that led to the impairment.

PCBs were measured in 24 fish samples. Only a single composite sample of largemouth bass (LMB) was analyzed from Lake Winona and the concentration was less than the detection limit. Total PCB concentrations were generally below the detection limit in Whitewater River. The maximum PCBs concentration was 0.044 mg/kg in a composite sample of brown trout (BT) collected from the Whitewater River in 1992. Subsequent PCB concentrations in BT collected in 2000 and 2010 were below the detection limits.

PFOS was measured in multiple species from Lake Winona. PFOS concentrations were low but detectable, ranging from 4.7 ng/g to 20.5 ng/g. These PFOS concentrations are well below the impairment threshold of 200 ng/g (ppb).

Overall, fish contaminants were low in the Whitewater River and Lake Winona. PFOS concentrations were detectable in the six species tested from Lake Winona, but were at low levels that would not cause a fish consumption advisory. Because of the low mercury concentrations in recent sampling of Whitewater River, another test of at least the white sucker should be done to determine if the river can be delisted for mercury in fish tissue.

Table 68. Fish species codes, common names and scientific names.

SPEC	Common Name	*Scientific Name*
BGS	Bluegill sunfish	*Lepomis macrochirus*
BKS	Black crappie	*Pomoxis nigromaculatis*
BT	Brown trout	*Salmo Trutta*
LMB	Largemouth bass	*Micropterus salmoides*
NP	Northern pike	*Esox Lucius*
RBT	Rainbow trout	*Salmo Gairdneri*
WE	Walleye	*Sander vitreus*
WHS	White crappie	*Pomoxis Annularis*
WSU	White sucker	*Catostomus commersoni*

Table 69. Summary statistics of mercury, PCBs and PFOS by waterway, species and year.

Waterway	AUID	SPEC[1]	Year	Anat[2]	Total Fish	Sam-ples	Length (in)			Mercury (mg/kg)				PCBs (mg/kg)				PFOS (µg/kg)		
							Mean	Min	Max	N	Mean	Min	Max	N	Mean	Min	Max	N	Mean	Max
GARVIN BROOK	07040003 - 541 -542 -	BT	1981	FILSK	5	1	11.7	11.7	11.7	1	0.02			1	< 0.02					
	543 -595	WSU	1981	FILSK	5	1	14.4	14.4	14.4	1	0.17			1	< 0.02					
WHITEWATER R.*	07040003 - 537 -538 -	BT	1981	FILSK	5	1	14.7	14.7	14.7	1	0.14			1	0.17					
	539 -525 -		1983	FILSK	15	3	10.9	10.8	11.1	3	0.14	0.14	0.14	3		< 0.05	< 0.25			
	524 -553 -		1992	FILSK	8	1	12.4	12.4	12.4	1	0.12			1	0.044					
	554 -523 -		2000	FILSK	11	11	11.3	8.5	14.9	11	0.093	0.02	0.25	2		< 0.01	< 0.01			
	515 -F18 -		2010	FILSK	27	27	11.3	8.9	14.7	27	0.043	0.02	0.07	6		< 0.025	< 0.025			
	F19 -F16 - F17 -512	RBT	2010	FILSK	5	5	12.6	11.5	14.4	5		< 0.01	< 0.01	2		< 0.025	< 0.025			
		WSU	1981	FILSK	5	1	14.9	14.9	14.9	1	**0.25**			1	< 0.02					
			1992	FILSK	10	2	15.2	13.5	16.9	2	**0.245**	0.14	**0.35**	1	0.023					
			2000	FILSK	3	1	13.5	13.5	13.5	1	0.2			1	<0.01					
			2010	FILSK	10	6	12.8	11.7	14.1	6	0.085	0.06	0.12	3		< 0.025	< 0.025			
LAKE WINONA	85001100	BGS	2007	FILSK	5	1	6.2			1	0.053							1	4.7	
			2009	FILSK	5	1	7.2			1	0.045									
			2009	FILSK	4	1	6.7											1	13.6	
		BKS	2009	FILSK	2	1	9.4			1	0.090									
		BKS	2009	FILSK	5	1	9.4											1	14.2	
		LMB	1986	FILSK	5	1	13.1			1	**0.380**			1	< 0.05					
			2007	FILSK	10	10	11.8	9.1	14.4	10	0.048	< 0.01	0.087							
			2009	FILSK	8	8	13.7	10.2	16.9									8	14.4	20.5
		NP	2009	FILSK	1	1	23.6			1	0.123							1	14.5	
		WE	2007	FILSK	5	5	13.2	10.9	16.4	5	0.039	0.026	0.056							
			2009	FILSK	5	5	20.4	18.1	22.0									5	10.3	14.6
		WHS	2009	FILSK	1	1	9.8											1	7.9	

*** Impaired for Aquatic Consumption – mercury in fish tissue**

1 **Species codes are defined in Table 68**

2 Anatomy codes: FILSK – fillet skin-on

Groundwater monitoring

There are 15 MPCA groundwater monitoring sites within the Mississippi River, Winona watershed. Fourteen are domestic water wells and one is a monitoring well. Domestic wells located along the Mississippi River draw much different water than those in higher elevations within the watershed. Samples from wells within the watershed indicated the presence of naturally-occurring minerals like iron as well as calcium and magnesium. These commonly will cause discoloration, odors or hardness of water but in most instances are not risks to human health. Chloride was present at low levels (below 100 mg/L) at all sites in the watershed. The EPA classifies chloride as an aesthetic contaminant in drinking water, meaning those affecting only odor and taste, and has set for it a Secondary Maximum Contaminant Level of 250 mg/L.

Pollutant trends for the Whitewater River

Water quality trends at long-term monitoring stations

Water chemistry data were analyzed for trends (Table 70) for the long term period of record (1974-2008) and near term period of record (1994-2008) for the South Fork Whitewater River and for the long term period of record (1981 – 2008) and near term period of record (1994-2008) for Garvin Brook. There were significant increases in nitrite/nitrates during the long term period of record and the short term record for both stations. There were also significant increases in chloride for the long term period of record for both stations. Conversely, there were significant decreases in total suspended solids, ammonia, and biological oxygen demand for the long term period of record for both stations and for total phosphorus for the long term period for Garvin Brook. The only near term period decreasing trend on Garvin Brook was for TSS.

Table 70. Trends in the Mississippi River (Winona) Watershed.

	Total Suspended Solids	Total Phosphorus	Nitrite/ Nitrate	Ammonia	Biochemical Oxygen Demand	Chloride
Whitewater River, South Fork N of CR 115, 3.5 mi. NW of Utica (S000-288) (WWR-26)						
overall trend (1974–2008)	**decrease**	**no trend**	**increase**	**decrease**	**decrease**	**increase**
estimated average annual change	-2.4%		1.8%	-2.0%	-2.8%	1.9%
estimated total change	**-57%**		**79%**	**-46%**	**-64%**	94%
recent trend (1994 – 2008)	**no trend**	**no trend**	**increase**	**no trend**	**no trend**	little data
estimated average annual change			2.5%			
Estimated total changed			46%			
median concentrations first 10 years	32	0.5	7.4	0.08	2.6	27
median concentrations most recent 10 years	16	0.4	10.5	0.03	1.0	43
Garvin Brook at CSAH-23, SW of Minnesota City (S000-828) (GB-4.5)						
overall trend (1981–2008)	**decrease**	**decrease**	**increase**	**decrease**	**decrease**	**increase**
average annual change	-4.0%	-1.7%	3.1%	-2.0%	-1.8%	3.6%
total change	**-67%**	**-38%**	**130%**	**-42%**	**-38%**	159%
recent trend (1994 – 2008)	**decrease**	**no trend**	**increase**	**no trend**	**no trend**	little data
estimated average annual change	-8.5%		2.6%			
estimated total change	**-74%**		**46%**			
median concentrations first 10 years	62	0.1	1.3	0.09	1.6	6
median concentrations most recent 10 years	23	0.1	2.3	<0.03	0.8	13

Analysis was performed using the Seasonal Kendall Test for Trends. Trends shown are significant at the 90% confidence level. Percentage changes are statistical estimates based on the available data. Actual changes could be higher or lower. A designation of "no trend" means that a statistically significant trend has not been found; this may simply be the result of insufficient data.

Concentrations are median summer (Jun-Aug) values, except for chlorides, which are median year-round values. All concentrations are in mg/L.

Water clarity trends at citizen monitoring sites

Citizen volunteer monitoring occurs at 88 streams in the watershed. There are currently no lakes within the watershed being monitored by volunteers. Of the 88 streams being monitored, 71 have insufficient information to determine a trend. There are 17 streams within the watershed that have shown no trend.

Table 71. Water Clarity Trends at Citizen Stream Monitoring Sites.

Mississippi River (Winona) Watershed HUC 07040003	Citizen Stream Monitoring Program	Citizen Lake Monitoring Program
number of sites w/ increasing trend	--	--
number of sites w/ decreasing trend	--	--
number of sites w/ no trend	17	--

The following maps are a series of graphics that provide an overall summary of assessment results by designated use, impaired waters, and fully supporting waters within the Mississippi River (Winona) Watershed.

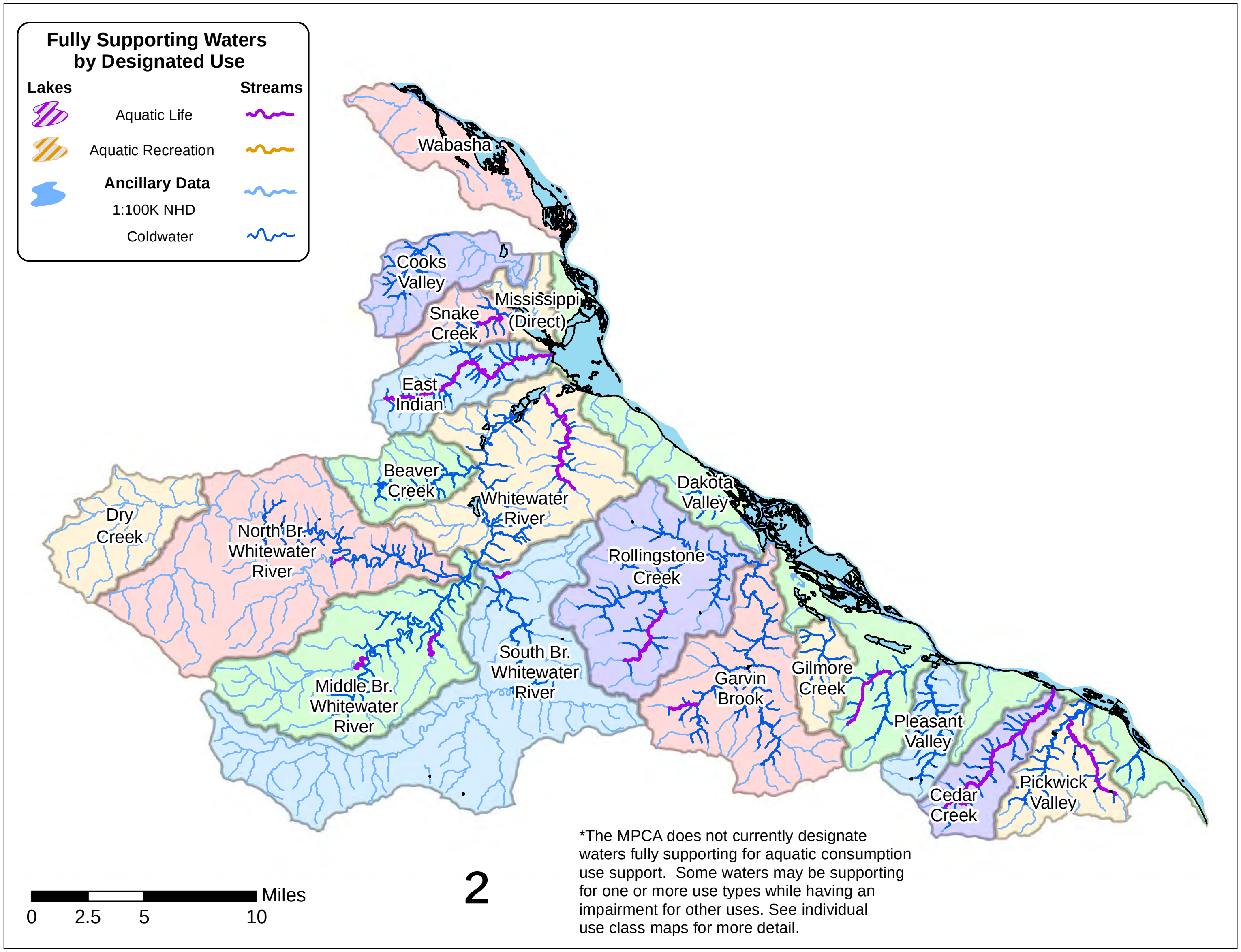

Figure 39. Fully supporting waters by designated use in the Mississippi River (Winona) Watershed.

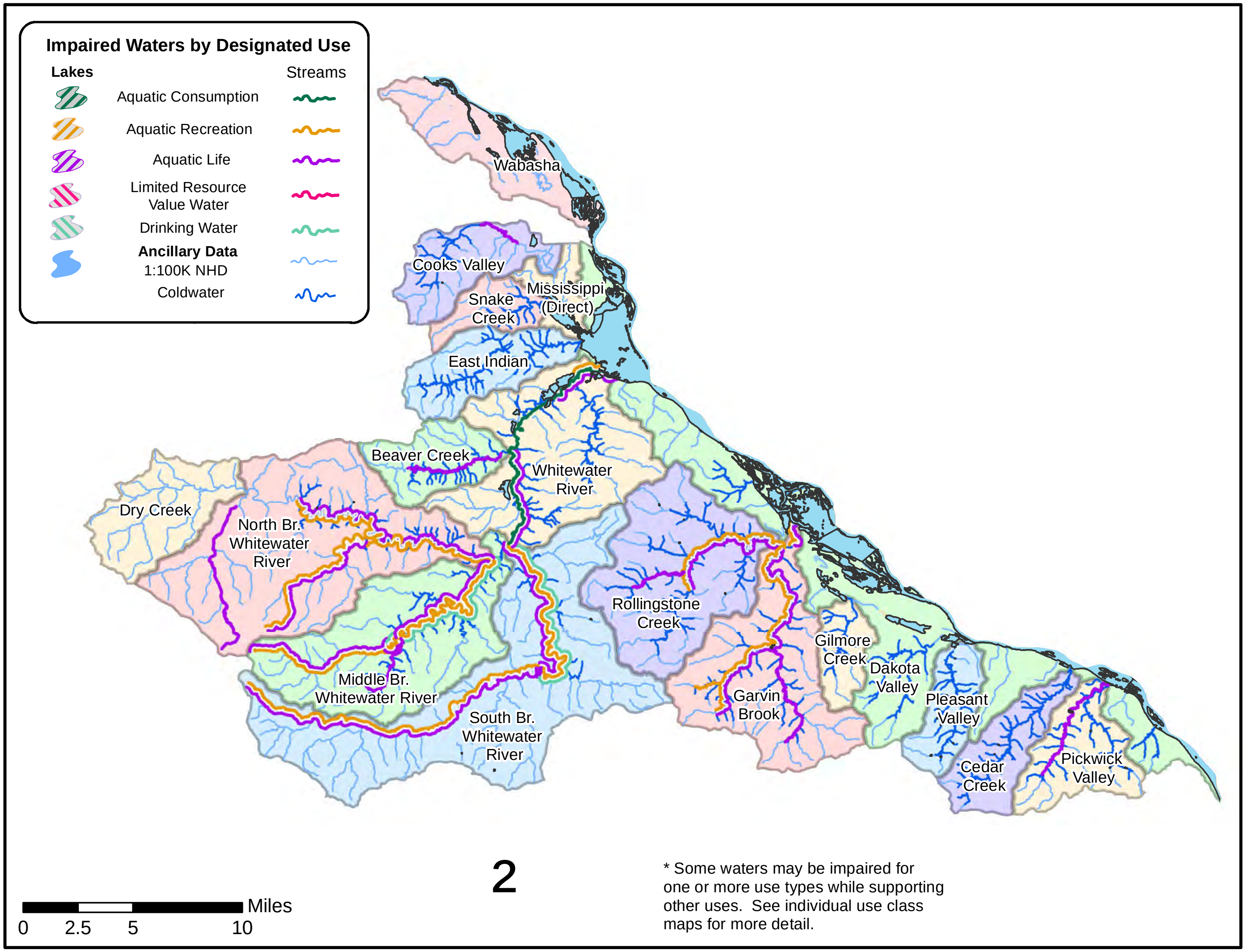

Figure 40. Impaired waters by designated use in the Mississippi River (Winona) Watershed.

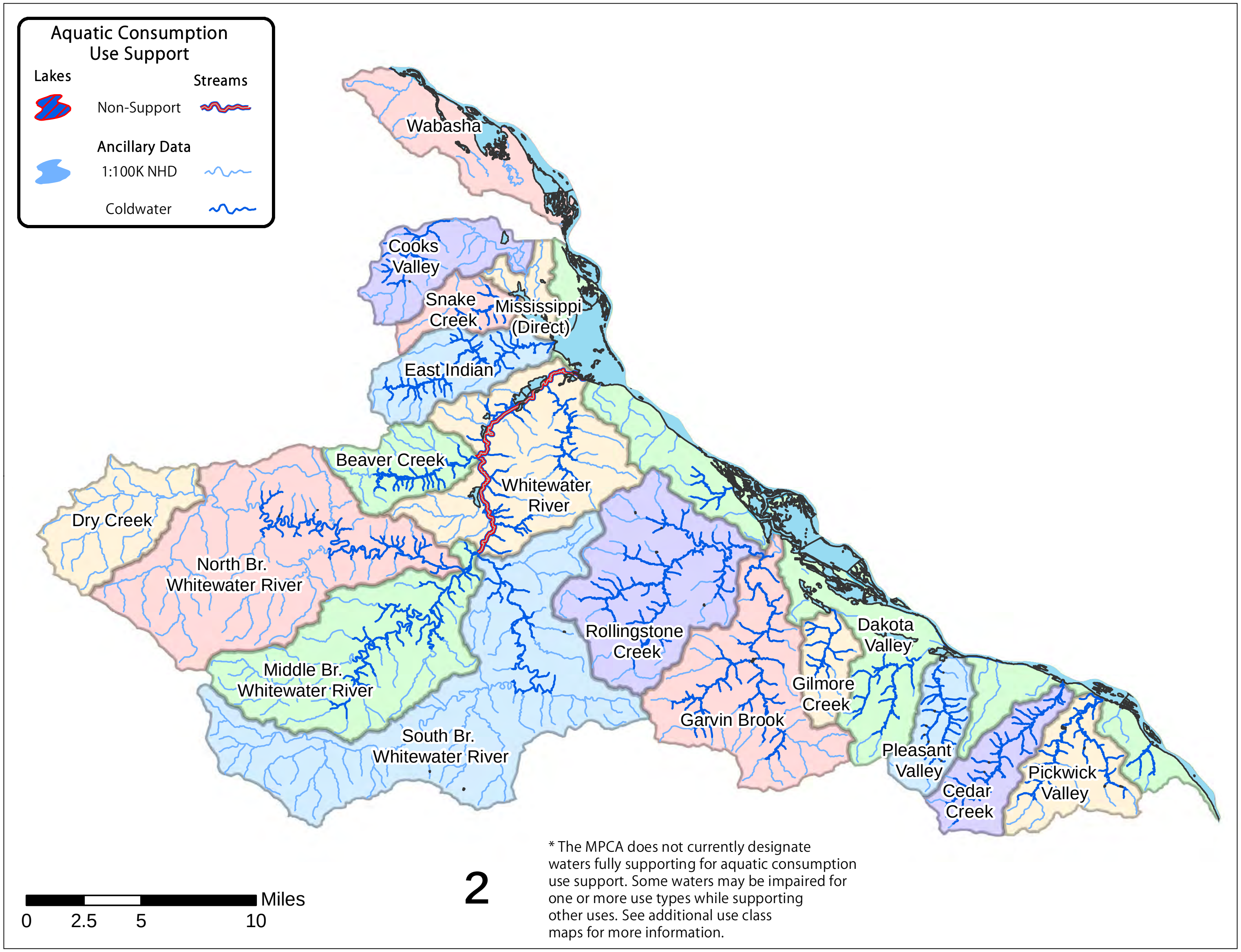

Figure 41. Aquatic Consumption Use support in the Mississippi River (Winona) Watershed.

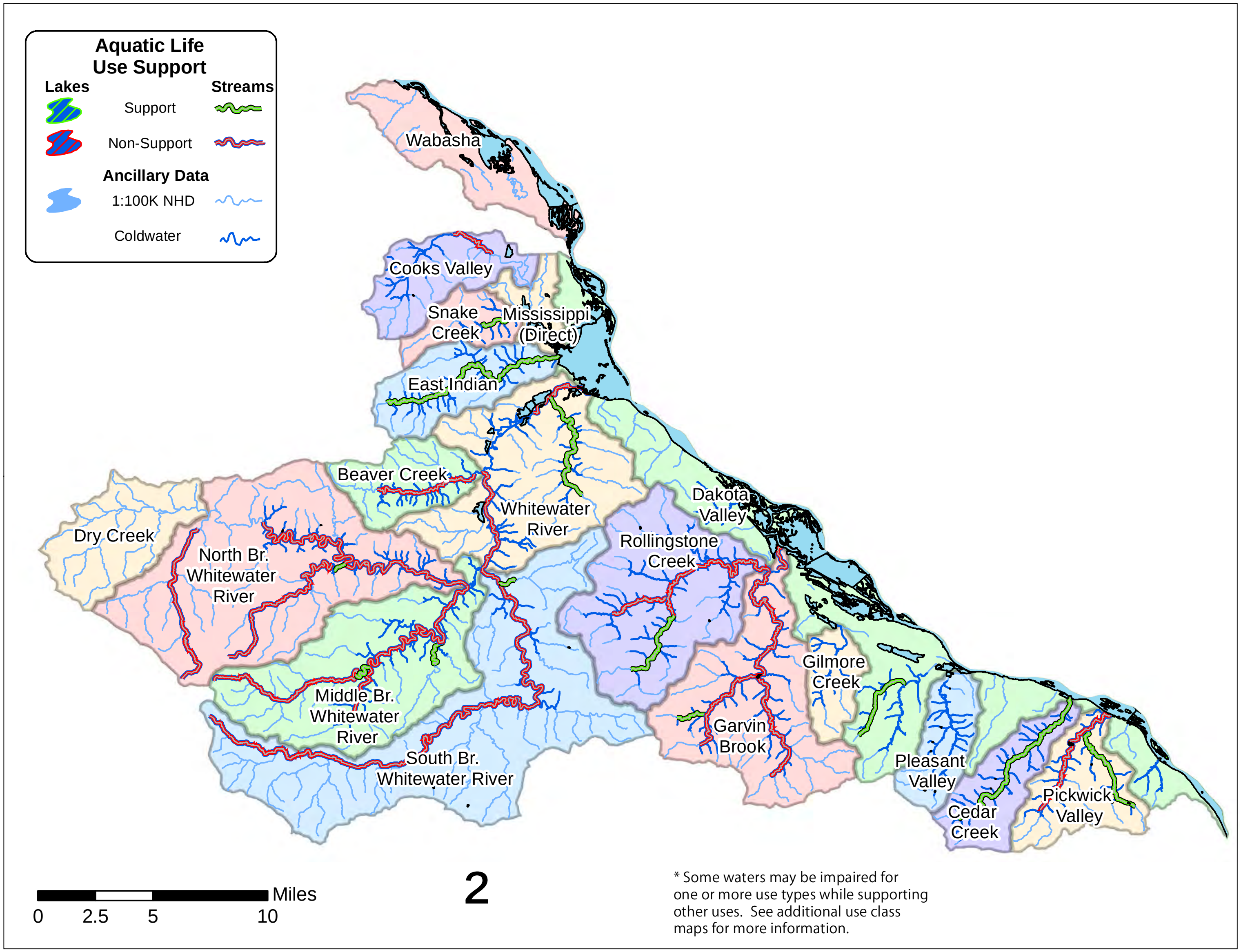

Figure 42. Aquatic Life Use support in the Mississippi River (Winona) Watershed.

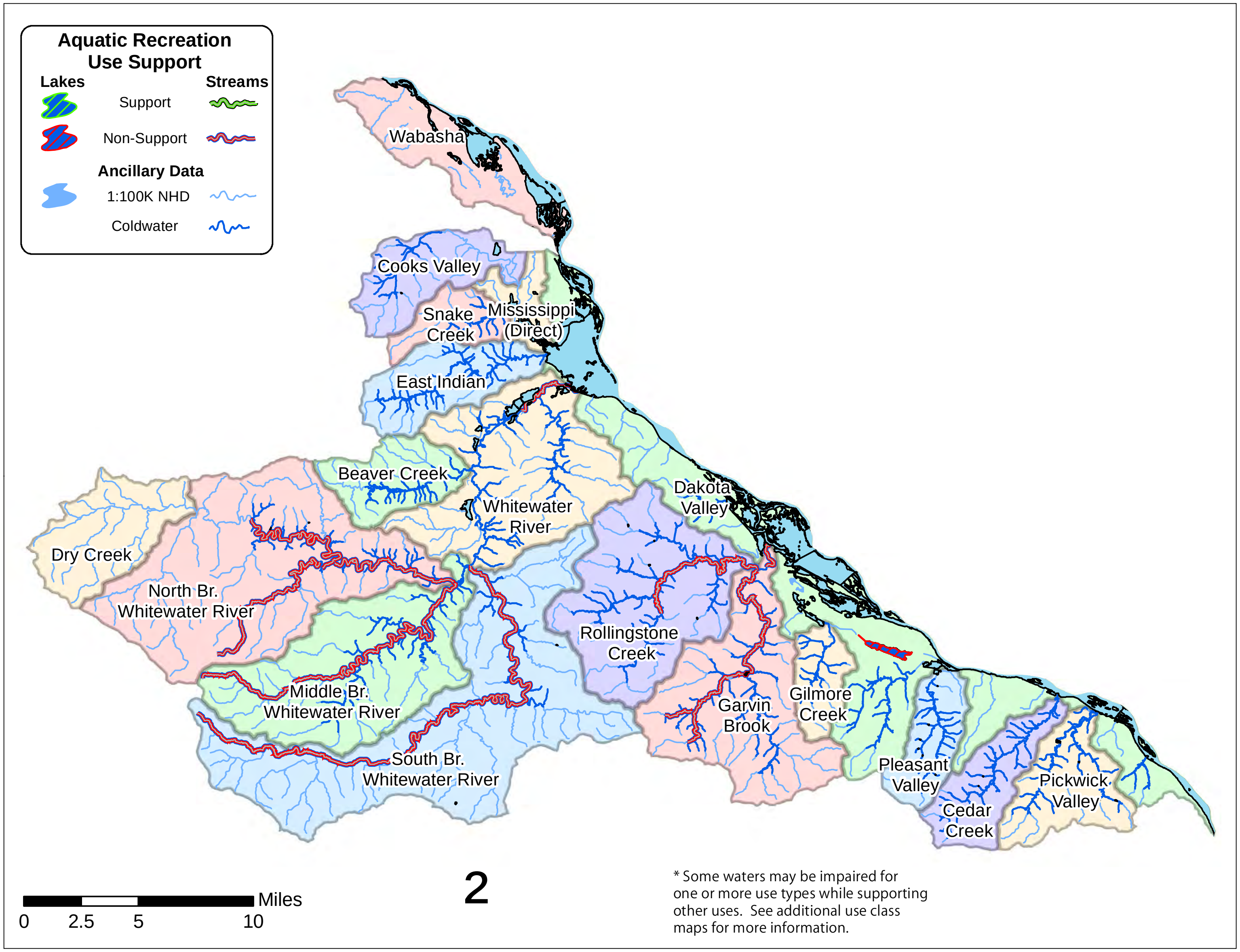

Figure 43. Aquatic Recreation Use support in the Mississippi River (Winona).

VII. Summaries and recommendations

While measures have been taken to reduce legacy landuse impacts in the watershed, streams are still recovering from landuse practices implemented during watershed settlement. The Whitewater River watershed's headwaters are part of a growing agricultural economy that transitions to a highly valued coldwater resource. Nonpoint source pollution from the upstream agricultural region is likely negatively impacting immediate and downstream water quality uses for aquatic life, recreation, consumption and drinking water. Twenty-eight of the fifty stream AUIDs were assessed for aquatic life and/or aquatic recreation (Table 66). Of the assessed streams, only 12 AUIDs were considered to be fully supporting for aquatic life and no streams were fully supporting of aquatic recreation. Eighteen AUIDs are non-supporting for aquatic life and/or recreation.

Impairment for aquatic recreation is widespread across the watershed, impacting all Whitewater River AUIDs where sufficient data was available to make an assessment. The abundance of permitted feedlots in the watershed (1600+) indicates that impairment is likely more widespread than Figure 43 and intensive watershed monitoring suggests. High bacteria levels could also be attributed to failing septic systems which are not well quantified across the watershed.

Aquatic life use impairments within the Mississippi River Winona are complex. Macroinvertebrate impairments surpass fish impairments. Biotic impairments are likely a result of nonpoint source pollution and localized stress linked to poor habitat condition. High nitrogen levels are likely impacting macroinvertebrate communities as seen in other watersheds across southeastern Minnesota. Data shows increased levels were most evident in upper and middle regions of the watershed and generally decrease moving east consistent with increased flows seen in this region due to springs.

Turbidity concerns are prolific but are not as universal as impairment for E. coli. As improvements have been made in the watershed to significantly reduce overland erosion by implementing soil conservation efforts and restoring natural vegetation along bluff slopes and in riparian zones, high levels of turbidity are likely stemming from stream bank erosion as streams cut into banks of alluvial sediment historically deposited from the watershed's uplands. Poor habitat conditions observed across many biological stations may be linked to turbidity and sedimentation issues as well as poor riparian landuse. Pre-existing turbidity impairments on all branches of the Whitewater River are currently being addressed by a TMDL in progress. Several small coldwater tributaries in the eastern region of the watershed met standards for turbidity, indicating that these smaller streams are more geomorphologically stable than the Whitewater system. This may be attributed to a greater percentage of natural landuse in their small watersheds and the degree to which landuse degradation occurred post settlement.

Warm to coldwater transitional zones are not broadly understood within the watershed and additional monitoring may help increase understanding to differentiate between thermal degradation and natural thermal transition and appropriately identify correct use classes.

The presence of fish contaminants was low within the Whitewater River and Lake Winona. Low mercury concentrations in recent sampling of Whitewater River in 2010 demonstrate considerable improvement over the 1992 survey which led to the watershed's formal impairment in 1998. Additional monitoring is recommended to potentially delist the Whitewater River for mercury in fish tissue.

While impairments are prevalent across the watershed, efforts to restore water quality and bring surface waters into attainment for designated uses are not futile. Future efforts to control sediment should include measures to stabilize stream bank channels. Addressing nonpoint source pollution would benefit from a targeted approach to BMP placement, identifying those karst features in the watershed that are likely more prone to be pathways of contamination and working with those landowners to limit potential contaminants from reaching those sensitive areas. Only by collaborating with landowners will the agricultural economy of the region move forward in a sustainable way that does not neglect water quality.

Literature Cited

Argabright, M.S., Cronshey, R.G., Helms, J.D., Pavelis, G.A., and Sinclair, H.R., Jr., 1996, Historical changes in soil erosion, 1930–1992, the northern Mississippi Valley Loess Hills: U.S. Department of Agriculture Natural Resources Conservation Service, Resource Economics and Social Sciences Division Historical Notes 5, 92 p.

Mast, M.A., and Turk, J.T., 1999, Environmental characteristics and water quality of Hydrologic Benchmark Network stations in the West-Central United States, 1963–95: U.S. Geological Survey Circular 1173–B, 130 p.

McCollor, S., and S. Heiskary. 1993. Selected Water Quality Characteristics of Minimally Impacted Streams from Minnesota's 7 Ecoregions. Addendum to Fandrei, G., S. Heiskary, and S. McCollor. 1988. Descriptive Characteristics of the 7 Ecoregions in Minnesota. Division of Water Quality, Program Development Section, Minnesota Pollution Control Agency, St. Paul, Minnesota. 140 p.

Minnesota Department of Agriculture (MNDA), 2009. Winona County Agricultural Profile. Agricultural Marketing Services Division, Minnesota Department of Agriculture. http://www.mda.state.mn.us/Global/MDADocs/food/business/econrpt-winonacnty.aspx.

Minnesota Department of Agriculture (MNDA), 2010a. Olmsted County Agricultural Profile. Agricultural Profile. Agricultural Marketing Services Division, Minnesota Department of Agriculture. http://www.mda.state.mn.us/Global/MDADocs/food/business/econrpt-olmstedcnty.aspx

Minnesota Department of Agriculture (MNDA), 2010b. Wabasha County Agricultural Profile. Agricultural Profile. Agricultural Marketing Services Division, Minnesota Department of Agriculture. http://www.mda.state.mn.us/food/business/agmktg-research/~/media/Files/food/business/countyprofiles/econrpt-wabasha.ashx.

Minnesota Pollution Control Agency (MPCA). 2007a. Guidance Manual for Assessing the Quality of Minnesota Surface Waters for the Determination of Impairment 305(b) Report and 303(d) List. Environmental Outcomes Division, Minnesota Pollution Control Agency, St. Paul, Minnesota.

Minnesota Pollution Control Agency (MPCA). 2007b. Minnesota Statewide Mercury Total Maximum Daily Load. Minnesota Pollution Control Agency, St. Paul, Minnesota.

Minnesota Pollution Control Agency (MPCA). 2008a. Watershed Approach to Condition Monitoring and Assessment. Appendix 7 *in* Biennial Report of the Clean Water Council. Minnesota Pollution Control Agency, St. Paul, Minnesota.

Minnesota Pollution Control Agency (MPCA). 2008b. Regionalization of Minnesota's Rivers for Application of River Nutrient Criteria. http://www.pca.state.mn.us/index.php/view-document.html?gid=6072.

Minnesota Pollution Control Agency (MPCA). 2010a. Aquatic Life Water Quality Standards Draft Technical Support Document for Total Suspended Solids (Turbidity). http://www.pca.state.mn.us/index.php/view-document.html?gid=14922.

Minnesota Pollution Control Agency (MPCA). 2010b. Aquatic Life Water Quality Standards Technical Support Document for Nitrate. http://www.pca.state.mn.us/index.php/view-document.html?gid=14949.

Minnesota Pollution Control Agency (MPCA). 2010c. Guidance Manual for Assessing the Quality of Minnesota Surface Water for the Determination of Impairment: 305(b) Report and 303(d) List. Environmental Outcomes Division, Minnesota Pollution Control Agency, St. Paul, Minnesota.

Minnesota Pollution Control Agency (MPCA). 2010d. Minnesota Milestone River Monitoring Report. http://www.pca.state.mn.us/index.php/water/water-types-and-programs/surface-water/streams-and-rivers/minnesota-milestone-river-monitoring-program.html.

Minnesota Pollution Control Agency (MPCA). 2010e. Regionalization of Minnesota's Rivers for Application of River Nutrient Criteria. http://www.pca.state.mn.us/index.php/view-document.html?gid=6072.

Minnesota Pollution Control Agency (MPCA). 2011. Aquatic Life Water Quality Standards Draft Technical Support Document for Total Suspended Solids (Turbidity). http://www.pca.state.mn.us/index.php/view-document.html?gid=14922.

Minnesota Pollution Control Agency (MPCA). 2012. Guidance Manual for Assessing the Quality of Minnesota Surface Water for the Determination of Impairment: 305(b) Report and 303(d) List. http://www.pca.state.mn.us/index.php/view-document.html?gid=16988.

Minnesota State Climatology Office, 2012. State Climatology Office, DNR Division of Ecological and Water Resources. University of Minnesota. http://climate.umn.edu/.

University of Missouri Extension (1999). Agricultural Phosphorus and Water Quality. Pub. G9181. http://extension.missouri.edu/explorepdf/agguides/soils/g09181.pdf.

National Resource Conservation Service (NRCS). 2008. Rapid Watershed Assessment: Buffalo-Whitewater (WI/MN) HUC: 07040003. NRCS. USDA. http://www.wi.nrcs.usda.gov/technical/rwabuff-white.html.

Nerbonne, and Vondracek, Bruce, 2001.Effects of Local Land Use on Physical Habitat, Benthic Macroinvertebrates and Fish in the Whitewater River, Minnesota, USA. Environmental Management Vol. 29, No. 1 pp 87-99.

Minnesota Rules Chapter 7050. 2008. Standards for the Protection of the Quality and Purity of the Waters of the State. Revisor of Statutes and Minnesota Pollution Control Agency, St. Paul, Minnesota.

Omernik, J.M. and A.L. Gallant. 1988. Ecoregions of the Upper Midwest States. EPA/600/3-88/037. Corvallis, OR: United States Environmental Protection Agency. 56 p.

State Climatology Office- MDNR Division of Ecological and Water Resources. 2010. http://www.climate.umn.edu/doc/hydro_yr_pre_maps.htm.

Waters, T.F. 1977. The Rivers and Streams of Minnesota. University of Minnesota Press, Minneapolis, Minnesota.

Whitewater River Watershed Project, 2013. http://www.whitewaterwatershed.org/.

White and Omernik, 2007.

Winona County Soil and Water Conservation District (SWCD), 2013. http://www.winonaswcd.org/.

University of Missouri Extension. 1999. Agricultural Phosphorus and Water Quality. Pub. G9181. http://extension.missouri.edu/publications/DisplayPub.aspx?P=G9181.

United States (U.S.) Census Bureau, 2010. American Fact Finder. U.S. Department of Commerce. http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=bkmk.

Appendix 1 – Water chemistry definitions

Dissolved oxygen (DO) – Oxygen dissolved in water required by aquatic life for metabolism. Dissolved oxygen enters into water from the atmosphere by diffusion and from algae and aquatic plants when they photosynthesize. Dissolved oxygen is removed from the water when organisms metabolize or breathe. Low DO often occurs when organic matter or nutrient inputs are high, and light inputs are low.

Escherichia coli (E. coli) – A type of fecal coliform bacteria that comes from human and animal waste. E. coli levels aid in the determination of whether or not fresh water is safe for recreation. Disease-causing bacteria, viruses and protozoans may be present in water that has elevated levels of E. coli.

Nitrate plus nitrite-nitrogen – Nitrate and nitrite-nitrogen are inorganic forms of nitrogen present within the environment that are formed through the oxidation of ammonia-nitrogen by nitrifying bacteria (nitrification). Ammonia-nitrogen is found in fertilizers, septic systems and animal waste. Once converted from ammonia-nitrogen to nitrate and nitrite-nitrogen, these species can stimulate excessive levels of algae in streams. Because nitrate and nitrite-nitrogen are water soluble, transport to surface waters is enhanced through agricultural drainage. The ability of nitrite-nitrogen to be readily converted to nitrate-nitrogen is the basis for the combined laboratory analysis of nitrate plus nitrite-nitrogen (nitrate-N), with nitrite-nitrogen typically making up a small proportion of the combined total concentration. These and other forms of nitrogen exist naturally in aquatic environments; however concentrations can vary drastically depending on season, biological activity, and anthropogenic inputs.

Orthophosphate – Orthophosphate (OP) is a water soluble form of phosphorus that is readily available to algae (bioavailable). While orthophosphates occur naturally in the environment, river and stream concentrations may become elevated with additional inputs from waste water treatment plants, noncompliant septic systems and fertilizers in urban and agricultural runoff.

pH – A measure of the level of acidity in water. Rainfall is naturally acidic, but fossil fuel combustion has made rain more acid. The acidity of rainfall is often reduced by other elements in the soil. As such, water running into streams is often neutralized to a level acceptable for most aquatic life. Only when neutralizing elements in soils are depleted, or if rain enters streams directly, does stream acidity increase.

Specific Conductance – The amount of ionic material dissolved in water. Specific conductance is influenced by the conductivity of rainwater, evaporation and by road salt and fertilizer application.

Temperature – Water temperature in streams varies over the course of the day similar to diurnal air temperature variation. Daily maximum temperature is typically several hours after noon, and the minimum is near sunrise. Water temperature also varies by season as doe’s air temperature.

Total Kjehldahl Nitrogen (TKN) – The combination of organically bound nitrogen and ammonia in wastewater. TKN is usually much higher in untreated waste samples then in effluent samples.

Total Phosphorus (TP) – Nitrogen (N), phosphorus (P) and potassium (K) are essential macronutrients and are required for growth by all animals and plants. Increasing the amount of phosphorus entering the system therefore increases the growth of aquatic plants and other organisms. Excessive levels of Phosphorous over stimulate aquatic growth and resulting in the progressive deterioration of water quality from overstimulation of nutrients, called eutrophication. Elevated levels of phosphorus can result in: increased algae growth, reduced water clarity, reduced oxygen in the water, fish kills, altered fisheries and toxins from cyanobacteria (blue green algae) which can affect human and animal health.

Total Suspended Solids (TSS) – TSS and turbidity are highly correlated. Turbidity is a measure of the lack of transparency or "cloudiness" of water due to the presence of suspended and colloidal materials such as clay, silt, finely divided organic and inorganic matter and plankton or other microscopic organisms. The greater the level of TSS, the murkier the water appears and the higher the measured turbidity.

Higher turbidity results in less light penetration which may harm beneficial aquatic species and may favor undesirable algae species. An overabundance of algae can lead to increases in turbidity, further compounding the problem.

Total Suspended Volatile Solids (TSVS) – Volatile solids are solids lost during ignition (heating to 500° C.) They provide an approximation of the amount of organic matter that was present in the water sample. ''Fixed solids'' is the term applied to the residue of total, suspended, or dissolved solids after heating to dryness for a specified time at a specified temperature. The weight loss on ignition is called ''volatile solids.''

Unnionized Ammonia (NH_3) – Ammonia is present in aquatic systems mainly as the dissociated ion NH_4^+, which is rapidly taken up by phytoplankton and other aquatic plants for growth. Ammonia is an excretory product of aquatic animals. As it comes in contact with water, ammonia dissociates into NH_4^+ ions and ^-OH ions (ammonium hydroxide). If pH levels increase, the ammonium hydroxide becomes toxic to both plants and animals.

Appendix 2 – Intensive watershed monitoring water chemistry stations in the Mississippi River (Winona) Watershed

Biological Station ID	STORET/ EQuIS ID	Waterbody Name	Location	11-digit HUC
10LM003	S000-451	Whitewater River, North Fork	Whitewater River, North Branch, 0.15 mi W of Twp Rd 16, 2.2 mi W of Elba	07040003120
10LM002	S001-825	Whitewater River, Middle Fork	Whitewater River, Middle Branch, At MN 74 in Elba	07040003130
10LM004	S001-743	Whitewater River, South Fork	Whitewater River, South Branch, At CSAH 26, 1 mi E of Elba	07040003140
10LM001	S001-767	Whitewater River	Whitewater River, At CSAH 23, 0.5 mi SE of Weaver	07040003160
10LM005	S001-532	Rollingstone Creek	Rollingstone Creek, At Middle Valley Road Bridge, 1.5 mi NW of MN City	07040003180
10LM006	S001-827	Garvin Brook	Garvin Brook, At CSAH 23, 1 mi. SW of Minnesota City	07040003190

Appendix 3.1 – AUID table of stream assessment results (by parameter and beneficial use)

AUID DESCRIPTIONS				USES						BIOLOGICAL CRITERIA		WATER QUALITY STANDARDS						
Assessment Unit ID (AUID)	Stream Reach Name	Reach Description	Reach Length (Miles)	Use Class	Aquatic Life	Aquatic Recreation	Aquatic Consumption	Drinking Water		Fish	Macroinvertebrates	Dissolved Oxygen	Turbidity	Chloride	pH	NH3	Pesticides	Bacteria (Aquatic Recreation)
HUC 11: 07040003065 (Wabasha)																		
NONE																		
HUC 11: 07040003075 (Cooks Valley)																		
07040003-556	Gorman Creek	Gorman Creek (Old Channel Zumbro River), Unnamed cr to Unnamed cr	2.66	2B, 3C	IF	NA	–	–		--	--	–	MTS	–	–	–	–	–
07040003-569	Gorman Creek	T110 R10W S27, west line to Unnamed cr	2.57	2B, 3C	IF*	NA	–	–		MTS	EXS	IF	IF	–	IF	–	–	–
HUC 11: 07040003080 (Snake Creek)																		
07040003-557	Snake Creek	Unnamed cr to Unnamed cr	1.83	1B, 2A, 3B	FS	NA	–	NA		MTS	MTS	IF	IF	–	IF	–	–	–
HUC 11: 07040003090 (East Indian)																		
07040003-573	East Indian Creek	T109 R11W S36, west line to Mississippi R	13.81	1B, 2A, 3B	FS	NA	–	NA		MTS	MTS	IF	EXP	–	IF	–	–	–
HUC 11: 07040003100 (Mississippi Direct)																		
NONE																		
HUC 11: 07040003110 (Dry Creek)																		
070403000-567	Dry Creek	T108 R13W S35, S line to N Fk Whitewater R	7.38	2C	NA*	--	--	--		NA	NA	–	–	–	–	–	–	–
														--				
HUC 11: 07040003120 (Whitewater River, North Branch)																		
07040003-525	Whitewater River, North Fork	Headwaters to T108 R12W S34, north line	9.28	2B, 3C	IF*	NA	–	–		MTS	EXP	IF	IF	–	IF	–	–	–
07040003-524	Whitewater River, North Fork	T108 R12W S27, south line to T108 R12W S25, east line	5.84	7	NA*	–	–	–		NA	NA	–	–	–	–	–	–	–
07040003-553	Whitwater River, North Fork	T108 R11W S30, west line to Unnamed cr	7.91	1B, 2A, 3B	NS	NS	–	IF		EXS	EXS	IF	EXS	–	IF	–	–	EX

Full Support (FS); Not Supporting (NS); Insufficient Data (IF); Not Assessed (NA); Meets standards or ecoregion expectations (MT/MTS), Potential Exceedence (EXP), Exceeds standards (EX/EXS).
Key for Cell Shading: = existing impairment, listed prior to 2012 reporting cycle; = new impairment; = full support of designated use. *Aquatic Life assessment and/or impairments have been deferred until the adoption of Tiered Aquatic Life Uses due to the AUID being predominantly (>50%) channelized or having biological data limited to a station occurring on a channelized portion of the stream.

AUID DESCRIPTIONS				USES					BIOLOGICAL CRITERIA		WATER QUALITY STANDARDS						
Assessment Unit ID (AUID)	Stream Reach Name	Reach Description	Reach Length (Miles)	Use Class	Aquatic Life	Aquatic Recreation	Aquatic Consumption	Drinking Water	Fish	Macroinvertebrates	Dissolved Oxygen	Turbidity	Chloride	pH	NH3	Pesticides	Bacteria (Aquatic Recreation)
07040003-526	Unnamed Creek	Unnamed cr to N Fk Whitewater R	3.61	7	NA	NA	–	–	NA	NA	–	–	–	–	–	–	–
07040003-536	Logan Branch	Headwaters to T107 R11W S4, east line	10.67	2B, 3C	NS	NS	–	–	MTS	MTS	IF	EXS	–	IF	–	--	EX
07040003-552	Logan Branch	Unnamed cr to N Fk Whitewater R	0.55	1B, 2A, 3B	FS	NS	–	IF	MTS	MTS	IF	IF	–	IF	–	–	--
07040003-554	Whitewater River, North Fork	Unnamed cr to M Fk Whitewater R	11.37	1B, 2A, 3B	NS	NS	–	IF	MTS	MTS	IF	EXP	MTS	MTS	MTS	MTS	EX
07040003-523	Whitewater River, North Fork	M Fk Whitewater R to S Fk Whitewater R	1.64	1B, 2A, 3B	IF	NA	–	NA	--	--	IF	EXS	–	–	–	–	–
HUC 11: 07040003130 (Whitewater River, Middle Branch)																	
07040003-515	Whitewater River, Middle Fork	Headwaters to T107 R11W S34, east line	9.56	2B, 3C	NS	NS	–	–	EXP	EXS	IF	EXS	–	IF	–	–	EX
07040003-F18	Whitewater River, Middle Fork	T107 R11W S35, west line to Crow Spring	1.56	1B, 2A, 3B	FS	IF	–	NA	MTS	MTS	IF	IF	–	IF	–	–	IF
07040003-610	Crow Spring (Middle Fork Whitewater Tributary)	T106 R11W S10, west line to Unnamed cr	2.26	1B, 2A, 3B	IF*	NA	–	IF	MTS	EXP	IF	IF	–	IF	–	–	–
07040006-611	Crow Spring (Middle Fork Whitewater Tributary)	Unnamed cr to M Fk Whitewater R	2.03	1B, 2A, 3B	NS	IF	–	IF	MTS	EXS	IF	IF	–	IF	–	–	EX
07040003-F19	Whitewater River, Middle Fork	Crow Spring to N Fk Whitewater R	11.39	1B, 2A, 3B	NS	NS	–	NS	MTS	EXP	IF	EXS	MTS	EXP	MTS	MTS	EX
07040003-576	Trout Run – Whitewater Park	T107 R10W S29, south line to Whitewater R	1.89	1B, 2A, 3B	FS	NA	–	NA	MTS	MTS	IF	IF	–	IF	–	–	–
HUC 11:07040003140 (Whitewater River, South Fork)																	
07040003-F16	Whitewater River, South Fork	Headwaters to St Charles Twp Rd 7	22.16	2B, 3C	NS	NS	–	–	EXP	EXP	IF	EXP	MTS	MTS	MTS	–	EX
07040003-F15	Unnamed creek	Unnamed cr to Unnamed cr	0.74	2B, 3C	NA*	NA	–	–	NA	NA	–	–	–	–	–	–	–
07040003-512	Whitewater River, South Fork	T106 R10W S1, west line to N Fk Whitewater R	12.08	1B, 2A, 3B	NS	NS	NS	NS	MTS	EXP	EXP	EXS	MTS	MTS	MTS	MTS	EX

Full Support (FS); Not Supporting (NS); Insufficient Data (IF); Not Assessed (NA); Meets standards or ecoregion expectations (MT/MTS), Potential Exceedence (EXP), Exceeds standards or ecoregion expectations (EX/EXS).
Key for Cell Shading: = existing impairment, listed prior to 2012 reporting cycle; = new impairment; = full support of designated use. *Aquatic Life assessment and/or impairments have been deferred until the adoption of Tiered Aquatic Life Uses due to the AUID being predominantly (>50%) channelized or having biological data limited to a station occurring on a channelized portion of the stream.

AUID DESCRIPTIONS				USES					BIOLOGICAL CRITERIA		WATER QUALITY STANDARDS						
Assessment Unit ID (AUID)	Stream Reach Name	Reach Description	Reach Length (Miles)	Use Class	Aquatic Life	Aquatic Recreation	Aquatic Consumption	Drinking Water	Fish	Macroinvertebrates	Dissolved Oxygen	Turbidity	Chloride	pH	NH3	Pesticides	Bacteria (Aquatic Recreation)
07040003-F11	Unnamed creek (Kieffer Valley)	T107 R10W S11, east line to S Fk Whitewater R	0.87	1B, 2A, 3B	FS	IF	–	NA	MTS	MTS	IF	IF	–	IF	–	–	–
07040003-F14	Unnamed creek	Unnamed cr to S Fk Whitewater R	0.87	2B, 3C	NA*	NA	–	–	NA	NA	–	–	–	–	–	–	–
07040003-F17	Whitewater River, South Fork	St Charles Twp Rd 7 to T106 R10W S2, east line	0.88	2B, 3B	NS	NA	–	–	MTS	EXP	IF	IF	–	IF	–	–	–
07040003-561	Unnamed creek	Unnamed cr to Unnamed cr	1.48	2B, 3B	IF	NA	–	–	–	–	–	MTS	–	–	–	–	–
07040003-612	Unnamed creek	Headwaters to S Fk Whitewater R	1.52	2B, 3B	IF	NA	–	–	–	–	IF	IF	MTS	–	–	–	IF
HUC 11: 07040003150 (Beaver Creek)																	
07040003-566	Beaver Creek	T108 R11W 524, W line to Unnamed cr	0.53	1B, 2A, 3B	NS	NA	–	IF	MTS	EXP	IF	MTS	–	IF	–	–	–
07040003-540	Beaver Creek	Unnamed cr to Whitewater R	6.08	1B, 2A, 3B	IF	NA	–	IF	–	–	–	MTS	–	–	–	–	–
HUC 11: 07040003160 (Whitewater River)																	
07040003-537	Whitewater RIver	S Fk Whitewater R to Beaver cr	6.08	1B, 2A, 3B	NS	NA	NS	IF	MTS	MTS	IF	EXS	MTS	MTS	MTS	–	–
07040003-574	Trout Creek (Trout Valley Creek)	T108 R9W S20, east line to Whitewater R	7.74	1B, 2A, 3B	FS	NA	–	IF	MTS	MTS	IF	IF	IF	IF	–	–	–
07040003-609	Unnamed Creek	Unnamed cr to Whitewater R	2.16	2B, 3C	IF	NA	–	–	IF	IF	IF	IF	--	IF	–	–	–
07040003-539	Whitewater River	T109 R10W S36, south line to Mississippi R	4.72	2B, 3B	NS	NS	NS	–	NA*	NA*	IF	MTS	MTS	MTS	MTS		EX
HUC 11: 07040003180 (Rollingstone Creek)																	
07040003-534	Rollingstone Creek (Rupprecht Creek)	T107 R9W S35, west line to Unnamed cr	4.71	1B, 2A, 3B	FS	NA	–	NA	MTS	MTS	IF	IF	–	IF	–	–	–
07040003-581	Bear Creek	Unnamed cr to Rollingstone cr	4.37	1B, 2A, 3B	NS	NA	–	NA	EXP	EXS	IF	IF	–	IF	–	–	–
07040003-533	Rollingstone Creek	Unnamed cr to Garvin Bk	10.96	1B, 2A, 3B	NS	NS	–	IF	MTS	MTS	IF	EXS	MTS	MTS	MTS	–	EX
07040003-555	Speltz Creek	Preston Valley cr to Rollingstone cr	2.99	1B, 2A, 3B	IF*	NA	–	NA	NA	NA	IF	EXP	–	IF	–	–	–
07040003-579	Speltz Creek	T108 R8W S36, west line to Preston Valley cr	0.99	1B, 2A, 3B	IF	NA	–	NA	–	–	--	MTS	–	–	–	–	–
07040003-B99	Unnamed Creek (Speltz Creek Tributary)	Headwaters to Preston Valley cr	0.09	1B, 2A, 3B	IF	NA	–	NA	–	–	--	MTS	–	–	–	–	–

Full Support (FS); Not Supporting (NS); Insufficient Data (IF); Not Assessed (NA); Meets standards or ecoregion expectations (MT/MTS), Potential Exceedence (EXP), Exceeds standards or ecoregion expectations (EX/EXS). Key for Cell Shading: = existing impairment, listed prior to 2012 reporting cycle; = new impairment; = full support of designated use. *Aquatic Life assessment and/or impairments have been deferred until the adoption of Tiered Aquatic Life Uses due to the AUID being predominantly (>50%) channelized or having biological data limited to a station occurring on a channelized portion of the stream.

AUID DESCRIPTIONS				USES						BIOLOGICAL CRITERIA		WATER QUALITY STANDARDS						
Assessment Unit ID (AUID)	Stream Reach Name	Reach Description	Reach Length (Miles)	Use Class	Aquatic Life	Aquatic Recreation	Aquatic Consumption	Drinking Water		Fish	Macroinvertebrates	Dissolved Oxygen	Turbidity	Chloride	pH	NH3	Pesticides	Bacteria (Aquatic Recreation)
HUC 11: 07040003190 (Garvin Brook)																		
07040003-542	Garvin Brook	T106 R8W S17, west line to Rollingstone cr	15.18	1B, 2A, 3B	NS	NS	–	IF		MTS	MTS	IF	EXS	MTS	EXP	MTS	MTS	EX
07040003-543	Garvin Brook	Rollingstone cr to T107 R8W S11, north line	0.54	1B, 2A, 3B	IF	NA	–	NA		–	–	–	MTS	–	–	–	–	–
07040003-559	Stockton Valley Creek	T106 R8W S23, south line to Garvin Bk	7.45	1B, 2A, 3B	NS	NA	–	NA		MTS	MTS	IF	MTS	–	–	–	–	–
07040003-906	Upper Garvin Brook	T107 R8W S33, west line to Garvin Bk	0.95	1B, 2A, 3B	IF	NA	–	NA		–	–	–	MTS	–	IF	–	–	–
HUC 11: 07040003210 (Gilmore Creek)																		
07040003-535	Gilmore Creek	T106 R7W S6, South line to Boiler's Lk (85-0010-00)	4.99	1B, 2A, 3B	IF*	NA	–	NA		NA	NA	IF	MTS	–	IF	–	–	–
07040003-549	Unnamed Creek	Boiler's Lk to Lk Winona	2.45	2B, 3C	IF	NA	–	--		–	–	--	MTS	–		–	–	–
HUC 11: 070400033230 (Pleasant Valley)																		
07040003-588	Pleasant Valley Creek	T106 R7W S25, west line to T106 R7W S1, north line	7.45	1A, 2B, 3B	IF*	NA	–	NA		NA	NA	–	MTS	–	--	–	–	–
07040003-620	Unnamed Creek	Unnamed cr to Pleasant Valley cr	0.23	1A, 2B, 3B	IF	NA	–	NA		–	–	IF	MTS	–	--	–	–	–
HUC 11: 07040003250 (Cedar Creek)																		
07040003-591	Cedar Creek (Cedar Valley Creek)	Unnamed cr to Mississippi R	11.7	1B, 2A, 3B	FS	NA	–	IF		MTS	MTS	–	MTS	–	--	–	MTS	–
HUC 11: 070400033260 (Pickwick Valley)																		
07040003-592	Big Trout Creek (Pickwick Creek)	Unnamed cr to Mississippi R	8.63	1B, 2A, 3B	NS	NA	–	NA		MTS	EXP	IF	MTS	–	IF	–	–	–
07040003-593	Little Trout Creek (Little Pickwick Creek)	T106 R5W S32, east line to Big Trout cr	5.53	1B, 2A, 3B	FS	NA	–	NA		MTS	MTS	IF	IF	–	IF	–	–	–
HUC 11: 07040003270 (Dakota Valley)																		
07040003-584	West Burns Valley Creek	T106 R11W S36, west line to Mississippi R	3.77	1B, 2A, 3B	FS	NA	–	NA		MTS	MTS	–	–	–	–	–	–	–
07040003-586	Burns Valley Creek	East Burns Valley cr to T107 R7W S35, east line	1.55	1B, 2A, 3B	IF	NA	–	NA		–	–	–	MTS	–	--	–	–	–
07040003-549	Unnamed Creek	Boilers Lk to Lk Winona	2.45	2B, 3C	IF	NA	--	--		--	--	--	MTS	--	--	--	--	--

Full Support (FS); Not Supporting (NS); Insufficient Data (IF); Not Assessed (NA); Meets standards or ecoregion expectations (MT/MTS), Potential Exceedence (EXP), Exceeds standards or ecoregion expectations (EX/EXS).
Key for Cell Shading: ☐= existing impairment, listed prior to 2012 reporting cycle; ☐= new impairment; ☐= full support of designated use. *Aquatic Life assessment and/or impairments have been deferred until the adoption of Tiered Aquatic Life Uses due to the AUID being predominantly (>50%) channelized or having biological data limited to a station occurring on a channelized portion of the stream.

Appendix 3.2 – Assessment results for lakes in the Mississippi River (Winona) Watershed

Lake ID	Lake Name	County	HUC-11	Ecoregion	Lake Area (ha)	Max Depth (m)	Watershed Area (ha)	% Littoral	Mean depth (m)	Support Status
85-0011-01	Winona (South Bay)	Winona	07040003270	Driftless Area	88	11.6	4,883	90	4.4	NS
85-0011-02	Winona (North Bay)	Winona	07040003270	Driftless Area	36	6.7	4,883	90	2.4	NS

Abbreviations: **FS** – Full Support; **NS** – Non-Support; **IF** – Insufficient Information; **N/A** – Not Assessed

Key for Cell Shading: ☐ = existing impairment, listed prior to 2012 reporting cycle; ☐ = new impairment; ☐ = full support of designated use.

Appendix 4.1 – Minnesota statewide IBI thresholds and confidence limits

Class #	Class Name	Use Class	Threshold	Confidence Limit	Upper	Lower
Fish						
1	Southern Rivers	2B, 2C	39	±11	50	28
2	Southern Streams	2B, 2C	45	±9	54	36
3	Southern Headwaters	2B, 2C	51	±7	58	44
10	Southern Coldwater	2A	45	±9	58	32
4	Northern Rivers	2B, 2C	35	±9	44	26
5	Northern Streams	2B, 2C	50	±9	59	41
6	Northern Headwaters	2B, 2C	40	±16	56	24
7	Low Gradient	2B, 2C	40	±10	50	30
11	Northern Coldwater	2A	37	±10	47	27
Invertebrates						
1	Northern Forest Rivers	2B, 2C	51.3	±10.8	62.1	40.5
2	Prairie Forest Rivers	2B, 2C	30.7	±10.8	41.5	19.9
3	Northern Forest Streams RR	2B, 2C	50.3	±12.6	62.9	37.7
4	Northern Forest Streams GP	2B, 2C	52.4	±13.6	66	38.8
5	Southern Streams RR	2B, 2C	35.9	±12.6	48.5	23.3
6	Southern Forest Streams GP	2B, 2C	46.8	±13.6	60.4	33.2
7	Prairie Streams GP	2B, 2C	38.3	±13.6	51.9	24.7
8	Northern Coldwater	2A	26	±12.4	38.4	13.6
9	Southern Coldwater	2A	46.1	±13.8	59.9	32.3

Appendix 4.2 – Biological monitoring results – fish IBI (assessable reaches)

National Hydrography Dataset (NHD) Assessment Segment AUID	Biological Station ID	Stream Segment Name	Drainage Area Mi^2	Fish Class	Threshold	FIBI	Visit Date
HUC 11: 07040003-065 (Wabasha Watershed)							
NONE							
HUC 11: 07040003-075 (Cooks Valley Watershed)							
07040003-569	10LM030	Gorman Creek	14.59	3	51	59	07-Jun-2010
HUC 11: 07040003-080 (Snake Creek Watershed)							
07040003-557	03LM002	Snake Creek	7.07	10	45	77	07-Jun-2010
HUC 11: 0704003-090 (East Indian Watershed)							
07040003-573	04LM049	East Indian Creek	7.70	10	45	51	21-Jun-2004
07040003-573	10LM031	East Indian Creek	14.35	10	45	52	14-Jul-2010
HUC 11: 07040003-100 (Mississippi Direct Watershed)							
NONE							
HUC 11: 07040003-110 (Dry Creek Watershed)							
NONE							
HUC 11: 07040003-120 (Whitewater River, North Branch Watershed)							
07040003-525	04LM005	Whitewater River, North Fork	1.55	3	51	83	24-Jun-2004
07040003-525	04LM005	Whitewater River, North Fork	1.55	3	51	84	14-Jul-2004
07040003-553	10LM035	Whitewater River, North Fork	54.90	10	45	35	10-Aug-2010
07040003-553	10LM010	Whitewater River, North Fork	63.38	10	45	55	14-Jun-2010
07040003-536	10LM011	Logan Branch	14.34	3	51	85	22-Jun-2010
07040003-552	04LM127	Logan Branch	17.29	3	51	65	23-Jun-2004
07040003-554	10LM003	Whitewater River, North Fork	102.19	10	45	88	16-Jun-2010
07040003-554	10LM003	Whitewater River, North Fork	102.19	10	45	87	10-Aug-2010
HUC 11:07040003-130 (Whitewater River, Middle Branch Watershed)							
07040003-515	10LM008	Whitewater River, Middle Fork	12.41	3	51	53	08-Jun-10
07040003-F18	04LM035	Whitewater River, Middle Fork	14.52	3	45	88	05-Aug-04
07040003-610	04LM128	Crow Spring (Middle Fork Whitewater River Tributary)	5.50	10	45	93	29-Jun-04
07040003-611	10LM009	Crow Spring (Middle Fork Whitewater River Tributary)	8.97	10	45	95	08-Jun-10

National Hydrography Dataset (NHD) Assessment Segment AUID	Biological Station ID	Stream Segment Name	Drainage Area Mi^2	Fish Class	Threshold	FIBI	Visit Date
07040003-F19	10LM037	Whitewater River, Middle Fork	25.19	10	45	81	09-Aug-2010
07040003-F19	10LM007	Whitewater River, Middle Fork	39.16	10	45	79	14-Jul-10
07040003-F19	10LM007	Whitewater River, Middle Fork	39.16	10	45	84	10-Aug-10
07040003-576	04LM101	Trout Run –Whitewater Park	7.54	10	45	94	23-Jun-04
07040003-F19	10LM002	Whitewater River, Middle Fork	53.33	10	45	89	16-Jun-10
07040003-F19	10LM002	Whitewater River, Middle Fork	53.33	10	45	90	13-Jul-10
HUC 11: 07040003-140 (Whitewater River, South Fork Watershed)							
07040003-F16	10LM018	Whitewater River, South Fork	8.98	3	51	65	08-Jun-10
07040003-F16	04LM020	Whitewater River, South Fork	31.09	2	45	46	28-Jun-04
07040003-F16	04LM020	Whitewater River, South Fork	31.09	2	45	39	24-Aug-04
07040003-F16	10LM014	Whitewater River, South Fork	34.06	2	45	44	15-Jun-10
07040003-F17	10LM016	Whitewater River, South Fork	51.93	10	45	54	13-Jul-10
07040003-512	04LM068	Whitewater River, South Fork	52.23	10	45	63	10-Aug-04
07040003-512	04LM102	Whitewater River, South Fork	78.02	10	45	79	2-Aug-04
07040003-512	10LM012	Whitewater River, South Fork	78.55	10	45	81	16-Jun-10
07040003-F11	10LM013	Unnamed creek (Kieffer Valley)	8.76	10	45	93	23-Jun-10
07040003-F11	10LM013	Unnamed creek (Kieffer Valley)	8.76	10	45	77	14-Jul-10
07040003-512	10LM004	Whitewater River, South Fork	92.76	10	45	76	17-Jun-10
HUC 11: 07040003-150 (Beaver Creek Watershed)							
07040003-566	04LM104	Beaver Creek	9.77	10	45	85	28-Jun-04
07040003-566	10LM033	Beaver Creek	15.05	10	45	88	12-Jul-10
HUC 11: 07040003-160 (Whitewater River Watershed)							
07040003-609	04LM105	Unnamed creek	5.19	3	51	44	22-Jun-04
07040003-537	04LM103	Whitewater River	267.01	10	45	50	03-Aug-04
07040003-537	04LM103	Whitewater River	267.01	10	45	76	15-Jun-10
07040003-574	04LM091	Trout Creek (Trout Valley Creek)	10.09	10	45	52	23-Jun-04
07040003-574	04LM091	Trout Creek (Trout Valley Creek)	10.09	10	45	49	25-Aug-04
07040003-574	10EM171	Trout Creek (Trout Valley Creek)	11.65	10	45	69	14-Jun-10
07040003-574	10EM171	Trout Creek (Trout Valley Creek)	11.65	10	45	53	08-Sep-10
07040003-574	10LM032	Trout Creek (Trout Valley Creek)	15.93	10	45	72	07-Jun-10

National Hydrography Dataset (NHD) Assessment Segment AUID	Biological Station ID	Stream Segment Name	Drainage Area Mi^2	Fish Class	Threshold	FIBI	Visit Date
07040003-574	10LM032	Trout Creek (Trout Valley Creek)	15.93	10	45	46	14-Jul-10
HUC 11: 07040003-180 (Rollingstone Creek Watershed)							
07040003-534	10LM022	Rollingstone Creek (Rupprecht Creek)	11.65	10	45	65	09-Jun-10
07040003-581	10LM023	Bear Creek	9.26	10	45	46	09-Jun-10
07040003-533	10LM020	Rollingstone Creek	30.81	10	45	46	28-Jun-10
07040003-533	10LM005	Rollingstone Creek	49.87	10	45	54	12-Jul-10
HUC 11: 07040003-190 (Garvin Brook Watershed)							
07040003-542	04LM099	Garvin Brook	4.03	10	45	89	21-Jun-04
07040003-559	10LM025	Stockton Valley Creek	18.75	10	45	58	09-Jun-10
07040003-542	10LM006	Garvin Brook	47.08	10	45	46	29-Jun-10
HUC 11: 07040003-210 (Gilmore Creek Watershed)							
NONE							
HUC 11: 07040003-230 (Pleasant Valley Watershed)							
NONE							
HUC 11: 07040003-250 (Cedar Creek Watershed)							
07040003-591	10LM027	Cedar Creek (Cedar Valley Creek)	15.77	10	45	56	13-Jul-10
HUC 11: 07040003-260 (Pickwick Valley Watershed)							
07040003-592	04LM092	Big Trout Creek (Pickwick Creek)	20.04	10	45	53	22-Jun-04
07040003-592	10LM028	Big Trout Creek (Pickwick Creek)	9.92	10	45	70	23-Jun-10
07040003-593	10LM029	Little Trout Creek (Little Pickwick Creek)	5.03	10	45	92	23-Jun-10
HUC 11: 07040003-270 (Dakota Valley Watershed)							
07040003-584	03LM003	West Burns Valley Creek	3.75	10	45	86	22-Jun-10

Appendix 4.3 – Biological monitoring results-macroinvertebrate IBI (assessable reaches)

National Hydrography Dataset (NHD) Assessment Segment AUID	Biological Station ID	Stream Segment Name	Drainage Area Mi^2	Invert Class	Threshold	MIBI	Visit Date
HUC 11: 07040003-065 (Wabasha Watershed)							
NONE							
HUC 11: 07040003-075 (Cooks Valley Watershed)							
07040003-569	10LM030	Gorman Creek	14.59	6	46.8	36.42	16-Aug-10
HUC 11: 07040003-080 (Snake Creek Watershed)							
07040003-557	03LM002	Snake Creek	7.07	9	46.1	79.15	16-Aug-10
HUC 11: 07040003-090 (East Indian Creek Watershed)							
07040003-573	10LM031	Indian Creek, East	14.35	9	46.1	45.11	19-Aug-10
07040003-573	04LM049	Indian Creek, East	7.70	9	46.1	73.56	18-Aug-04
HUC 11: 07040003-110 (Dry Creek Watershed)							
NONE							
HUC 11: 07040003-120 (Whitewater River, North Fork Watershed)							
0704003-525	04LM005	Whitewater River, North Fork	1.55	5	35.9	23.3	18-Aug-04
07040003-553	10LM035	Whitewater River, North Fork	54.90	9	46.1	24.72	17-Aug-10
07040003-553	10LM010	Whitewater River, North Fork	63.38	9	46.1	29.26	17-Aug-10
07040003-536	10LM011	Logan Branch	14.34	5	35.9	47.64	17-Aug-10
07040003-552	04LM127	Logan Branch	17.29	9	46.1	43.69	17-Aug-04
07040003-554	10LM003	Whitewater River, North Fork	102.19	9	46.1	65.50	19-Aug-10
HUC 11: 07040003-130 (Whitewater River, Middle Fork Watershed)							
07040003-515	10LM008	Whitewater River, Middle Fork	12.41	6	46.8	26.52	18-Aug-10
07040003-515	10LM008	Whitewater River, Middle Fork	12.41	6	46.8	35.36	18-Aug-10
07040003-518	04LM035	Whitewater River, Middle Fork	14.52	5	35.9	45.54	16-Aug-04
07040003-610	04LM128	Crow Spring (Middle Fork Whitewater River Tributary)	5.50	9	46.1	44.47	16-Aug-04
07040003-611	10LM009	Crow Spring (Middle Fork Whitewater River Tributary)	8.97	9	46.1	27.15	17-Aug-10
07040003-F19	10LM037	Whitewater River, Middle Fork	25.19	9	46.1	58.94	18-Aug-10
07040003-F19	10LM007	Whitewater River, Middle Fork	39.16	9	46.1	30.59	18-Aug-10
07040003-576	04LM101	Trout Run - Whitewater Park	7.54	9	46.1	55.62	17-Aug-04

National Hydrography Dataset (NHD) Assessment Segment AUID	Biological Station ID	Stream Segment Name	Drainage Area Mi^2	Invert Class	Threshold	MIBI	Visit Date
07040003-F19	10LM002	Whitewater River, Middle Fork	53.33	9	46.1	51.61	18-Aug-10
HUC 11: 07040003-140 (Whitewater River, South Fork Watershed)							
07040003-F16	10LM018	Whitewater River, South Fork	8.98	5	35.9	42.46	19-Aug-10
07040003-F16	04LM020	Whitewater River, South Fork	31.09	5	35.9	35.09	01-Sep-04
07040003-F16	04LM020	Whitewater River, South Fork	31.09	5	35.9	24.31	09-Sep-04
07040003-F16	10LM014	Whitewater River, South Fork	34.06	5	35.9	36.28	24-Aug-10
07040003-F17	10LM016	Whitewater River, South Fork	51.93	9	46.1	38.60	24-Aug-10
07040003-512	04LM068	Whitewater River, South Fork	52.23	9	46.1	42.44	17-Aug-04
07040003-512	04LM102	Whitewater River, South Fork	78.02	9	46.1	33.62	17-Aug-04
07040003-512	10LM012	Whitewater River, South Fork	78.55	9	46.1	62.79	18-Aug-10
07040003-F11	10LM013	Unnamed creek (Kieffer Valley)	8.76	9	46.1	62.58	17-Aug-10
07040003-F11	10LM013	Unnamed creek (Kieffer Valley)	8.76	9	46.1	52.75	17-Aug-10
07040003-512	10LM004	Whitewater River, South Fork	92.76	9	46.1	66.04	18-Aug-10
HUC 11: 07040003-150 (Beaver Creek Watershed)							
07040003-566	10LM033	Beaver Creek	15.05	9	46.1	65.12	19-Aug-10
07040003-566	10LM033	Beaver Creek	15.05	9	46.1	65.46	19-Aug-10
07040003-566	04LM104	Beaver Creek	9.77	9	46.1	43.30	21-Sep-04
07040003-566	04LM104	Beaver Creek	9.77	9	46.1	27.41	18-Aug-04
HUC 11: 07040003-160 (Whitewater River Watershed)							
07040003-609	04LM105	Unnamed creek	5.19	5	35.9	28.97	17-Aug-04
07040003-537	04LM103	Whitewater River	267.01	9	46.1	44.03	18-Aug-04
07040003-537	04LM103	Whitewater River	267.01	9	46.1	45.06	24-Aug-04
07040003-537	04LM103	Whitewater River	267.01	9	46.1	58.56	18-Aug-10
07040003-574	04LM091	Trout Creek (Trout Valley Creek)	10.09	9	46.1	53.57	20-Aug-04
07040003-574	10EM171	Trout Creek (Trout Valley Creek)	11.65	9	46.1	67.97	16-Aug-10
07040003-574	10LM032	Trout Creek (Trout Valley Creek)	15.93	9	46.1	57.04	16-Aug-10
HUC 11: 07040003-180 (Rollingstone Creek Watershed)							
07040003-534	10LM022	Rollingstone Creek (Rupprecht Creek)	11.65	9	46.1	47.60	18-Aug-10
07040003-581	10LM023	Bear Creek	9.26	9	46.1	27.31	18-Aug-10

National Hydrography Dataset (NHD) Assessment Segment AUID	Biological Station ID	Stream Segment Name	Drainage Area Mi^2	Invert Class	Threshold	MIBI	Visit Date
HUC 11: 07040003-180 (Rollingstone Creek Watershed) (continued)							
07040003-533	10LM020	Rollingstone Creek	30.81	9	46.1	47.34	18-Aug-10
07040003-533	10LM005	Rollingstone Creek	49.87	9	46.1	51.74	18-Aug-10
HUC 11: 07040003-190 (Garvin Brook Watershed)							
07040003-542	04LM099	Garvin Brook	4.03	9	46.1	80.15	23-Aug-04
07040003-542	04LM099	Garvin Brook	4.03	9	46.1	68.60	09-Sep-04
07040003-559	10LM025	Stockton Valley Creek	18.75	9	46.1	67.05	17-Aug-10
07040003-559	10LM025	Stockton Valley Creek	18.75	9	46.1	57.36	17-Aug-10
07040003-542	10LM006	Garvin Brook	47.08	9	46.1	29.35	16-Aug-10
HUC 11: 07040003-210 (Gilmore Creek Watershed)							
NONE							
HUC 11: 07040003-230 (Pleasant Valley Watershed)							
NONE							
HUC 11: 07040003-250 (Cedar Creek Watershed)							
07040003-591	10LM027	Cedar Creek (Cedar Valley Creek)	15.77	9	46.1	62.67	18-Aug-10
HUC 11: 07040003-260 (Pickwick Valley Watershed)							
07040003-592	10LM028	Big Trout Creek (Pickwick Creek)	9.92	9	46.1	34.30	18-Aug-10
07040003-593	10LM029	Little Trout Creek (Little Pickwick Creek)	5.03	9	46.1	73.01	16-Aug-10
07040003-592	04LM092	Big Trout Creek (Pickwick Creek)	20.04	9	46.1	81.22	21-Sep-04
07040003-592	04LM092	Big Trout Creek (Pickwick Creek)	20.04	9	46.1	55.74	19-Aug-04
HUC 11: 07040003-270 (Dakota Valley Watershed)							
07040003-584	03LM003	West Burns Valley Creek	3.75	9	46.1	54.31	17-Aug-10

Appendix 5.1 – Good/fair/poor thresholds for biological stations on non-assessed channelized AUIDs

Ratings of **Good** for channelized streams are based on Minnesota's general use threshold for aquatic life (Appendix 4.1). Stations with IBIs that score above this general use threshold would be given a rating of **Good**. The **Fair** rating is calculated as a 15 point drop from the general use threshold. Stations with IBI scores below the general use threshold, but above the **Fair** threshold would be given a rating of **Fair**. Stations scoring below the Fair threshold would be considered **Poor**.

Class #	Class Name	Good	Fair	Poor
Fish				
1	Southern Rivers	>38	38-24	<24
2	Southern Streams	>44	44-30	<30
3	Southern Headwaters	>50	50-36	<36
4	Northern Rivers	>34	34-20	<20
5	Northern Streams	>49	49-35	<35
6	Northern Headwaters	>39	39-25	<25
7	Low Gradient Streams	>39	39-25	<25
10	Southern Coldwater	>43	43-17	<17
11	Northern Coldwater	>36	36-22	<22
Invertebrates				
1	Northern Forest Rivers	>51	52-36	<36
2	Prairie Forest Rivers	>31	31-16	<16
3	Northern Forest Streams RR	>50	50-35	<35
4	Northern Forest Streams GP	>52	52-37	<37
5	Southern Streams RR	>36	36-21	<21
6	Southern Forest Streams GP	>47	47-32	<32
7	Prairie Streams GP	>38	38-23	<23
8	Northern Coldwater	>23	23-11	<11
9	Southern Coldwater	>44	44-18	<18

Appendix 5.2 – Channelized stream reach and AUID IBI scores-FISH (non-assessed)

National Hydrography Dataset (NHD) Assessment Segment AUID	Biological Station ID	Stream Segment Name	Drainage Area Mi^2	Fish Class	Good	Fair	Poor	FIBI	Visit Date
HUC 11: 0704003065 (Wabasha)									
NONE									
HUC 11: 07040003075 (Cooks Valley)									
NONE									
HUC 11: 07040003080 (Snake Creek)									
NONE									
HUC 11: 07040003090 (East Indian Creek)									
NONE									
HUC 11: 070400030110 (Dry Creek)									
07040003-567	10LM034	Dry Creek	22.96	3	>50	50-36	<36	52	21-Jun-10
HUC 11: 07040003120 (Whitewater River, North Fork)									
07040003-525	10EM059	Whitewater River, North Fork	21.11	3	>50	50-36	<36	64	12-Jul-10
07040003-524	04LM135	Whitewater River, North Fork	23.15	3	>50	50-36	<36	71	12-Jul-10
07040003-526	10LM036	Unnamed Creek	5.80	3	>50	50-36	<36	69	22-Jun-10
HUC 11: 07040003130 (Whitewater River, Middle Fork)									
NONE									
HUC 11: 07040003140 (Whitewater River, South Fork)									
07040003-F14	10LM015	Unnamed creek	13.62	3	>50	50-36	<36	17	23-Jun-10
07040003-F15	10LM019	Unnamed creek	6.16	3	>50	50-36	<36	70	08-Jun-10
HUC 11: 07040003150 (Beaver Creek)									
NONE									
HUC 11: 07040003160 (Whitewater River)									
07040003-539	10LM001	Whitewater River	320.11	1	>38	38-24	<24	68	08-Sep-10
HUC 11: 07040003180 (Rollingstone Creek)									
07040003-555	10LM021	Speltz Creek	9.86	10	>45	45-30	<30	35	09-Jun-10
HUC 11: 07040003190 (Garvin Brook)									
07040003-542	10LM024	Garvin Brook	15.28	10	>45	45-30	<30	75	09-Jun-10

National Hydrography Dataset (NHD) Assessment Segment AUID	Biological Station ID	Stream Segment Name	Drainage Area Mi^2	Fish Class	Good	Fair	Poor	FIBI	Visit Date
HUC 11: 07040003210 (Gilmore Creek)									
07040003-535	04LM100	Gilmore Creek	9.19	10	>45	45-30	<30	84	22-Jun-04
07040003-535	04LM100	Gilmore Creek	9.19	10	>45	45-30	<30	82	10-Jun-10
HUC 11: 07040003230 (Pleasant Valley)									
07040003-588	04LM094	Pleasant Valley Creek	11.84	10	>45	45-30	<30	25	22-Jun-04
07040003-588	04LM094	Pleasant Valley Creek	11.84	10	>45	45-30	<30	40	10-Jun-10
HUC 11: 07040003250 (Cedar Creek)									
NONE									
HUC 11: 07040003260 (Pickwick Valley)									
NONE									
HUC 11: 0704000270 (Dakota Valley)									
NONE									

Appendix 5.3 – Channelized stream reach and AUID IBI scores-macrinverbrates (non-unassessed)

National Hydrography Dataset (NHD) Assessment Segment AUID	Biological Station ID	Stream Segment Name	Drainage Area Mi^2	Invert Class	Good	Fair	Poor	MIBI	Visit Date
HUC 11: 07040003065 (Wabasha)									
NONE									
HUC 11: 07040003075 (Cooks Valley)									
NONE									
HUC 11: 07040003080 (Snake Creek)									
NONE									
HUC 11: 07040003090 (East Indian Creek)									
NONE									
HUC 11: 07040003110 (Dry Creek)									
07040003-567	10LM034	Dry Creek	22.96	6	>47	47-32	<32	31.51	17-Aug-10
HUC 11: 07040003120 (Whitewater River, North Fork)									
07040003-525	10EM059	Whitewater River, North Fork	21.11	6	>47	47-32	<32	50.31	17-Aug-10
07040003-524	04LM135	Whitewater River, North Fork	23.15	6	>47	47-32	<32	34.93	18-Aug-04
07040003-524	04LM135	Whitewater River, North Fork	23.15	6	>47	47-32	<32	18.78	17-Aug-10
07040003-524	04LM036	Whitewater River, North Fork	23.15	6	>47	47-32	<32	34.93	18-Aug-04
07040003-526	10LM036	Unnamed Creek	5.80	5	>36	36-21	<21	38.86	17-Aug-10
HUC 11: 07040003130 (Whitewater River, Middle Fork)									
NONE									
HUC 11: 07040003140 (Whitewater River, South Fork)									
07040003-F15	10LM019	Unnamed Creek	6.16	5	>36	36-21	<21	37.00	19-Aug-10
HUC 11: 07040003150 (Beaver Creek)									
NONE									
HUC 11: 07040003160 (Whitewater River)									
07040003-539	10LM001	Whitewater River	320.11	6	>47	47-32	<32	31.95	19-Aug-10
HUC 11: 07040003180 (Rollingstone Creek)									
07040003-555	10LM021	Speltz Creek	9.86	9	>46	46-31	<31	42.18	18-Aug-10

National Hydrography Dataset (NHD) Assessment Segment AUID	Biological Station ID	Stream Segment Name	Drainage Area Mi^2	Invert Class	Good	Fair	Poor	MIBI	Visit Date
HUC 11: 07040003190 (Garvin Brook)									
07040003-542	10LM024	Garvin Brook	15.28	9	>46	46-31	<31	92.59	17-Aug-10
HUC 11: 07040003210 (Gilmore Creek)									
07040003-535	04LM100	Gilmore Creek	9.19	9	>46	46-31	<31	60.10	17-Aug-10
07040003-535	04LM100	Gilmore Creek	9.19	9	>46	46-31	<31	58.66	19-Aug-04
HUC 11: 07040003230 (Pleasant Valley)									
07040003-588	04LM094	Pleasant Valley Creek	11.84	9	>46	46-31	<31	55.11	19-Aug-04
07040003-588	04LM094	Pleasant Valley Creek	11.84	9	>46	46-31	<31	47.28	21-Sep-04
07040003-588	04LM094	Pleasant Valley Creek	11.84	9	>46	46-31	<31	38.88	18-Aug-10
07040003-588	04LM094	Pleasant Valley Creek	11.84	9	>46	46-31	<31	51.43	18-Aug-10
HUC 11: 07040003250 (Cedar Creek)									
NONE									
HUC 11: 07040003260 (Pickwick Valley)									
NONE									
HUC 11: 07040003270 (Dakota Valley)									
NONE									

Appendix 6.1 – Minnesota's ecoregion-based lake eutrophication standards

Ecoregion	TP µg/L	Chl-a µg/L	Secchi meters
NLF – Lake Trout (Class 2A)	< 12	< 3	> 4.8
NLF – Stream trout (Class 2A)	< 20	< 6	> 2.5
NLF – Aquatic Rec. Use (Class 2B)	< 30	< 9	> 2.0
NCHF – Stream trout (Class 2A)	< 20	< 6	> 2.5
NCHF – Aquatic Rec. Use (Class 2B)	< 40	< 14	> 1.4
NCHF – Aquatic Rec. Use (Class 2B) Shallow lakes	< 60	< 20	> 1.0
WCBP & NGP – Aquatic Rec. Use (Class 2B)	< 65	< 22	> 0.9
WCBP & NGP – Aquatic Rec. Use (Class 2B) Shallow lakes	< 90	< 30	> 0.7

Appendix 6.2 – MINLEAP model estimates of phosphorus loads for lakes in the Mississippi River (Winona) Watershed

Lake ID	Lake Name	Obs TP (µg/L)	MINLEAP TP (µg/L)	Obs Chl-a (µg/L)	MINLEAP Chl-a (µg/L)	Obs Secchi (m)	MINLEAP Secchi (m)	Avg. TP Inflow (µg/L)	TP Load (kg/yr)	Background TP (µg/L)	%P Retention	Outflow (hm3/yr)	Residence Time (yrs)	Areal Load (m/yr)	Trophic Status
85-0011-01	Winona (South Bay)	53	68	52	31	1	1	151	966	24	55	6	0.6	7	E
85-0011-02	Winona (North Bay)	85	97	69	52	0.9	0.8	149	950	30	35	6	0.1	18	E

Abbreviations: **H** – Hypereutrophic, **E** – Eutrophic, **M** – Mesotrophic, **O** – Oligotrophic, --- No data

Appendix 7 – Fish species found during biological monitoring surveys

Common Name	Quantity of Stations Where Present	Quantity of Individuals Collected
American brook lamprey	13	56
bigmouth buffalo	1	2
bigmouth shiner	6	99
black crappie	2	2
blacknose dace	27	446
bluegill	3	21
bluntnose minnow	6	148
bowfin	1	1
brassy minnow	2	74
brook stickleback	40	904
brook trout	15	402
brown trout	46	3327
central mudminnow	5	17
central stoneroller	15	608
common shiner	5	77
creek chub	33	1460
emerald shiner	2	17
fantail darter	19	406
fathead minnow	16	295
golden redhorse	2	9
green sunfish	11	37
hybrid sunfish	3	11
Iowa darter	5	160
johnny darter	34	1242
largemouth bass	3	12
logperch	2	32
longnose dace	23	1881

Common Name	Quantity of Stations Where Present	Quantity of Individuals Collected
mimic shiner	1	1
mottled sculpin	15	1274
mud darter	3	43
northern hogsucker	1	1
northern pike	2	11
pumpkinseed	1	17
rainbow trout	7	52
sauger	2	2
shorthead redhorse	5	18
silver redhorse	1	1
slimy sculpin	11	453
smallmouth bass	2	2
southern redbelly dace	6	55
spotfin shiner	1	7
spottail shiner	1	1
tadpole madtom	1	2
walleye	1	1
white sucker	43	4865