Lower Minnesota River Watershed Monitoring and Assessment Report

Minnesota Pollution Control Agency

June 2017

Authors

MPCA Lower Minnesota River Watershed Report Team:

Erin Andrews, Pat Baskfield, Joel Chirhart, Jordan Donatell, David Duffey, Chandra Henrich and Mike Koschak, Jane de Lambert, Bruce Monson, Shawn Nelson, Aaron Onsrud and Kris Parson

Contributors / acknowledgements

Citizen Stream Monitoring Program Volunteers
Metropolitan Council Environmental Services
Minnesota Department of Natural Resources
Minnesota Department of Health
Minnesota Department of Agriculture
Carver County Environmental Services
Le Sueur County Environmental Services
Lower Minnesota Watershed District
Nine Mile Creek Watershed District
Prior Lake Spring Lake Watershed District
Riley Purgatory Creek Watershed District
Scott County Watershed Management Organization
Sibley County Environmental Services

The MPCA is reducing printing and mailing costs by using the Internet to distribute reports and information to wider audience. Visit our website for more information.

MPCA reports are printed on 100% post-consumer recycled content paper manufactured without chlorine or chlorine derivatives.

Project dollars provided by the Clean Water Fund (from the Clean Water, Land and Legacy Amendment).

Minnesota Pollution Control Agency

520 Lafayette Road North | Saint Paul, MN 55155-4194 |

651-296-6300 | 800-657-3864 | Or use your preferred relay service. | Info.pca@state.mn.us

This report is available in alternative formats upon request, and online at www.pca.state.mn.us.

Document number: wq-ws3-07020012b

Contents

Figures

Tables

List of acronyms

AQR Aquatic Recreation

AUID Assessment Unit Identification Determination

CI Confidence Interval

CLMP Citizen Lake Monitoring Program

CSAH County State Aid Highway

CSMP Citizen Stream Monitoring Program

CWA Clean Water Act

DNR Minnesota Department of Natural Resources

DO Dissolved Oxygen

EPA U. S. Environmental Protection Agency

EQuIS Environmental Quality Information System

FIBI Fish Index of Biotic Integrity

FWMC Flow Weighted Mean Concentration

HUC Hydrologic Unit Code

IBI Index of Biotic Integrity

IWM Intensive Watershed Monitoring

LRVW Limited Resource Value Water

MDA Minnesota Department of Agriculture

MDH Minnesota Department of Health

MIBI Macroinvertebrate Index of Biotic Integrity

MPCA Minnesota Pollution Control Agency

MSHA Minnesota Stream Habitat Assessment

Nitrate-N Nitrate Plus Nitrite Nitrogen

NHD National Hydrologic Dataset

NH3 Ammonia

ORVW Out-Standing Resource Value

PCB Poly Chlorinated Biphenyls

SWAG Surface Water Assessment Grant

TALU Tiered Aquatic Life Uses

TCMA Twin Cities Metropolitan Area

TMDL Total Maximum Daily Load

TP Total Phosphorous

TSS Total Suspended Solids

USGS United States Geological Survey

WPLMN Water Pollutant Load Monitoring Network

WWTPs Wastewater Treatment Plants

Executive summary

The Lower Minnesota River Watershed holds 1,835 $mi.^2$ of southeast central Minnesota, spanning the terminal segment of the Minnesota River before it joins the Mississippi River, stretching 87 miles from rural Ottawa northeast to the doorstep of urban St. Paul. The Minnesota Valley National Wildlife Refuge, a 70 mile stretch of protected land that borders the Minnesota River from Henderson to Bloomington, provides critical habitat to migratory wildfowl and wildlife within the region as well as ample opportunities for outdoor recreation near the heart of the Twin Cities. While the Minnesota River is the prominent water feature within the watershed, this report will focus on the watershed's lakes and tributary streams; an assessment report focusing on the entire length of the mainstem Minnesota River is scheduled for completion later in 2017.

The watershed is also home to roughly 120 square miles of lakes, 133 lakes are greater than 10 acres in size. While a majority of lake basins within the watershed are shallow in nature, 25% are considered deep water basins. Major lakes in the watershed include: High Island Lake, Prior Lake, Lake Waconia, Bush Lake, Titlow Lake, Long Meadow Lake, Blackdog Lake and Washington Lake. Fishing, boating and swimming are popular activities on many of the region's lakes.

Tributaries within the Lower Minnesota encompass 2,482 miles of flowing water including: agricultural drainage ditches, streams and rivers. Principal tributaries within the Lower Minnesota subwatershed include Rush River, High Island Creek, Le Sueur Creek, Sand Creek, Bevens Creek, Carver Creek, Nine Mile Creek and Credit River. The Lower Minnesota's reaches are predominately classified as Warmwater and are home to 61 species of riverine fish, providing essential habitat that small minnows and some large game fish species utilize for part if not all of their lifecycles. A handful of Coldwater stream systems also emerge from the springs along the Minnesota River's bluffs, Eagle Creek in Savage provides a rare opportunity for trout angling within the metro area. Calcareous fen wetlands are a unique feature within the watershed that are another product of groundwater springs emerging from the base of the Minnesota River's steep blufflands. These wetlands house sensitive plant species, rarely observed within the state.

The watershed itself is unique due to the diversity of land use, public perception, local funding and active local government units. Moving across the watershed to its outlet, there is a dramatic shift in landuse from west to northeast, where an economy almost exclusively reliant upon row crop agriculture transitions to sprawling residential suburban communities and urban industry in the watershed's northeastern reaches. The greater watershed is home to more than half a million people. Populations within the watershed's northern counties are anticipated to grow which will expand the ever-growing south and southwestern extent of the Twin Cities Metropolitan Area (TCMA), increasing the demand for housing and transitioning farmland of Carver, Scott and Rice counties to residential and urban uses.

This report documents water quality assessment decisions made in 2016 regarding the results of MPCA's 2014 Intensive Watershed Monitoring study on the tributary streams of the Lower Minnesota River Watershed. One hundred-seventeen unique stream reaches and 103 lakes were assessed as part of the study. Eighty-four percent of stream reaches assessed for aquatic life failed to meet standards, while 94% of stream reaches assessed for aquatic recreation failed to meet standards. Fifty-seven percent of lakes assessed for aquatic life failed to meet standards, while 55% of lakes assessed for aquatic recreation failed to meet standards. Four lakes: Crystal, McMahon, Mitchell and Bryant were removed from the impaired waters list due to successful restoration efforts, a demonstration that through cooperation and the efficient use of best management practices improvements to water quality are possible.

Fish tissue monitoring for consumption advisories in the watershed identified that 74% of 46 lakes analyzed for mercury in fish tissue exceeded standards, 46% of 13 lakes tested for PFOS resulted in restricted consumption advisories and no new Poly Chlorinated Biphenyls (PCB) impairments were identified in 29 lakes tested. However, fish consumption advisories for PCBs will remain on Snelling Lake unless new data reveals improvement.

Anthropogenic disturbance in both urban and rural landscapes are having negative impacts on the watershed's lakes, leading to excessive nutrient loading and declining aquatic communities. Elevated nutrient levels are fueling nuisance algal blooms stifling recreational enjoyment and creating public health hazards. This in turn can deter the public from enjoying their local resources having negative impacts on local businesses that are reliant on healthy recreational opportunities. Local solutions are vital to keeping our lakes clean; reducing nutrient inputs can be accomplished by mitigating impervious surface runoff, limiting yard waste that can enter lakes, protecting shoreline buffers, ensuring septic systems are within compliance and reducing fertilizer use. Many impairments identified in lake aquatic biological communities are the result of in-lake and shoreline habitat issues.

Human disturbance is having its toll on the watershed's rivers and streams as well. Overall stream aquatic biology is performing very poorly in the watershed. Impairments were identified in all subwatersheds; 75% of 87 reaches assessed for fish did not meet standards, and 79% of 70 reaches assessed for macroinvertebrates did not meet standards. Impairments impact both headwaters sites as well as the outlets of all subwatersheds that are protected for aquatic life. Fish and macroinvertebrate communities across the watershed were generally dominated by generalist taxa tolerant to degraded water quality conditions and had few if any sensitive species. Elevated levels of sediment, nutrients, chloride and bacteria are persistent problems in many of the watershed's streams and tributaries. Many existing chemical impairments in the watershed were confirmed by monitoring completed in 2014, including Total Suspended Solids (TSS) listings for Rush River, High Island Creek, Buffalo Creek, Bevens Creek, Carver Creek, Sand Creek and Riley Creek as well as five chloride listings in the Sand and Nine Mile Creek systems. Utilizing new stream standards for river nutrients, 6 new impairments have been identified in the Bevens, Carver and Sand creek systems; however, impairment is likely more widespread as data was not always sufficient to make complete assessments and limited datasets suggested that elevated nutrients were a common theme in many of the watersheds tributaries. Elevated bacteria levels are also a persistent problem across the watershed. Efforts to control inputs are needed from concentrated animal activity in flood plains, manure management on farms, urban yard waste and by bringing Wastewater Treatment Plants (WWTPs) and septic systems into compliance.

Elevated concentrations of TSS and nitrates are a result of non-point source pollution from urban and agricultural sources. High concentrations of total phosphorous (TP) can be caused by both point sources like WWTPs and non-point sources of pollution like agriculture and sediments. More than 90% of the watershed's historic wetlands have been drained to accommodate an increase in tillable acres, decreasing water retention on the landscape. This in conjunction with intense tile drainage leads to dramatic impacts on downstream waterbodies during stormflow events. Drain tiles efficiently move excess water from agricultural fields to ditches and streams generating powerful discharges during storm events creating intense pulses of flow that carve out stream banks and carry with them intense sediment loads. Similar impacts are observed in urban systems where impervious surfaces feed storm water culverts that rapidly drain to riverine systems. High sediment levels bury coarse substrates, which provide habitat for spawning fish and the aquatic insects that they consume, fill in deep pools which shelter fish from predators and the intense summer heat and at high levels can inhibit a fish's ability to find food. Prized game fish rely on aquatic insects and smaller minnow species for their own diets, thus reducing the health of fodder species will diminish the greater ecosystem and eventually deplete species sought by anglers. Tile and storm water drains can also carry dissolved nutrients and bacteria, which can also be harmful to aquatic communities. High levels of nutrients can lead to eutrophication causing nuisance algal blooms and low dissolved oxygen (DO) conditions while high bacteria levels can pose risks to human health.

Healthy aquatic biological communities not only have recreational and intrinsic value; they also provide a valuable service, acting as proverbial 'canaries in the coal mine' within our aquatic systems. An absence of species sensitive to pollution in a river, stream or lake can be an indication of greater water quality problems which may in turn pose risks to human health, albeit through contact (swimming, boating, wading) or drinking water and can have economical implications as well. These water quality concerns can accumulate moving downstream in a lotic system; thus, protecting and restoring small upstream reaches will benefit larger downstream waterbodies.

Tremendous efforts have been taken on the part of local and state entities showing a strong interest in restoring and protecting the Lower Minnesota Watershed's water quality. However, dramatic improvements on the landscape are still needed to bring waters to attainment of water quality standards. Efforts must continue to manage point source contributions from urban sources including industry and wastewater treatment plants but also must reign in unregulated non-point sources from agricultural and urban contributors. Continued cooperation is necessary from all stakeholders to improve conditions on the landscape for the betterment of Minnesota.

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. 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, 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 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 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 Lower Minnesota River Watershed beginning in the summer of 2014. This report provides a summary of all water quality assessment results in the Lower Minnesota River Watershed and incorporates all data available for the assessment process including watershed monitoring, volunteer monitoring and monitoring conducted by local government units.

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 80 major watersheds. 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).

Intensive watershed monitoring

The intensive watershed monitoring (IWM) strategy utilizes a nested watershed design allowing the sampling of streams within watersheds from a coarse to a fine scale (Figure 1). 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 80 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, aggregated 12-HUC and 14-HUC (Figure 1). 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 2. Intensive watershed monitoring sites for streams in the Lower Minnesota River Watershed.) 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 aggregated 12-HUC is the next smaller subwatershed scale, which generally consists of major tributary streams with drainage areas ranging from 75 to 150 mi^2. Each aggregated 12-HUC outlet (green dots in Figure 2. Intensive watershed monitoring sites for streams in the Lower Minnesota River Watershed.) is sampled for biology and water chemistry for the assessment of aquatic life and aquatic recreation use support. Within each aggregated 12-HUC, smaller watersheds (14 HUCs, typically 10-20 mi^2), are sampled at each outlet that flows into the major aggregated 12-HUC tributaries. Each of these minor subwatershed outlets is sampled for biology to assess aquatic life use support (red dots in Figure 2.

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 and where applicable, where fish community health can be determined. Lakes are prioritized by size, accessibility (can the public access the lakes), and presence of recreational use.

Specific locations for sites sampled as part of the intensive monitoring effort in the Lower Minnesota River Watershed are shown in Figure 2. Intensive watershed monitoring sites for streams in the Lower Minnesota River Watershed. and are listed in Appendices 2.1 and 2.2.

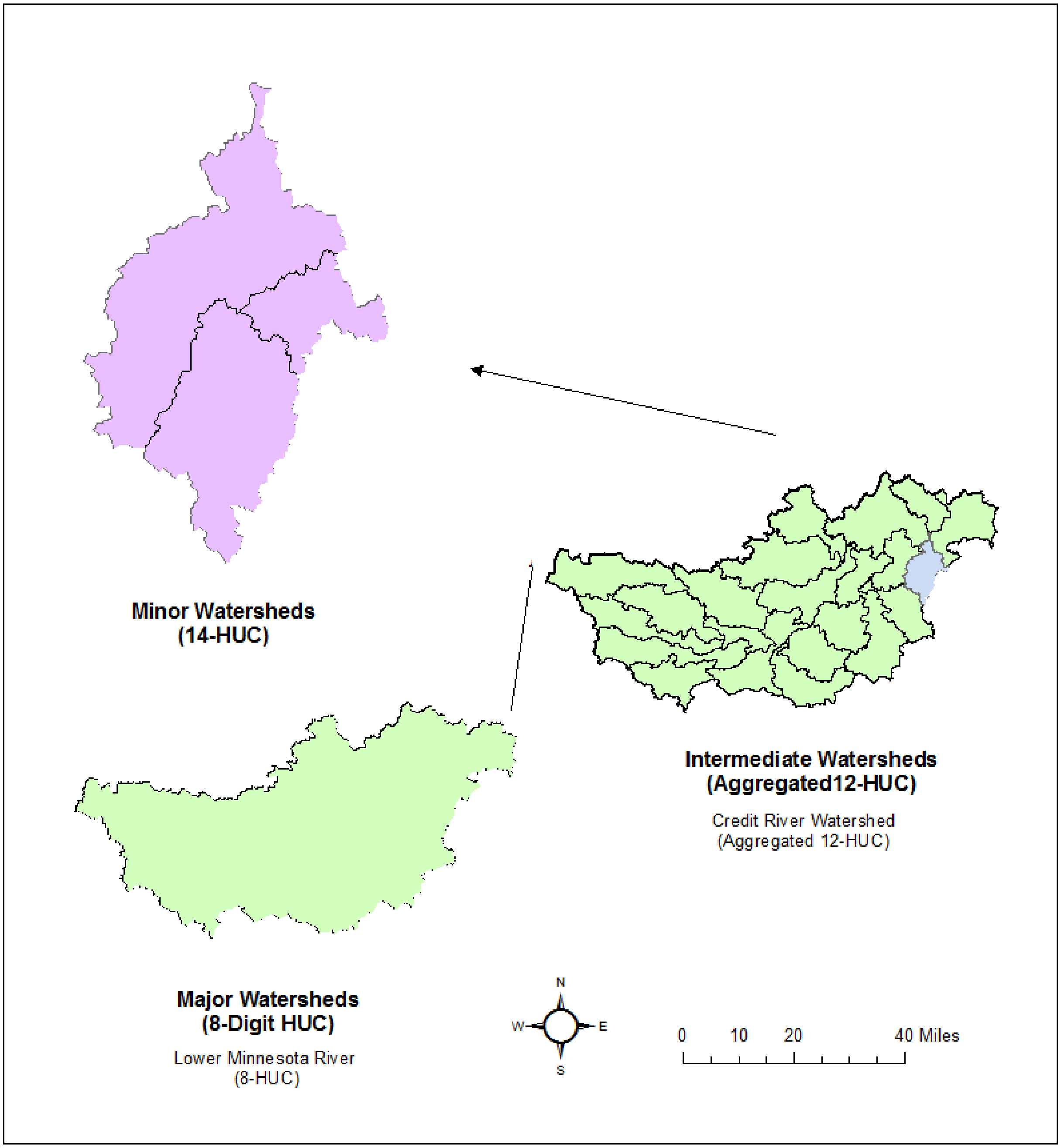


Figure 1. The intensive watershed monitoring design.

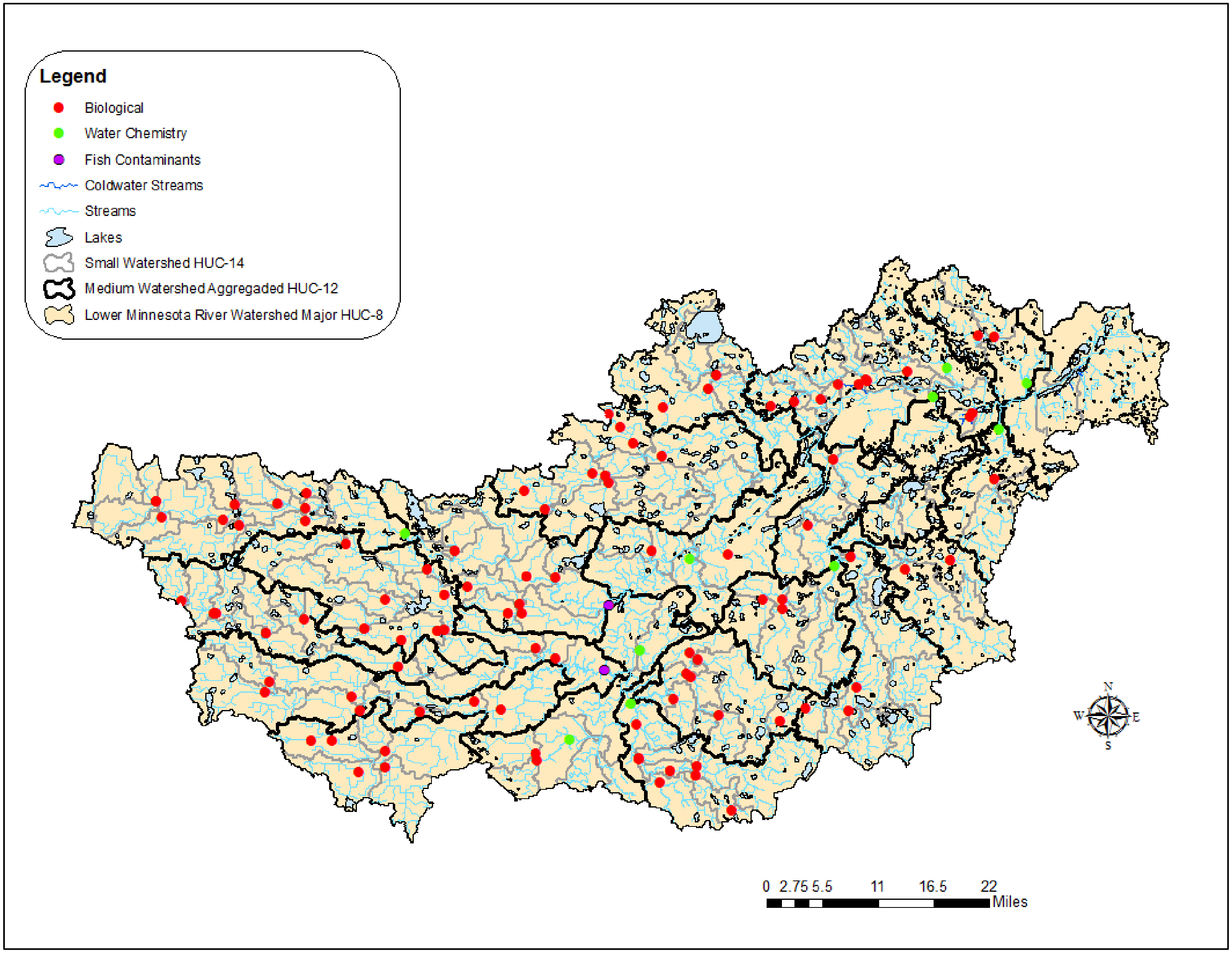


Figure 2. Intensive watershed monitoring sites for streams in the Lower Minnesota River Watershed.

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 IWM process. Funding passes from MPCA through Surface Water Assessment Grants (SWAGs) to local groups such as counties, soil and water conservation districts, 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 3 provides an illustration of the locations where citizen monitoring data were used for assessment in the Lower Minnesota River Watershed.

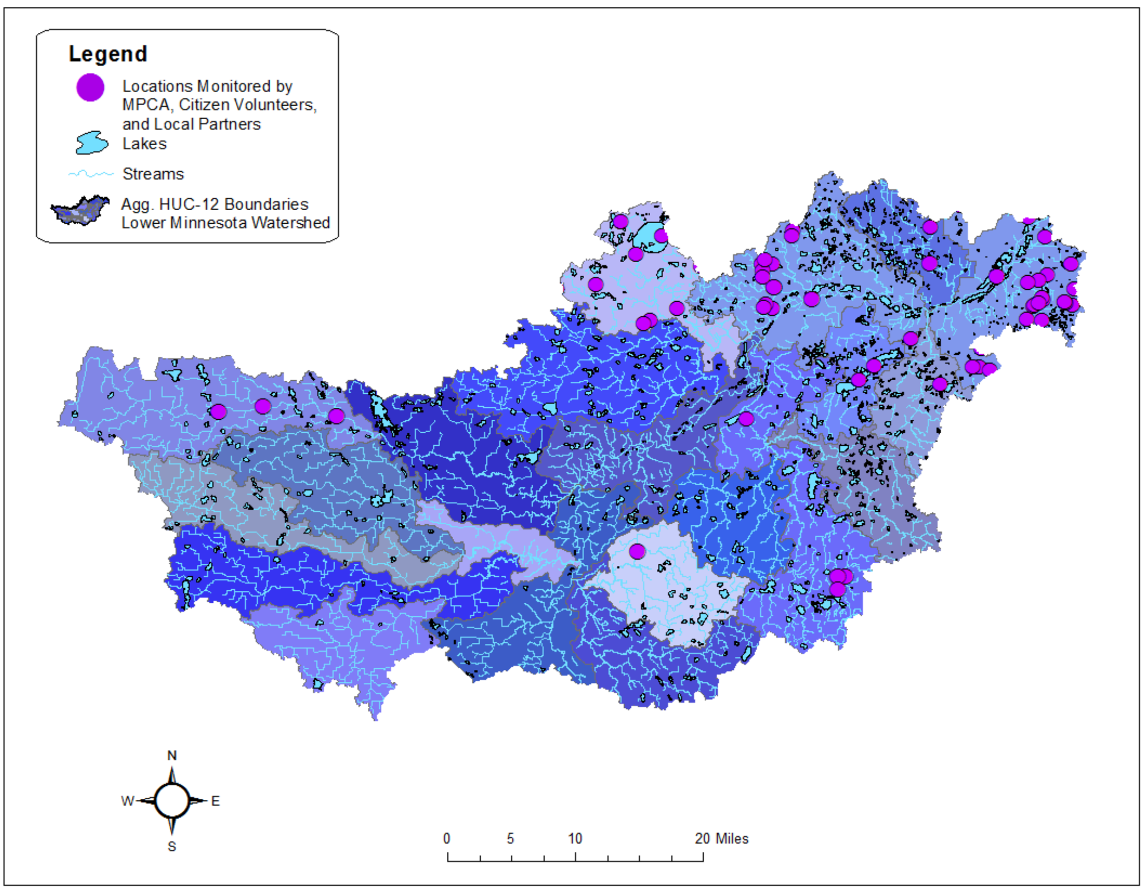


Figure 3. Monitoring locations of local groups, citizens and the MPCA lake monitoring staff in the Lower Minnesota River Watershed.

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). https://www.pca.state.mn.us/sites/default/files/wq-iw1-04.pdf.

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 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.

Protection of aquatic life means the maintenance of a healthy aquatic community, including fish, macroinvertebrates and plants. Biological monitoring, the sampling of aquatic organisms, 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. To effectively use biological indicators, the MPCA employs the Index of Biotic Integrity (IBI). This index is a scientifically validated combination of measurements of the biological community (called metrics). An IBI is comprised of multiple metrics that measure different aspects of aquatic communities (e.g., dominance by pollution tolerant species, loss of habitat specialists). Metric scores are summed together and the resulting index score characterizes the biological integrity or "health" of a site. The MPCA has developed stream IBIs for (fish and macroinvertebrates) since these communities can respond differently to various types of pollution. The MPCA also uses a lake fish IBI developed by the Minnesota Department of Natural Resources (DNR) to determine if lakes are meeting aquatic life use. Because the lakes, rivers, and streams in Minnesota are physically, chemically, and biologically diverse, IBI's are developed separately for different stream classes and lake class groups to account for this natural variation. Further interpretation of biological community data is provided by an assessment threshold or biocriteria against which an IBI score can be compared within a given stream class. In general, an IBI score above this threshold is indicative of aquatic life use support, while a score below this threshold is indicative of non-support. Additionally, chemical parameters are measured and assessed against numeric standards developed to be protective of aquatic life. For streams, these include pH, DO, un-ionized ammonia nitrogen, chloride, total suspended solids, pesticides, and river eutrophication. For lakes, pesticides and chlorides contribute to the overall aquatic life use assessment.

Protection for aquatic life uses in streams and rivers are divided into three tiers: Exceptional, General, and Modified. Exceptional Use waters support fish and macroinvertebrate communities that have minimal changes in structure and function from the natural condition. General Use waters harbor "good" assemblages of fish and macroinvertebrates that can be characterized as having an overall balanced distribution of the assemblages and with the ecosystem functions largely maintained through redundant attributes. Modified Use waters have been extensively altered through legacy physical modifications, which limit the ability of the biological communities to attain the General Use. Currently the Modified Use is only applied to streams with channels that have been directly altered by humans (e.g., maintained for drainage, riprapped). These tiered uses are determined before assessment based on the attainment of the applicable biological criteria and/or an assessment of the habitat. For additional information, see: http://www.pca.state.mn.us/index.php/water/water-permits-and-rules/water-rulemaking/tiered-aquatic-life-use-talu-framework.html).

Table 1. Table of proposed tiered aquatic life use standards.

Proposed Tiered Aquatic Life Use	Acronym	Proposed Use Class Code	Description
Warm water General	WWg	2Bg	Warm water Stream protected for aquatic life and recreation, capable of supporting and maintaining a balanced, integrated, adaptive community of warm or cool water aquatic organisms that meet or exceed the General Use biological criteria.
Warm water Modified	WWm	2Bm	Warm water Stream protected for aquatic life and recreation, physically altered watercourses (e.g., channelized streams) capable of supporting and maintaining a balanced, integrated, adaptive community of warm or cool water aquatic organisms that meet or exceed the Modified Use biological criteria, but are incapable of meeting the General Use biological criteria as determined by a Use Attainability Analysis
Warm water Exceptional	WWe	2Be	Warm water Stream protected for aquatic life and recreation, capable of supporting and maintaining an exceptional and balanced, integrated, adaptive community of warm or cool water aquatic organisms that meet or exceed the Exceptional Use biological criteria.
Coldwater General	CWg	2Ag	Coldwater Stream protected for aquatic life and recreation, capable of supporting and maintaining a balanced, integrated, adaptive community of cold water aquatic organisms that meet or exceed the General Use biological criteria.
Coldwater Exceptional	CWe	2Ae	Coldwater Stream protected for aquatic life and recreation, capable of supporting and maintaining an exceptional and balanced, integrated, adaptive community of cold water aquatic organisms that meet or exceed the Exceptional Use biological criteria.

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, DO 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 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 DNR. The Protected Waters Inventory provides the identification numbers for lake, reservoirs and wetlands. These identification numbers serve as the AUID and are composed of an eight-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 4).

The first step in the aquatic life assessment process is largely an automated process performed by logic programmed into a database application where all data from the 10 year assessment window is gathered; the results are referred to as 'Pre-Assessments'. Data filtered into the "Pre-Assessment" process is then reviewed to insure that data is valid and appropriate for assessment purposes. Tiered use designations are determined before data is assessed based on the attainment of the applicable biological criteria and/or an assessment of the habitat. Stream reaches are assigned the highest aquatic life use attained by both biological assemblages on or after November 28, 1975. Streams that do not attain the Exceptional or General Use for both assemblages undergo a Use Attainability Analysis (UAA) to determine if a lower use is appropriate. A Modified Use can be proposed if the UAA demonstrates that the General Use is not attainable as a result of legal human activities (e.g., drainage maintenance, channel stabilization) which are limiting the biological assemblages through altered habitat. Decisions to propose a new use are made through UAA workgroups, which include watershed project managers and biology leads. The final approval to change a designated use is through formal rulemaking.

The next step in the aquatic life assessment process is a comparison of the monitoring data to water quality standards. 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 extenuating circumstances that should be considered (e.g., flow, time/date of data collection, or habitat).

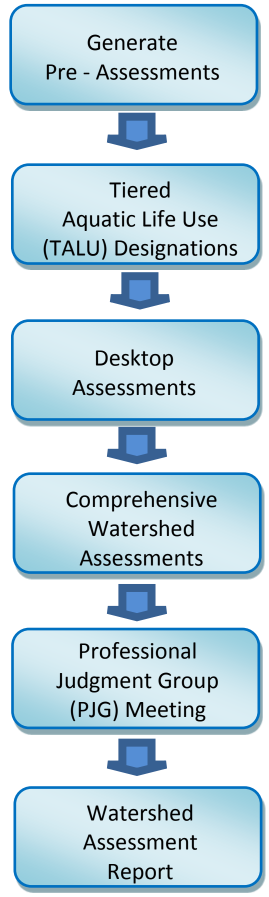


Figure 4. Flowchart of aquatic life use assessment process.

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 2016) https://www.pca.state.mn.us/sites/default/files/wq-iw1-04i.pdf for guidelines and factors considered when making such determinations.

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.

Watershed overview

The Lower Minnesota River Watershed spans 1,835 mi2 across south central Minnesota, the 12th largest HUC-8 watershed within the state. The Lower Minnesota continues at the terminus of the Middle Minnesota River Watershed, gaining the flow of all of the Minnesota River's upstream watersheds. The watershed stretches from east central Renville County to southwestern Ramsey County, encompassing a majority of Sibley, Le Sueur, Scott and Carver counties, and portions of McLeod, Nicollet, Rice, Dakota and Hennepin counties. The watershed is divided by the Minnesota River running its terminal course to the Mississippi River. The Minnesota River flows north from Le Sueur, heading in a northeasterly direction through Belle Plaine, Jordan, Chaska, Chanhassen, Shakopee, Savage and Bloomington before ultimately joining the Mississippi River in St. Paul at Fort Snelling State Park. Throughout its lower course the Minnesota gains the flow of many small tributaries including Rush River and High Island Creek to the west, Le Sueur Creek, Sand Creek and Credit River to the east and Bevens, Carver and Nine Mile Creeks to the north.

The Lower Minnesota River Watershed's streams are almost exclusively classified as Warmwater. The western reaches of the watershed are generally flat showing little change in topography and transition to a dramatic drop in elevation on the western edges of the Minnesota River bluff. The eastern reaches of the watershed are more rolling in nature and show a similar shift towards high relief when reaching the eastern bluffs of the Minnesota River. This topographical shift in the lower reaches of the watershed give rise to Coldwater springs that feed the regions precious few trout streams and calcareous fen wetlands. The watershed's lake rich character in its northern and eastern reaches are a product of historical glacial activity and provide an important recreational resource for the watershed. Its largest lakes include High Island Lake, Lake Waconia, Bush Lake, Orchard Lake and Prior Lake.

The Minnesota River valley formed at the end of the last ice age 9,000 – 12,000 years ago. Glaciers retreated from their southern expanses moving northwest; as meltwaters reached the continental divide at Browns Valley, the new river joined Glacial Lake Agassiz. Unable to flow north due to ice blocking outlets to the Arctic and Atlantic, newly formed Glacial River Warren began flowing south, cutting a deep valley which presently stretches as much as five miles wide and rises as much as 250 feet above its flood plain (Waters, 1977).

Prior to European settlement, tall grass and wet prairies stretched across the Minnesota River's western shores while east of the river an immense 'Big Woods' of oak, maple, basswood and hickory rose from the landscape. In 1852, along the banks of the Minnesota River to the south of the watershed in St. Peter, the Treaty of Traverse de Sioux opened Minnesota to European settlement, displacing the indigenous Dakota tribe.

Few features in the modern landscape of the Lower Minnesota River Watershed have remained unaltered by agriculture and urban development. Intensive wetland drainage and plowing of native prairies and forestlands, gave rise to the western and southern regions agricultural economies. The TCMA in the northern reaches of the watershed continues to move south as there are greater demands for housing and development from a growing population. Remaining natural features in the watershed are predominately limited to protected areas that provide habitat to the regions wildlife, the most prominent being the protected corridor along the Minnesota River Valley that extends from Henderson to Bloomington including the Minnesota Valley National Wildlife Refuge.

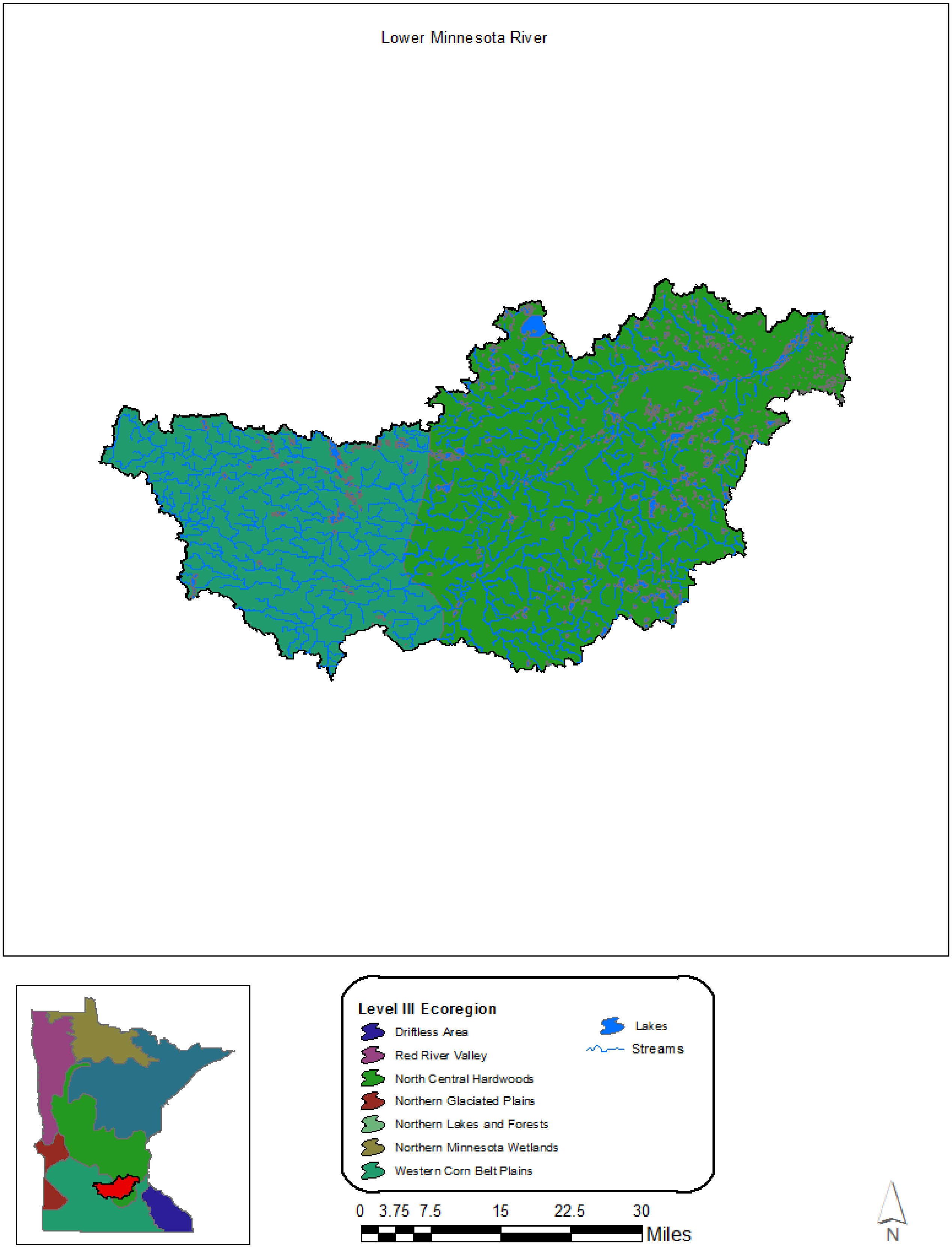


Figure 5. The Lower Minnesota River Watershed within the North Central Hardwood Forests and Western Corn Belt Plains ecoregions of east central Minnesota.

The western two-fifths of the Lower Minnesota watershed falls within the northern boundaries of the Western Corn Belt Plains ecoregion. The ecoregion is the "national (and world) leader in corn and soybean production" but also includes some small grain crops and livestock production (USGS, 2016). The remainder of the watershed lies within the northern hardwood forest ecoregion; today the ecoregion encompasses regrowth of what remains from forests historically cleared for commercial timber harvest and land clearing for agricultural use. Soils in the watershed are mainly comprised of the Central Iowa and Minnesota Till Prairie complex consisting of rich organic glacial prairie soils that provide a rich medium for cultivation. Soil type is not designated in the northeastern portion of the watershed due to extensive anthropogenic disturbance caused during the development of residential, urban and industrial areas of the greater TCMA which have extensively altered a majority of this regions natural soil complexes see (Figure 6).

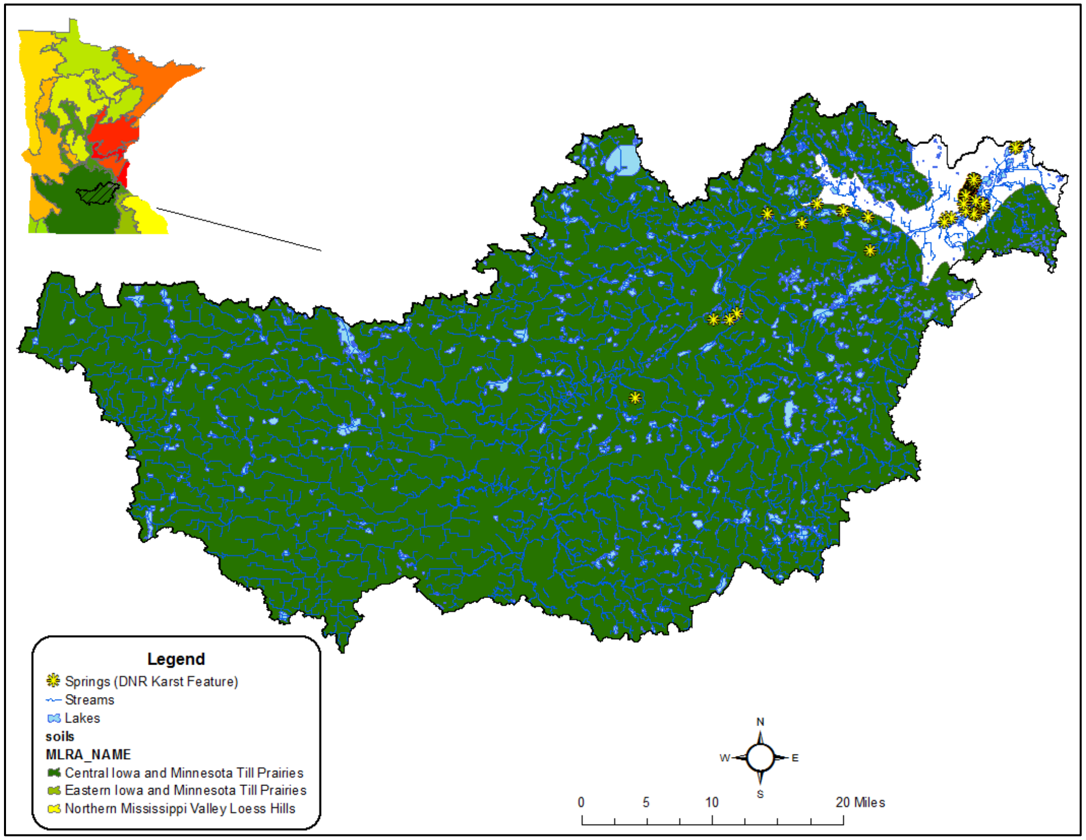


Figure 6. Major land resource areas (MLRA) and springs in the Lower Minnesota River Watershed.

Land use summary

The Lower Minnesota Watershed's landuse can be characterized as cropland (56.8%), developed (16.2%), rangeland (10.9%), forested (8.6%), wetland (3.3%) and open water (4.1%) (See Figure 7) (NLCD). Wetland estimates vary by source but it is believed some wetlands in NLCD estimates fall into forested and other categories. National Wetland Inventory estimates that the 10.6% of the watershed is wetland, while the dataset is 30 years old; this dataset better represents true wetland coverage across the watershed.

Ninety-six of the watershed's land is privately owned (NRCS, 2007). The Lower Minnesota Watershed includes parcels of 11 counties (percentage of watershed by county: Sibley (30.1%), Scott (19.3%), Le Sueur (13.1 %), Carver (12.6 %), Nicollet (7.7 %), Hennepin (6%), McLeod (3.6%), Dakota (3.6%), Rice (2.7%), Renville (1.3%) and Ramsey (0.0%); NRCS, 2007). The western and south central portions of watershed are primarily rural and dominated by row crop agriculture, moving north and east the landuse transitions to small acreages and commuter communities and further north into the residential and urban expanse of the southernTCMA.

The Natural Resources Conservation Service (NRCS) estimates that there are 2,650 farms in the Lower Minnesota; 58% of the watershed's farmers are fulltime producers. Most of the Lower Minnesota's farms are small, 42% are less than 180 acres (NRCS, 2007). Median sized farms ranging from 180 – 400 acres comprise 35% of farms; while larger operations make up nearly a quarter of the watershed's farms, 13% are 500 – 999 acres and 9% are greater than 1000 acres (NRCS, 2007). There are 811 permitted feedlots in the watershed (permits are required when an enterprise has more than 1000 animal units confined on a site for more than 45 days of a year (an animal unit is defined as an animal equivalent of 1,000 pounds live weight and equates to 1,000 head of beef cattle, 700 dairy cows, 2,500 swine weighing more than 55 pounds, 125,000 broiler chickens, or 82,000 laying hens or pullets) (USDA, 2017). A majority of the watershed's livestock animals fall within the "Other category" (sheep, goats, fur bearing animals, apiculture, horse and equine production, bison, llamas, etc.) at 51%, followed by swine at 26% and turkey at 18% (NRCS, 2007).

In Sibley County, from 2007 to 2012, there was a 9% decline in the number of farms, no change in the amount of land in agriculture, while there is a 9% increase in farm size (USDA, 2012). In 2012, Sibley was the state's leading egg producer, home to nearly 2.5 million laying hens (USDA, 2012). In Le Sueur County, from 2007 to 2012, there was a 4% decrease in the number of farms, a 4% decrease in the number of land in farms and no change in farm size (USDA, 2012). In 2012, Le Sueur County was the state's sixth leading producer of pheasants (USDA, 2012). In Nicollet County, from 2007 to 2012, there was an 8% drop in the number of farms, no change in the amount of land in farms and an 8% increase in farm size (USDA, 2012). In 2012, Nicollet County was the state's leading producer of pullets for laying flock replacement, the third leading producer of laying hens, the seventh leading producer of hogs and the 8th leading producer of poultry in the state (USDA, 2012). In Scott County, there was a 7% increase in the number of farms, a 20% increase in the amount of land in farms and a 13% increase in overall farm size from 2007 to 2012. (USDA, 2012). In 2012, Scott County was the state's leading producer of pigeons, the third largest producer of pheasants and the fourth leading producer of fruit, tree nuts and berries (USDA, 2012). In Carver County there was a 1% decrease in the number of farms, an 8% decrease in land in farms and a 7% decrease in farm size from 2007 to 2012 (USDA, 2012). In 2012, Carver was the state's leading producer of ducks, the eighth leading producer of aquaculture and the ninth leading producer of pheasants, horses and nurseries (USDA, 2012).

While the watershed is primarily rural, its northern reaches lie along the southern boundaries of the greater TCMA and include Bloomington, Minnesota's fourth largest city with a population of 87,224. Estimated population within the entire watershed is 518,330 people and is expected to increase as urban sprawl continues to expand south and southwest of the Twin Cities (NRCS, 2007). Three of the northern most counties in the watershed, Scott, Carver and Hennepin, were among the state's five fasting growing counties from 2010 – 2015 (Scott County +8.4% (+51,400 residents); Carver +8.5% (+28,593 residents), Hennepin +6.0% (+105,503 residents)) and are expected to continue this rising trend (MSDS, 2017). Le Sueur and Nicollet counties also having rising trends in growth while Sibley County has a declining trend (MSDS, 2017).

Rural communities in the watershed include: Arlington, Belle Plaine, Cologne, Gaylord, Gibbon, Green Isle, Henderson, Jordan, Le Center, Le Sueur, Lonsdale, New Auburn, New Prague, Norwood Young America, Waconia and Winthrop; while suburban communities include: Bloomington, Burnsville, Carver, Chaska, Eden Prairie, Edina, Hopkins, Minnetonka, Prior Lake, Savage and Shakopee.

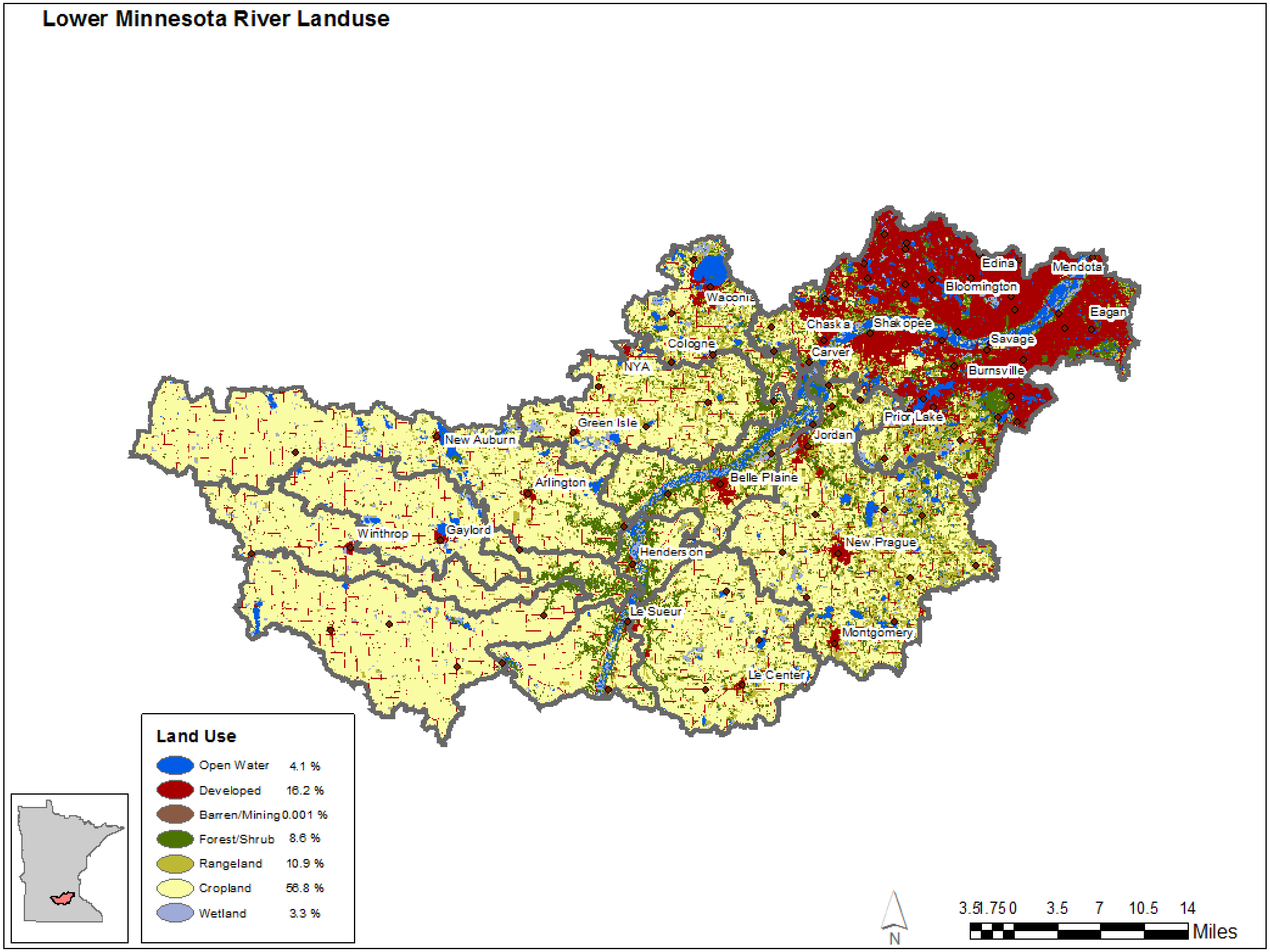


Figure 7. Land use in the Lower Minnesota River Watershed.

Surface water hydrology

The Lower Minnesota Watershed is the terminal drainage of the Minnesota River. Unlike other true 8-HUC watersheds, the Lower Minnesota is a collection of small tributary streams that feed into one of the state's principal rivers. In its southern reaches Le Sueur Creek, Rush River and High Island Creek join the river. Moving downstream in the outskirts of the southwestern metro, the river gains the flow of Sand, Carver and Bevens creeks. Within the suburban corridor, Nine Mile Creek and the Credit River converge with the Minnesota River. Countless other small named and unnamed tributaries join the river along its final course to the Mississippi. From Ottawa to St. Paul the Minnesota River travels 87 miles, dropping 90 feet in elevation over its course.

There are 133 lakes greater than 10 acres in size within the Lower Minnesota; Lake Waconia is the watershed's largest lake at 3,069 acres. Other major lakes in the region include High Island Lake, Prior Lake, Titlow Lake and Bush Lake. The greatest concentration of lakes within the watershed is within its downstream reaches. While a majority of the watershed's lakes are shallow in nature, nearly a quarter are classified as deep water.

A majority of stream reaches within the Lower Minnesota Watershed have been straightened, moved or modified for anthropogenic purposes (See Figure 8). The Minnesota Altered Water Coarse Project indicates that 65.4% of the watershed have been altered by channelization, while 16.6% remain natural (See Figure 9). Only 1.2% of stream reaches are impounded; however, even small impoundments can have dramatic negative impacts on fish populations.

Several of the watershed's tributary streams are impounded throughout their courses, including Le Sueur Creek, Forest Prairie Creek, Chaska Creek, East Creek, Purgatory Creek, Sand Creek and Nine Mile Creek. Historic dams on the watershed's tributary streams are generally remnants of a bygone milling age while more modern structures were designed to regulate water levels and prevent localized flooding or limit common carp migration. The natural removal of the High Island Creek dam by floodwaters in 2014 enabled renewed fish migration and the introduction of extirpated species whose populations had diminished after the dam's construction in 1939.

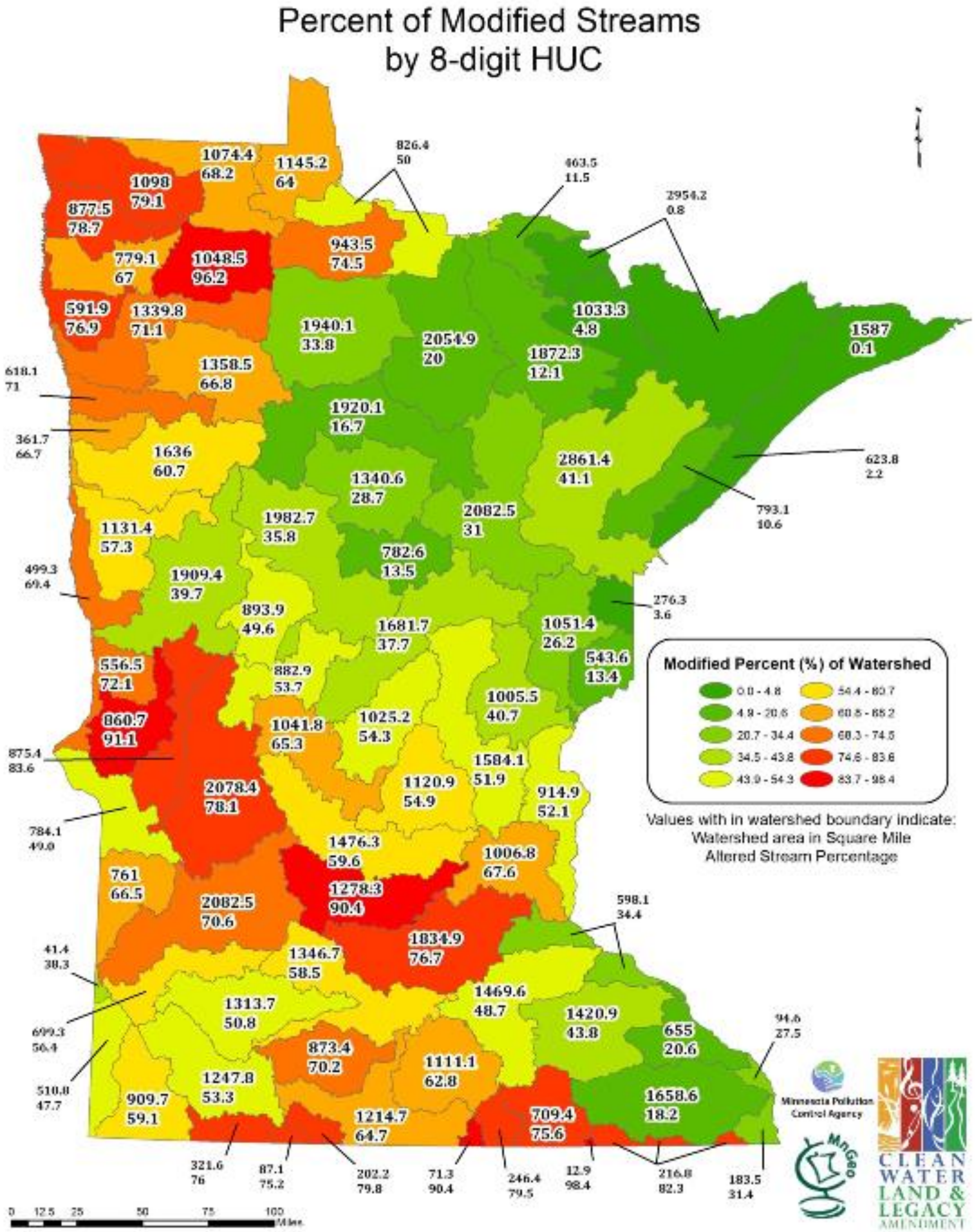


Figure 8. Map of percent modified streams by major watershed (8-HUC).

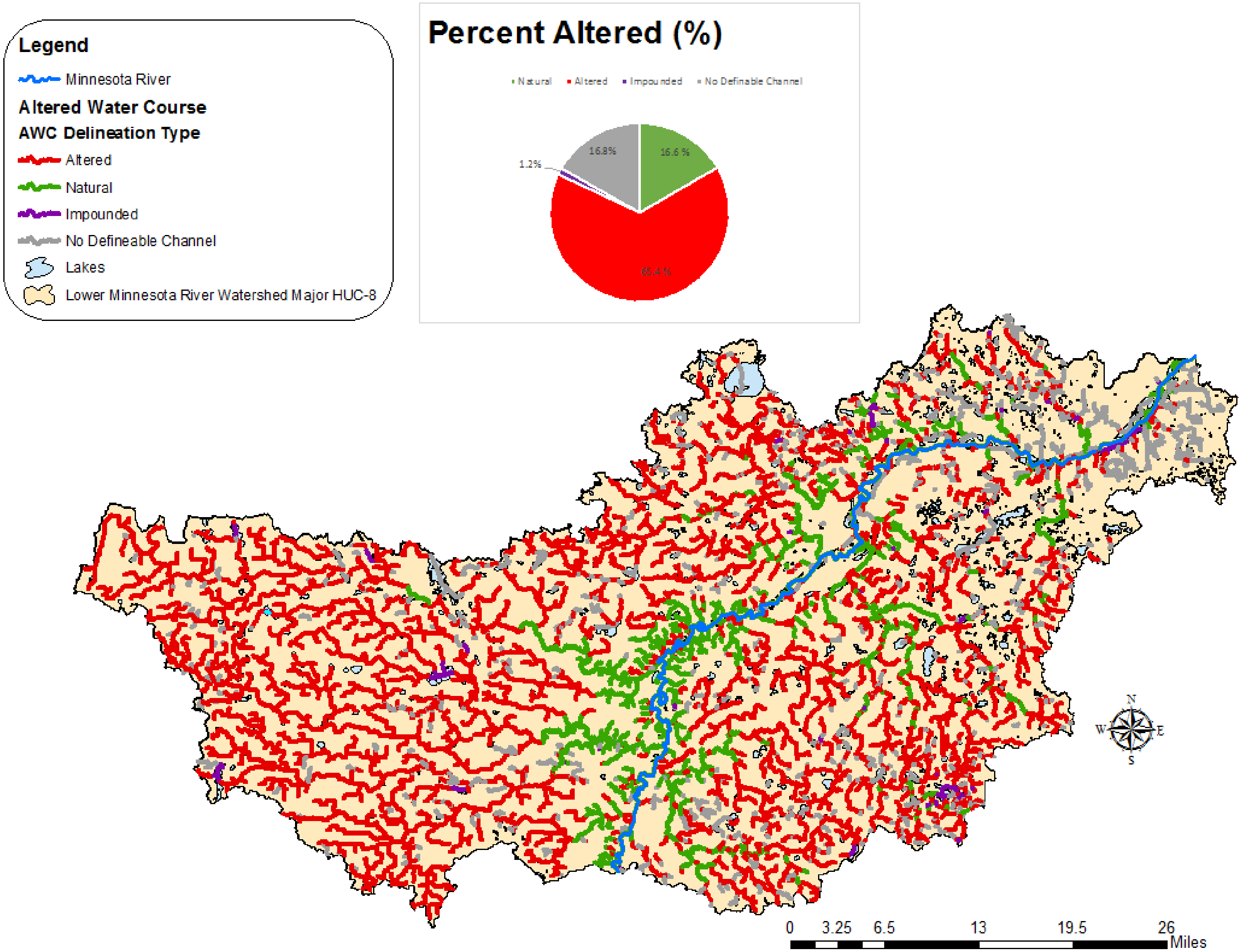


Figure 9. Comparison of natural to altered streams in the Lower Minnesota River Watershed (percentages derived from Statewide Altered Water Course Project.

Climate and precipitation

Minnesota has a continental climate, marked by warm summers and cold winters. The mean annual temperature for Minnesota is 40.1˚F. The mean summer (June-August) temperature for Central Minnesota and Lower Minnesota River watershed is 68.1˚F and the mean winter (December-February) temperature is 12.5˚ F. (NOAA, 2017)

Precipitation is an important source of water input to a watershed. Figure 10 shows two representations of precipitation for the water year 2014-2015. Total precipitation is displayed on the left and on the right and how that total differed from normal amounts. Precipitation in the Lower Minnesota River Watershed ranged from 36-40+ inches in water year 2014 which was 6-10 inches above normal. In water year 2015, total precipitation ranged from 20-28 inches, which was well below normal in the western portion of the watershed and slightly less than normal in the eastern portion (DNR, 2016a).

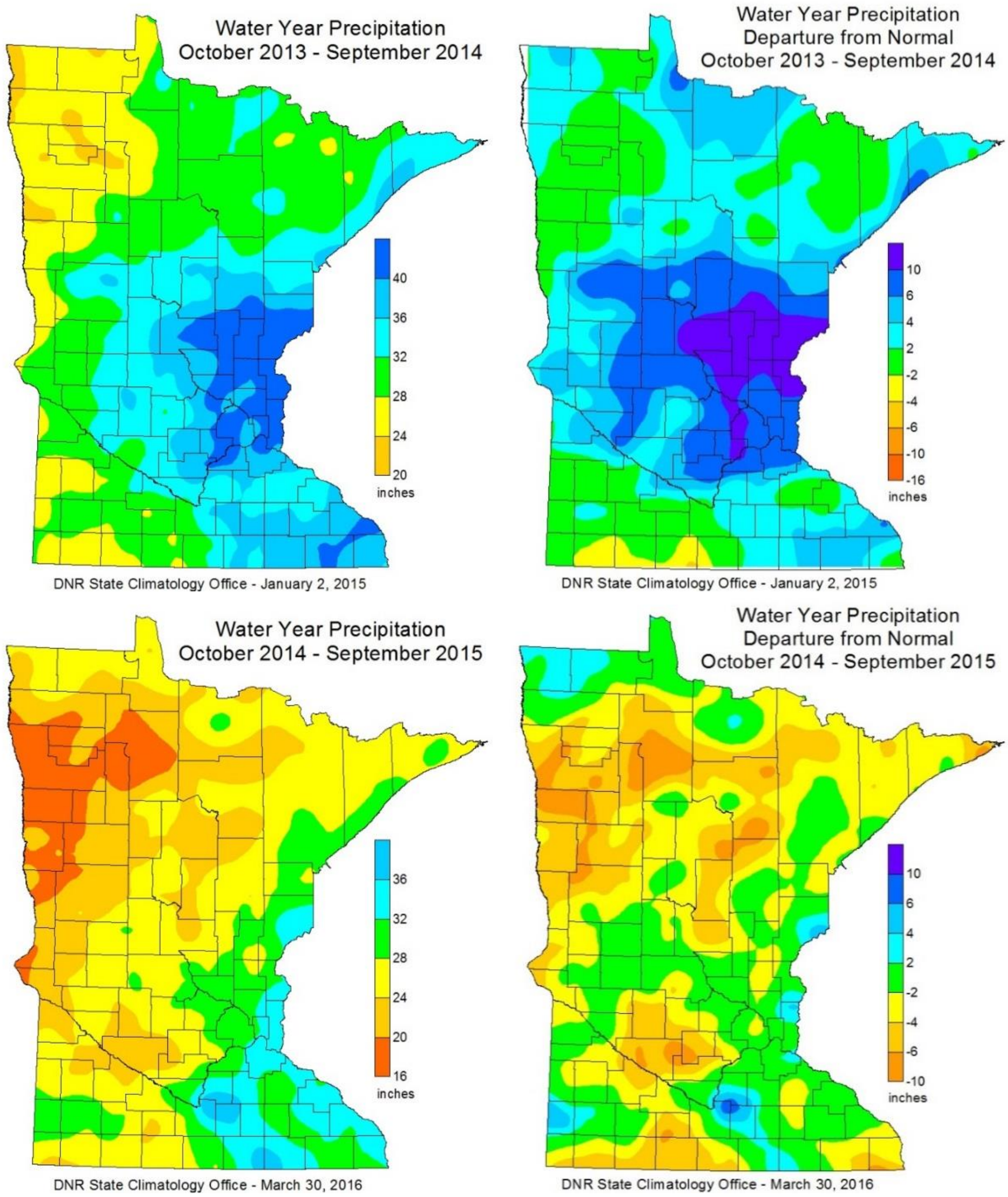
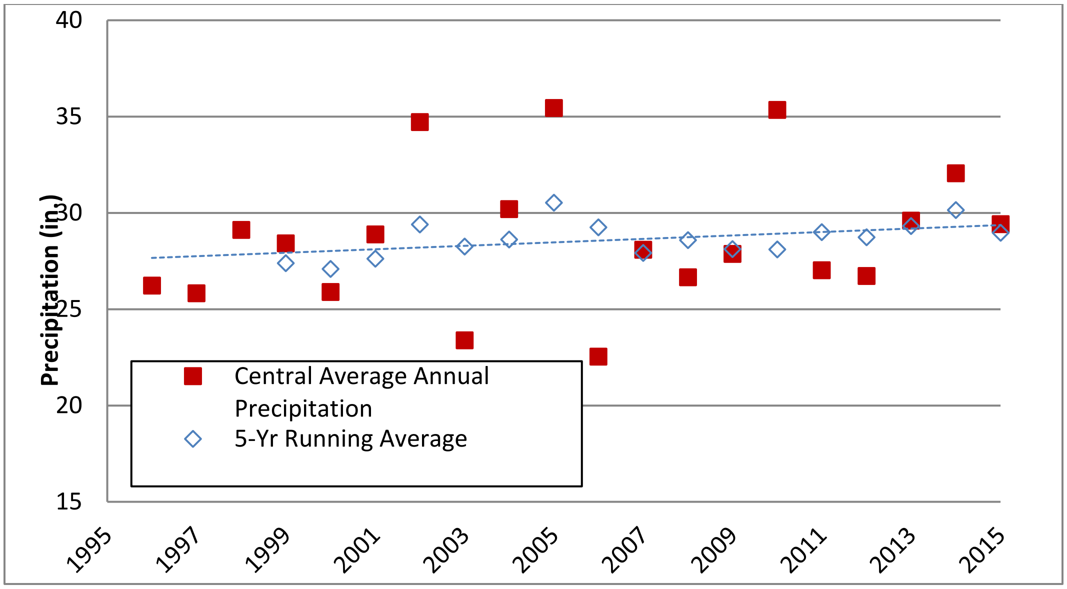


Figure 10. Statewide precipitation levels during the 2014-2015 water years.

[Figure 11](#) displays the areal average representation of precipitation in Central Minnesota for 20 and 100 years, respectively. An areal average is a spatial average of all the precipitation data collected within a certain area presented as a single dataset. Though rainfall can vary in intensity and time of year, rainfall totals in the Southwest region display no significant trend over the last 20 years. However, precipitation in Central Minnesota exhibits a significant rising trend over the past 100 years (p=0.001). This is a strong trend and matches similar trends throughout Minnesota (WRCC 2016).



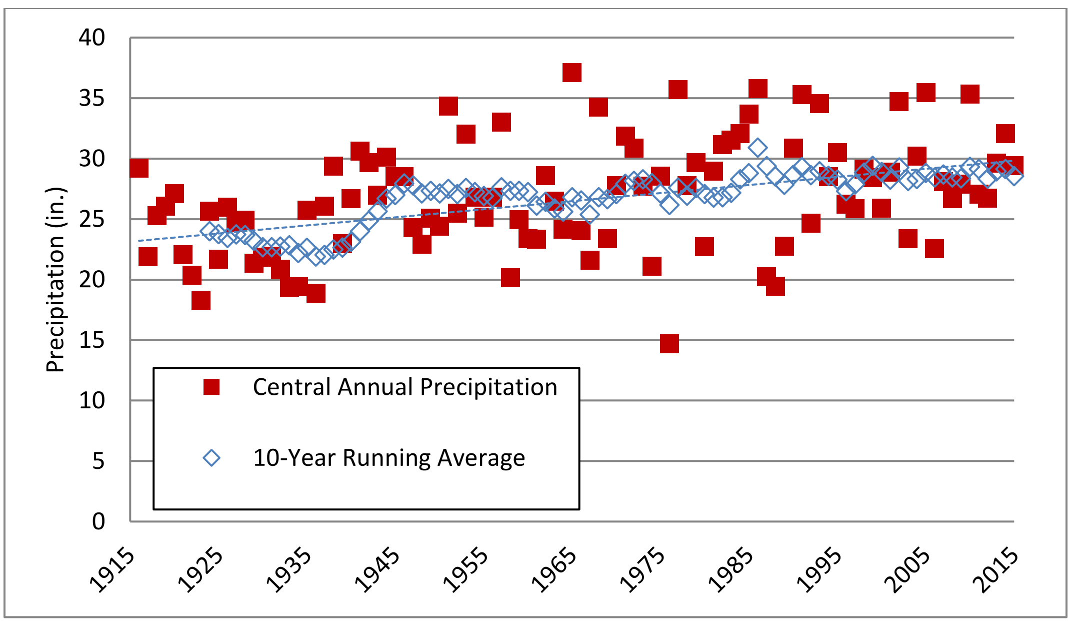


Figure 11. Average annual precipitation in northeast Minnesota (Above: 1966-2015 with five-year running average; Below: 1916-2015 with 10-year running average.)

Hydrogeology and groundwater quality

The Minnesota DNR has characterized defined groundwater provinces in the state, based on bedrock and glacial geology. Three groundwater provinces are present within the Lower Minnesota River Watershed ([Figure 12](#)). The Western Province in the western portion of the watershed is made up of clayey glacial drift over Cretaceous bedrock. The overlying unconsolidated sediments contain aquifers of limited extent. The eastern edge of the watershed is part of the Metro Province, which is characterized by thick unconsolidated sediments over sedimentary bedrock; both of which have good aquifer properties. The largest portion of the watershed is part of the Central Province, characterized by thick glacial sediments with sand and gravel aquifers over deep, fractured bedrock (DNR, 2001).

Potential groundwater recharge in the Lower Minnesota River Watershed gradually increases from west where it is about 4-6 inches per year to the east where it is about 6-8 inches per year and can be as high as 8-10 inches per year at a few points in the Minnesota River valley (USGS, 2007).

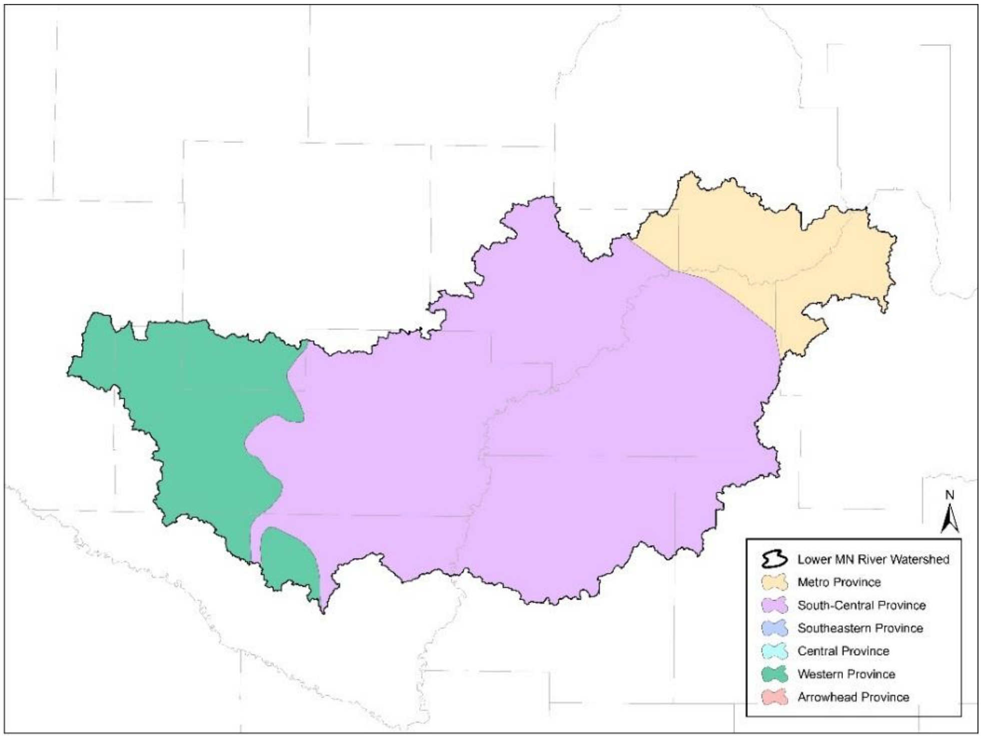


Figure 12. Groundwater provinces in the Lower Minnesota River Watershed (DNR, 2001).

Wetlands

Excluding open water portions of lakes, ponds and rivers, the Lower Minnesota River Watershed has approximately 124,812 acres of wetlands, which is equivalent to 10.61% of the watershed area. While NLCD estimates 3.3% of the watersheds total land cover as wetland, some wetlands in NLCD estimates misidentify wetlands lumping them in open water, forested and other categories. The 10.61% estimates stem from the National Wetland Inventory, while the dataset is 30 years old, this dataset better represents true wetland coverage across the watershed.

Wetlands with herbaceous emergent vegetation are the most common wetland class in this watershed comprising 8.37% of the total wetland area (Figure 13). Shallow open water habitat wetlands are the second most common (1.12%) wetland class. Forested and scrub-shrub wetlands each make up less than 1% of the wetland area in the Lower Minnesota Watershed.

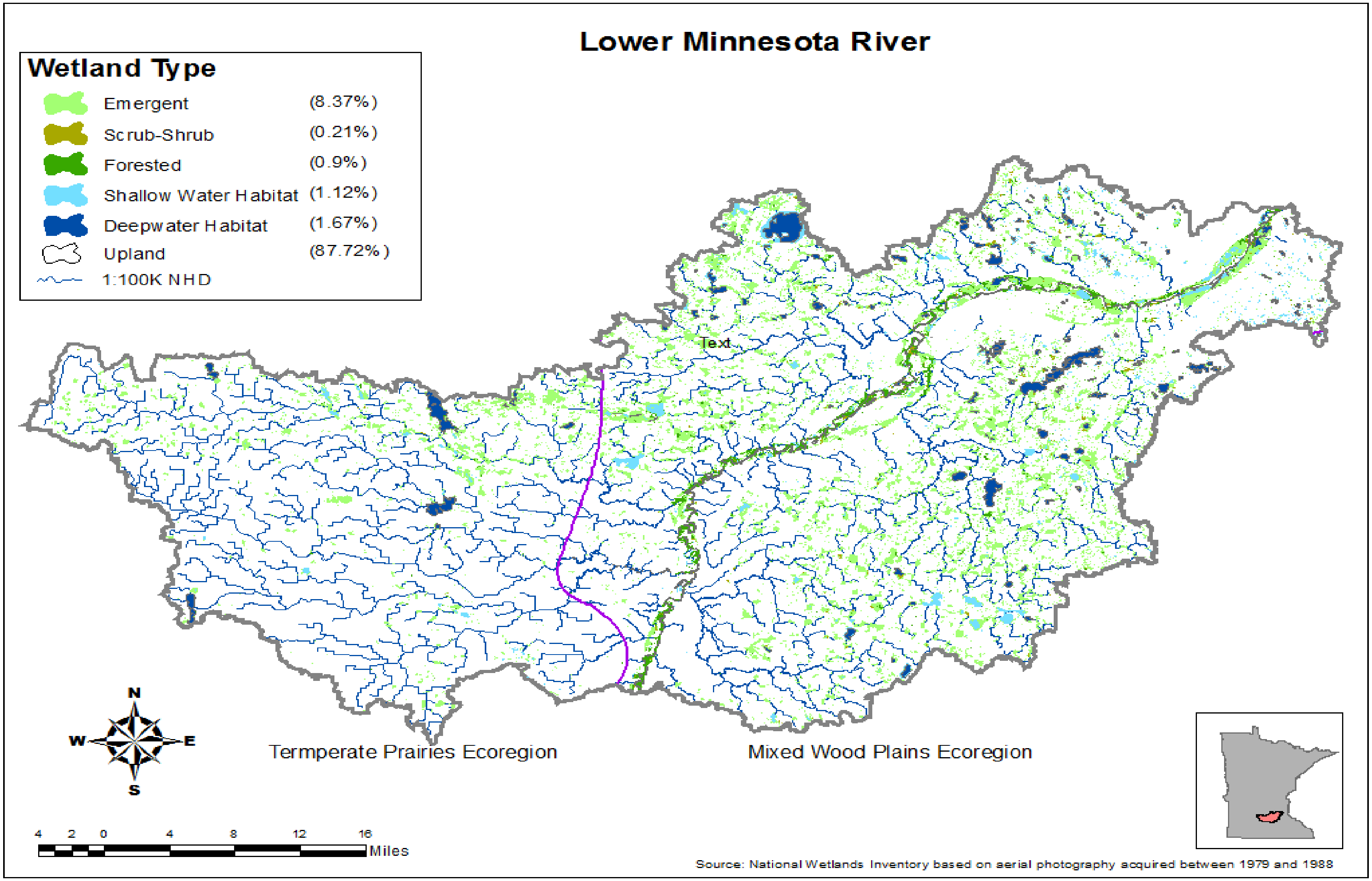


Figure 13. Wetlands and surface water in the Lower Minnesota River Watershed. Wetland data are from the original National Wetlands Inventory.

Coarse moraine deposits and glacial till are characteristic of the Lower Minnesota Watershed surface geology are very conducive to wetland development. Ground moraine geology dominates the western two-fifths of the Lower Minnesota, and this western portion of the watershed occurs in the Temperate Prairie level II ecoregion. The eastern three fifths of the watershed is in the Mixed Wood Plains Level II Ecoregion and its surface geology is primarily stagnation or end moraine and associated sand and gravel till.

Carver Creek, Porter Creek, Trib. to Minnesota River and Bevens Creek HUC-12 subwatersheds respectively support the highest percentage of wetland area ranging from 17.8 to 15.9%. These estimates and distribution observations represent a snapshot of the location, type and extent of wetlands from the original national wetland inventory (NWI) based on early 1980's imagery. Updated state wetland inventory data have been published recently; however, analysis of wetland extent could not be completed using these data due to intersecting edge issues across two phases of the updated inventory that meet in this watershed.

Natural Resources Conservation Service digital soil survey (SSURGO) soil map units with drainage classes of either Poorly Drained or Very Poorly Drained suggest approximately 537,538 acres of wetland or 46% of the Lower Minnesota River Watershed were present prior to European settlement. Figure 14 presents estimates of wetland loss in the Lower Minnesota River HUC-12 subwatersheds. This analysis found that historically, wetlands in the North Branch Rush River, South Branch Rush River, Judicial Ditch 1A and Middle Branch Rush River each comprised over 70% of their respective subwatershed area. The vast majority of historic wetlands in these subwatersheds have been drained to improve agricultural productivity. Today, less than 10% of historic wetlands in the watershed remain.

A few special feature wetlands occur in the Lower Minnesota Watershed. Calcareous fens are sensitive, special feature wetlands dominated by graminoid species and unique forbs growing on peat with mineral rich groundwater discharges maintaining near permanent saturation of the peat substrate. Given their uniqueness and sensitivity to landscape changes and pollutant loading, calcareous fens are classed in Minn. R. ch 7050.0335 as restricted Out-Standing Resource Value (ORVW) waters. Fourteen occurrences of calcareous fen communities occur on lower terraces along the river within the Lower Minnesota Watershed. Several of these occur as complexes of several separate pockets of calcareous fen disjunct from each other. These include Seminary Fen, Savage Fen, Black Dog Lake Fen, Nichol's Meadow Fen and Gun Club Lake Fen. Other special feature wetlands present in the Lower Minnesota River Watershed are several waters that support wild rice. Analysis of a recent compilation of waters known to support wild rice finds 16 locations where wild rice grows in the Lower Minnesota Watershed, most of these locations are shallow lakes fringed by emergent wetlands.

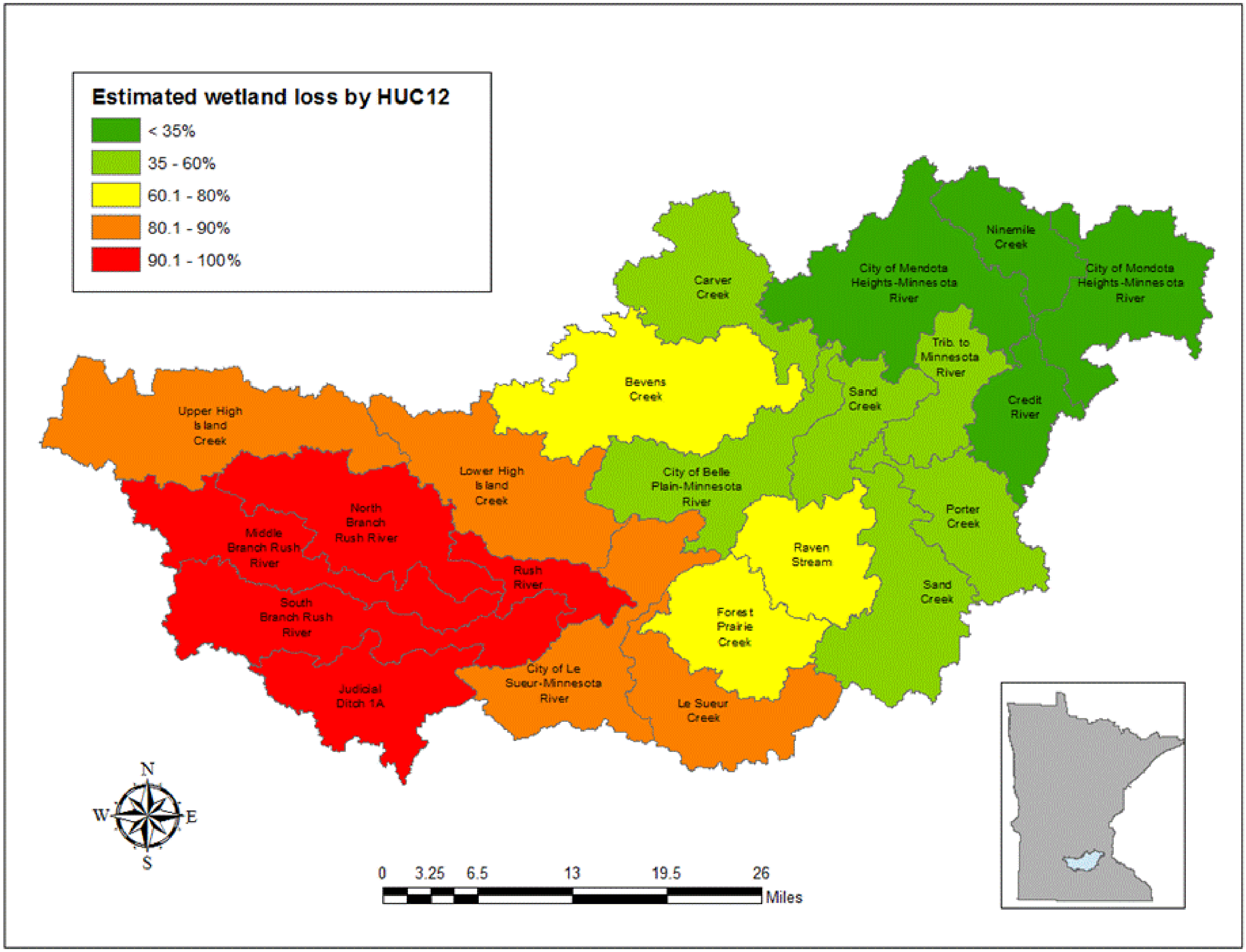


Figure 14. Estimated historic wetland loss by HUC 12 subwatershed within the Lower Minnesota Watershed, based on analysis of SSURGO drainage class data selected on "Very Poorly" and "Poorly" drained soil map units.

Watershed-wide data collection methodology

Lake water sampling

MPCA sampled seven lakes in 2014 and four in 2015 as part of the Clean Water Legacy Surface Water Monitoring project for the purpose of enhancing the dataset for lake assessment of aquatic recreation. Local government units were awarded Surface Water Assessment Grant monies to conduct monitoring on six lakes. There are currently 36 volunteers enrolled in the MPCA's Citizens Lake Monitoring Program (CLMP) that are conducting lake monitoring within the watershed. Considerable lake monitoring occurred funded by local government units and the Metropolitan Council in this watershed. Sampling methods are similar among monitoring groups 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 (June to September) for phosphorus, chlorophyll-a and Secchi depth.

Stream water sampling

Twenty-two intensive water chemistry stations (10X) were sampled from May thru September in 2014, and again June thru August of 2015, 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 aggregated HUC-12 subwatershed that was >40 mi.^{2} in area (purple circles and green circles/triangles in (Figure 2). A Surface Water Assessment Grant (SWAG) was awarded to Carver, Le Sueur, Sibley and Scott counties to assist in 10X monitoring at 21 stations, while MPCA conducted 10X monitoring at one remaining station (See Appendix 2.1 for locations of stream water chemistry monitoring sites. See Appendix 1 for definitions of stream chemistry analytes monitored in this study). Due to the flow through nature of the Lower Minnesota River Watershed, several aggregated HUC-12 subwatersheds did not have traditional single outlets but rather several small tributaries entering the mainstem Minnesota River. In these circumstances, 1 or 2 intensive water chemistry stations were placed on the most prominent tributaries. For example, an intensive water chemistry location on Roberts Creek represented the City of Belle Plaine 12-HUC, as it was the largest tributary within the subwatershed. Two intensive water chemistry locations within the City of Le Sueur 12-HUC were placed on Barne Fry Creek and a Tributary to Judicial Ditch 2, representing both the eastern and western tributaries of the subwatershed. Purgatory Creek was selected as the intensive water chemistry collection site for the City of Mendota Heights subwatershed, as it was the largest tributary within that subwatershed. Within the Bevens Creek Subwatershed, both Bevens Creek and Silver Creek were sampled intensively for water chemistry, due to the watershed's size and local interest.

Stream flow methodology

MPCA and the DNR jointly monitor stream water quantity and quality at dozens of sites across the state on major rivers, at the mouths of most of the state's major watersheds and at the mouths of some aggregated HUC-12 subwatersheds. Information and data on these sites are available at the DNR/MPCA Cooperative Stream Gaging webpage at: http://www.dnr.state.mn.us/waters/csg/index.html.

Lake biological sampling

A total of 23 lakes were monitored for fish community health in the Lower Minnesota River Watershed. While data from the last 10 years contributed to the watershed assessments, the majority of data utilized for the 2015 assessment was collected throughout 2010 to 2015. Complete waterbody assessments to determine aquatic life use support were completed for 18 lake basins. The remaining five were deemed either not assessable or insufficient conclusive information to render a final aquatic life use assessment due to recent winter kills or uncertainty surrounding appropriate criteria for assessment.

To measure the health of aquatic life at each lake, a fish index of biological integrity (IBI) was calculated based on monitoring data collected in the lake. A fish classification framework was developed to account for natural variation in community structure, which is attributed to area, maximum depth, alkalinity, shoreline complexity and geographic location. As a result, an IBI is available for four different groups of lake classes (Schupp Lake Classification, DNR). Each IBI class uses a unique suite of metrics, scoring functions, impairment thresholds and confidence intervals (CIs). IBI scores higher than the impairment threshold and upper CI indicate that the lake supports aquatic life. Scores below the impairment threshold and lower CI indicate that the lake 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 the consideration of potential local and watershed stressors and additional monitoring information (e.g., water chemistry, physical habitat, plant surveys, and observations of local land use activities).

Stream biological sampling

The biological monitoring component of the IWM in the Lower Minnesota River Watershed was completed during the summer of 2014. A total of 90 sites were newly established across the watershed and sampled. These sites were located near the outlets of most minor HUC-14 watersheds. In addition, 42 existing biological monitoring stations within the watershed were revisited in 2014 and 2015. These monitoring stations were initially established as part of a random Minnesota River Basin wide survey in 2004, as part of the Minnesota River Assessment Project (MRAP) in 1990 and 2010, as part of metro surveys conducted in 2000 or as part of a 2007 survey which investigated the quality of channelized streams with intact riparian zones. While data from the last 10 years contributed to the watershed assessments, the majority of data utilized for the 2016 assessment was collected in 2014. A total of 96 AUIDs were sampled for biology in the Lower Minnesota River Watershed. Waterbody assessments to determine aquatic life use support were conducted for 96 AUIDs. 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.

To measure the health of aquatic life at each biological monitoring station, indices of biological integrity (IBIs), specifically Fish and Invert 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 seven distinct warm water classes and two Coldwater 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 3.1). 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 the consideration of 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 Appendices 3.2 and 3.3.

Fish contaminants

Minnesota Department of Natural Resource (DNR) fisheries staff collect most of the fish for the Fish Contaminant Monitoring Program. In addition, MPCA's biomonitoring staff collect up to five piscivorous (top predator) fish and five forage fish as part of IWM efforts. All fish collected by the MPCA are analyzed for mercury and the two largest individual fish of each species are analyzed for polychlorinated biphenyls (PCBs).

Captured fish were wrapped in aluminum foil and frozen until they were thawed, scaled (or skinned), filleted and ground to a homogenized tissue sample. Homogenized fillets were placed in 60 mL glass jars with Teflon™ lids and frozen until thawed for lab analysis. The Minnesota Department of Agriculture Laboratory analyzed the samples for mercury and PCBs. If fish were tested for perfluorochemicals (PFCs), whole fish were shipped to AXYS Analytical Laboratory, which analyzed the homogenized fish fillets for 13 PFCs. Of the measured PFCs, only perfluorooctane sulfonate (PFOS) is reported because it bioaccumulates in fish to levels that are potentially toxic and a reference dose has been developed.

From the fish contaminant analyses, MPCA determines which waters exceed impairment thresholds. The Impaired Waters List is prepared by the MPCA and submitted every even year to the U.S. Environmental Protection Agency (EPA). MPCA has included waters impaired for contaminants in fish on the Impaired Waters List since 1998. Impairment assessment for PCBs (and PFOS when tested) in fish tissue is based on the fish consumption advisories prepared by the Minnesota Department of Health (MDH). If the consumption advice is to restrict consumption of a particular fish species to less than a meal per week the MPCA considers the lake or river impaired. The threshold concentration for impairment (consumption advice of one meal per month) is an average fillet concentration of 0.22 mg/kg for PCBs (and 0.200 mg/kg for PFOS).

Monitoring of fish contaminants in the 1970s and 1980s showed high concentrations of PCBs were primarily a concern downstream of large urban areas in large rivers, such as the Mississippi River, and in Lake Superior. Therefore, PCBs are now tested where high concentrations in fish were measured in the past and the major watersheds are screened for PCBs in the watershed monitoring collections.

Before 2006, mercury in fish tissue was assessed for water quality impairment based on MDH's fish consumption advisory, the same as PCBs. With the adoption of a water quality standard for mercury in edible fish tissue, 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. At least five fish samples of the same species are required to make this assessment and only the last 10 years of data are used for the assessment. MPCA's Impaired Waters List includes waterways that were assessed as impaired prior to 2006 as well as more recent impairments.

Load monitoring

The Watershed Pollutant Load Monitoring Network (WPLMN) is a long-term program designed to measure 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; at the outlets of the major tributaries (HUC-8 scale) draining to these rivers; and for subwatersheds of the major watersheds. Intensive water quality sampling occurs at all WPLMN sites. Thirty-five samples per year are allocated for basin and major watershed sites and 25 samples per season (ice out through October 31) for subwatershed sites. Water sample results and daily average flow data are coupled in the $FLUX_{32}$ pollutant load model to estimate the transport (load) of nutrients and other water quality constituents past a sampling station over a given period of time. Loads and flow weighted mean concentrations

(FWMCs) are calculated for TSS, total phosphorus (TP), dissolved orthophosphate, nitrate plus nitrite nitrogen (NO_3+NO_2-N), and total Kjeldahl nitrogen (TKN).

More information can be found at the WPLMN website.

Groundwater monitoring

Groundwater quality

The MPCA's Ambient Groundwater Monitoring Program monitors trends in statewide groundwater quality by sampling for a comprehensive suite of chemicals including nutrients, metals and volatile organic compounds. These ambient wells represent a mix of deeper domestic wells and shallow monitoring wells. The shallow wells interact with surface waters and exhibit impacts from human activities more rapidly. Available data from federal, state and local partners are used to supplement reviews of groundwater quality in the region.

Groundwater quantity

Monitoring wells from the DNR Observation Well Network track the elevation of groundwater across the state. The elevation of groundwater is measured as depth to water in feet and reflects the fluctuation of the water table as it rises and falls with seasonal variations and anthropogenic influences. Data from these wells and others are available at:
http://www.dnr.state.mn.us/waters/groundwater_section/obwell/waterleveldata.html.

Groundwater/surface water withdrawals

The DNR permits all high capacity water withdrawals where the pumped volume exceeds 10,000 gallons/day or 1 million gallons/year. Permit holders are required to track water use and report back to the DNR yearly. Information on the program and the program database are found at:
http://www.dnr.state.mn.us/waters/watermgmt_section/appropriations/wateruse.html.

Wetland monitoring

The MPCA is actively developing methods and building capacity to conduct wetland quality monitoring and assessment. Our primary approach is biological monitoring—where changes in biological communities may be indicating a response to human-caused impacts. The MPCA has developed Indices of Biological Integrity (IBIs) to monitor the macroinvertebrate condition of depressional wetlands with open water and the Floristic Quality Assessment (FQA) to assess vegetation condition in all of Minnesota's wetland types. For more information about the wetland monitoring (including technical background reports and sampling procedures), please visit the MPCA Wetland monitoring and assessment webpage.

The MPCA currently does not monitor wetlands systematically by watershed. Rather, the MPCA is using probabilistic monitoring to assess status and trends of wetland quality in the state and by major ecoregion. Probabilistic monitoring refers to the process of randomly selecting sites to monitor, from which, an unbiased estimate of the resource can be made. Regional probabilistic survey results can provide a reasonable approximation of the current wetland quality in the watershed.

Individual subwatershed results

HUC 10 and Aggregated 12-HUC subwatersheds

Assessment results for aquatic life and recreation use are presented for each Aggregated HUC-12 subwatershed within the Lower Minnesota River Watershed, except for the Sand Creek and High Island Creek subwatersheds, which are presented as HUC-10 watersheds in an effort to combine connected riverine systems in a single discussion. The decision to present the Rush River system as parceled aggregated HUC-12 subwatersheds was made due to its large size and many branches.

The primary objective is to portray all the full support and impairment listings within an aggregated HUC-12 or HUC-10 subwatershed resulting from the complex and multi-step assessment and listing process. 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 aggregated HUC-12 subwatersheds contain the assessment results from the 2016 Assessment Cycle as well as any impairment listings from previous assessment cycles. Discussion of assessment results focuses primarily on the 2016 IWM effort, but also considers available data from the last ten years.

The proceeding pages provide an account of each aggregated HUC-12 or HUC-10 subwatershed. Each account includes a brief description of the aggregated HUC-12 or HUC-10 subwatershed and summary tables of the results for each of the following: a) stream aquatic life and aquatic recreation assessments, and b) lake aquatic life and recreation assessments. Following the tables is a narrative summary of the assessment results and pertinent water quality projects completed or planned for the aggregated HUC-12 or HUC-10 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 aggregated HUC-12 or HUC-10 subwatershed (i.e., where sufficient information was available to make an assessment). Primarily, these tables reflect the results of the 2016 assessment process 2018 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); determinations made during the desktop phase of the assessment process (See Figure 4). Assessment of aquatic life is derived from the analysis of biological (fish and invert IBIs), DO, total suspended solids, chloride, pH, total phosphorus, chlorophyll-a, biochemical oxygen demand and un-ionized ammonia (NH_3) data, while the assessment of aquatic recreation in streams is based solely on bacteria (Escherichia coli) data. Included in each table is the specific aquatic life use classification for each stream reach: Coldwater community (2A); cool or warm water community (2B); or indigenous aquatic community (2C). Where applicable and sufficient data exists, assessments of other designated uses (e.g., LRVW, drinking water, and aquatic consumption) are discussed in the summary section of each aggregated HUC-12 or HUC-10 subwatershed as well as in the watershed-wide results and discussion section.

Lake assessments

A summary of lake water quality is provided in the aggregated HUC-12 or HUC-10 subwatershed sections where available data exists. This includes aquatic recreation (phosphorus, chlorophyll-a, and Secchi) and aquatic life, where available (chloride and fish IBI). Similar to streams, parameter level and over all use decisions are included in the table.

Le Sueur Creek Aggregated 12-HUC HUC 0702001201-01

The Le Sueur Creek Subwatershed stretches 79 mi.^{2} across north central to northwestern Le Sueur County. Greenleaf Lake is the source of Le Sueur Creek. From the outlet, Le Sueur creek flows north before turning southwest and continues west, just north of Le Center, for seven miles before shifting north towards the city of the Le Sueur, where it gains the flow of Forest Prairie Creek before ultimately joining the Minnesota River. Le Sueur Creek has many small unnamed tributaries. Greenleaf Lake, near Doyle, has a public access and provides opportunity for lake recreation. Agriculture is the watershed's primary landuse, 70% is utilized for crop production while nearly 11% is used for pasture. Forested coverage ranks at 9% and is almost entirely centralized in the downstream reaches of the watershed where relief is greatest and limits the lands utility for agricultural purposes. Nearly 7% of the watershed is developed; this includes the towns of Le Sueur and Le Center. Only 2% of the watershed remains as wetlands, which limits water storage capacity on the landscape.

Table 2. Aquatic life and recreation assessments on stream reaches: Le Sueur Creek Aggregated 12-HUC. Reaches are organized upstream to downstream in the table.

AUID *Reach Name,* *Reach Description*	Biological Station ID	Reach Length (miles)	Use Class	Aquatic Life Indicators: Fish IBI	Invert IBI	Dissolved Oxygen	TSS	Secchi Tube	Chloride	pH	Ammonia -NH_3	Pesticides ***	Eutrophication	**Aquatic Life**	**Aquatic Rec. (Bacteria)**
07020012-823 ***Le Sueur Creek,*** *CD 23 to W Prairie St*	07MN063	3.67	2Bm, 3C	EX	--	IF	IF	IF	--	IF	IF	--	IF	IMP	--
07020012-824 ***Le Sueur Creek,*** *W Prairie St to Forest Prairie Cr*	14MN106, 14MN093, 14MN092, 03MN074	21.05	2Bg, 3C	EX	EX	IF	MTS	MTS	MTS	MTS	MTS	--	IF	IMP	IMP
07020012-768 ***Unnamed creek,*** *CD 56 to Le Sueur Cr*	14MN036	0.98	2Bg, 3C	EX	EX	IF	IF	IF	--	IF	IF	--	IF	IMP	--

Abbreviations for Indicator Evaluations: **MTS** = Meets Standard; **EX** = Fails Standard; **IF** = Insufficient Information

Abbreviations for Use Support Determinations: **--** = No Data, **NA** = Not Assessed, **IF** = Insufficient Information, **SUP** = Full Support (Meets Criteria); **IMP** = Impaired (Fails Standards)

Key for Cell Shading: = existing impairment, listed prior to 2014 reporting cycle; = new impairment; = full support of designated use; = insufficient information.

Abbreviations for Use Class: **WWg** = Warmwater general, **WWm** = Warmwater modified, **WWe** = Warmwater exceptional, **CWg** = Coldwater general, **CWe** = Coldwater exceptional, **LRVW** = limited resource value water

*Assessments were completed using proposed use classifications changes that have not yet been written into rule.

Table 3. Lake assessments: Le Sueur Creek Aggregated 12-HUC.

Lake Name	DNR ID	Area (acres)	Max Depth (ft)	Assessment Method	Ecoregion	Secchi Trend	Aquatic Life Indicators: Fish IBI	Aquatic Life Indicators: Chloride	Aquatic Life Indicators: Pesticides ***	Aquatic Recreation Indicators: Total Phosphorus	Aquatic Recreation Indicators: Chlorophyll-a	Aquatic Recreation Indicators: Secchi	Aquatic Life Use	Aquatic Recreation Use
Greenleaf	40-0020-00	303	17	Shallow Lake	NCHF	Insufficient Data	--	--	--	EX	EX	EX	--	NS

Abbreviations for Ecoregion: DA = Driftless Area, NCHF = North Central Hardwood Forest, NGP = Northern Glaciated Plains, NLF = Northern Lakes and Forests, NMW = Northern Minnesota Wetlands, RRV = Red River Valley, WCBP = Western Corn Belt Plains

Abbreviations for Secchi Trend: D = decreasing/declining trend, I = increasing/improving trend, NT = no detectable trend, -- = not enough data

Abbreviations for Indicator Evaluations: -- = No Data, **MTS** = Meets Standard; **EX** = Exceeds Standard; **IF** = Insufficient Information

Abbreviations for Use Support Determinations: **--** = No Data, **NA** = Not Assessed, **IF** = Insufficient Information, **FS** = Full Support (Meets Criteria); **NS** = Not Support (Impaired, exceeds standard)

Key for Cell Shading: ☐ = existing impairment, listed prior to 2014 reporting cycle; ☐ = new impairment; ☐ = full support of designated use; ☐= insufficient information.

Summary

Lakes

Aquatic recreation use (AQR) data on lake basins in this subwatershed was limited to Greenleaf Lake. The ecoregion standard for AQR use protects lake users from nuisance algal bloom conditions fueled by elevated phosphorus concentrations that degrade recreational use potential. AQR data was available from Greenleaf Lake in 2009 and 2010, numerous gross violations in the TP and response Chlorophyll-a (Chl-a) datasets indicates extended periods of nuisance algal blooms coinciding with poor recreational water quality. This shallow basin mixes frequently throughout the open water months. This results in historical inputs of phosphorus from the lake sediments to be resuspended and released into the water column fueling additional algal blooms. Considering the small size of the contributing watershed local efforts could be beneficial to curb further nutrient inputs.

Streams

Forest Prairie Creek begins at the outflow of Greenleaf Lake, which is a likely contributor to high nutrients observed in the watershed. While elevated nutrient concentrations were common throughout the subwatershed, eutrophication response was not measured in the stream. Assessable water chemistry datasets in this subwatershed were limited to the downstream reaches of Le Sueur Creek. Bacteria concentrations on the reach of Le Sueur Creek (-824) prior to the Forest Creek confluence were negatively impacting the AQR use potential resulting in a new impairment, the next downstream reach (-724) failed to meet minimum data requirements but indicated bacteria problem is likely. Decreased clarity and increased sediment loads were evident downstream of the Forest Prairie Creek confluence, most of the violations were linked to short term deviations during anomalous high flow events in June 2010 and 2012. Land use, human disturbance and altered hydrology will continue to play a large role in sediment transport within the reach.

Both assessed reaches on Le Sueur Creek have been newly listed for aquatic life impairment for fish (-823) and both fish and macroinvertebrates on the furthest downstream reach (-824). Fish IBI scores were lowest upstream in the watershed at station 07MN063. Standards were met at the next downstream station 14MN106 and fell below standards at further downstream stations. Macroinvertebrate IBI scores showed the opposite pattern, with passing scores in the most downstream station (03MN074) while scores fell well below standards in the upper stations (14MN092, 14MN106). Stream connectivity is a likely source of stress to the fish populations of Le Sueur Creek. Biological station 03MN074 is bracketed by manmade fish barriers above and below the sampling reach. Species counts are highest at this downstream station (19 – 29 across 3 visits) and diminish moving upstream of the barriers to eight species and down to five species at the upstream most station. Fish taxa diversity also appears to be decreasing overtime comparing 2003 the visit to 2014 and 2015 visits. Stream habitat assessments suggest instream habitat improves moving downstream on Le Sueur Creek with scores transitioning from poor to fair ultimately to good at the furthest downstream station. The health of the macroinvertebrate community reflects the habitat quality on the Le Sueur mainstem, as the highest macroinvertebrate IBI scores were paired with the highest habitat scores. The lowest part of the watershed also had the most consistent flows, which could also explain the higher macroinvertebrate IBI scores. Sites further up in the watershed were either not sampled for macroinvertebrates due to being dry or having very low flows at the time of sampling (14MN093, 07MN063), suggesting that unstable hydrology is a potential stressor. Additional potential areas of stress identified include: stream bank erosion, instream sedimentation, reduced biological habitat cover and limited natural instream channel development. Elevated levels of phosphorous were consistently seen across biological station grab samples of Le Sueur Creek, while elevated nitrogen levels appeared concentrated in the lower reaches of the creek. Chemistry data collected during a biological visit also suggests extremely low levels of DO may be problematic in the headwaters stream reach of Le Sueur Creek (-823).

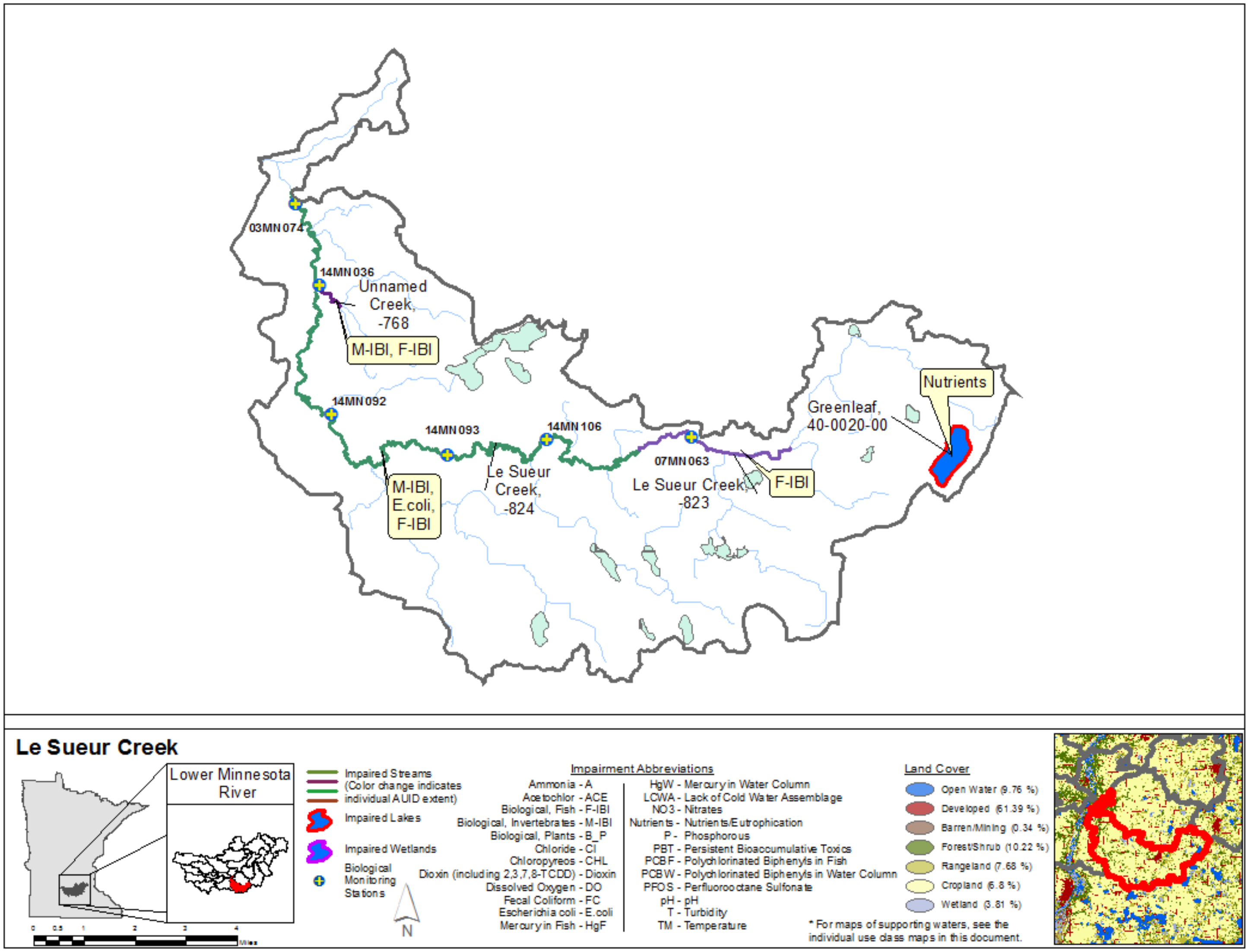


Figure 15. Currently listed impaired waters by parameter and land use characteristics in the Le Sueur Creek Aggregated 12-HUC.

Forest Prairie Creek Aggregated 12-HUC HUC 0702001201-02

The Forest Prairie Creek Subwatershed encompasses 70.76 mi.2 of northwestern Le Sueur County. Its headwaters lie a few miles west of Montgomery and flow in a northwesterly direction, just north of the small community of St. Thomas. The creek turns southwest towards its confluence with Le Sueur Creek approximately one mile northeast of the community of Le Sueur. Along its course, the Le Sueur Creek is fed by several small tributaries and agricultural drainage ditches. Agrarian landuse dominates the terrain, 77% of the subwatershed is utilized for row crop cultivation while 9% serves as pasture for livestock. Forested regions are limited, covering only 6.7% of the total area and occur in the more rugged terrain of the lower Forest Prairie Creek valley where the land has limited agricultural utility. Clear Lake, north of Le Center; provide opportunity for lake recreation in the watershed. Wetlands are essentially absent in the watershed, covering a meager 2% of the total landuse, leaving little water storage capacity on the landscape.

Table 4. Aquatic life and recreation assessments on stream reaches: Forest Prairie Creek Aggregated 12-HUC. Reaches are organized upstream to downstream in the table.

AUID **Reach Name**, *Reach Description*	Biological Station ID	Reach Length (miles)	Use Class	Aquatic Life Indicators: Fish IBI	Invert IBI	Dissolved Oxygen	TSS	Secchi Tube	Chloride	pH	Ammonia -NH_3	Pesticides ***	Eutrophication	Aquatic Life	Aquatic Rec. (Bacteria)
07020012-772, ***County Ditch 42,*** *School Lk to Clear Lk outlet*	14MN030	2.34	2Bm, 3C	EX	EX	IF	IF	IF	--	IF	IF	--	IF	IMP	--
07020012-725 ***Forest Prairie Creek,*** *CD 29 to Le Sueur Cr*	14MN034, 14MN033, 14MN120	13.72	2Bg, 3C	EX	EX	IF	IF	MTS	MTS	MTS	MTS	--	IF	IMP	IMP
07020012-767, ***Judicial Ditch 4,*** *Unnamed ditch to Forest Prairie Cr*	14MN035	0.77	2Bm, 3C	EX	--	IF	IF	IF	--	IF	IF	--	IF	IMP	--
07020012-764, ***County Ditch 34,*** *Unnamed Ditch to Forest Prairie Creek*	14MN032	1.69	2Bg	EX	EX	--	--	--	--	--	--	--	--	IMP	--
07020012-766 ***County Ditch 8/53,*** *Unnamed ditch to CD34*	14MN097	3.77	2Bm, 3C	MTS	MTS	IF	IF	IF	--	IF	IF	--	IF	SUP	--
07020012-763 ***Unnamed ditch,*** *Unnamed ditch to Forest Prairie Cr*	14MN031	3.06	2Bg, 3C	EX	EX	IF	IF	IF	--	IF	IF	--	IF	IMP	--

Abbreviations for Indicator Evaluations: **MTS** = Meets Standard; **EX** = Fails Standard; **IF** = Insufficient Information
Abbreviations for Use Support Determinations: **--** = No Data, **NA** = Not Assessed, **IF** = Insufficient Information, **SUP** = Full Support (Meets Criteria); **IMP** = Impaired (Fails Standards)
Key for Cell Shading: = existing impairment, listed prior to 2014 reporting cycle; = new impairment; = full support of designated use; = insufficient information.
Abbreviations for Use Class: **WWg** = Warmwater general, **WWm** = Warmwater modified, **WWe** = Warmwater exceptional, **CWg** = Coldwater general, **CWe** = Coldwater exceptional, **LRVW** = limited resource value water
*Assessments were completed using proposed use classifications changes that have not yet been written into rule.

Table 5. Lake assessments: Forest Prairie Creek Aggregated 12-HUC.

Lake Name	DNR ID	Area (acres)	Max Depth (ft)	Assessment Method	Ecoregion	Secchi Trend	Aquatic Life Indicators:			Aquatic Recreation Indicators:			Aquatic Life Use	Aquatic Recreation Use
							Fish IBI	Chloride	Pesticides ***	Total Phosphorus	Chlorophyll-a	Secchi		
Clear	40-0079-00	280	20	Deep Lake	NCHF	Insufficient Data	IF	--	--	EX	EX	IF	IF	NS

Abbreviations for Ecoregion: DA = Driftless Area, NCHF = North Central Hardwood Forest, NGP = Northern Glaciated Plains, NLF = Northern Lakes and Forests, NMW = Northern Minnesota Wetlands, RRV = Red River Valley, WCBP = Western Corn Belt Plains
Abbreviations for Secchi Trend: D = decreasing/declining trend, I = increasing/improving trend, NT = no detectable trend, -- = not enough data
Abbreviations for Indicator Evaluations: -- = No Data, **MTS** = Meets Standard; **EX** = Exceeds Standard; **IF** = Insufficient Information
Abbreviations for Use Support Determinations: **--** = No Data, **NA** = Not Assessed, **IF** = Insufficient Information, **FS** = Full Support (Meets Criteria); **NS** = Not Support (Impaired, exceeds standard)
Key for Cell Shading: = existing impairment, listed prior to 2014 reporting cycle; = new impairment; = full support of designated use; = insufficient information.

Summary

Lakes

Clear Lake had nutrient and chlorophyll-a data indicating poor recreational water quality conditions throughout the majority of the dataset collected in 2009 and 2010. The ecoregion standard for aquatic recreation use (AQR) protects lake users from nuisance algal bloom conditions fueled by elevated phosphorus concentrations that degrade recreational use potential. Land use and historical loading are clearly driving nutrient availability and nuisance algal blooms. Fish IBI data was available from 2013. Data was not available to confidently place this lake in a lake class for assessment. As a result, a formal assessment for biota could not be completed.

Streams

Limited water chemistry datasets were available for aquatic life use assessment from small headwater tributaries. Tributary streams and ditches within the subwatershed are also generally showing a degraded biological condition, four additional new impairments are proposed on County Ditch 42 (-772) (FIBI and MIBI), the headwaters of Forest Prairie Creek; Judicial Ditch 4 (-767) (FIBI); County Ditch 34 (-764) (FIBI and MIBI) and an unnamed ditch (-763) (FIBI and MIBI). Although nutrient, DO, and sediment datasets did not meet minimum assessment requirements violations in each dataset were present and should be considered in stressor identification.

Complete water chemistry datasets were limited to the downstream reach of Forest Prairie Creek from 2009, 2010, 2014 and 2015. Sediment and phosphorus concentrations were elevated; however, due to disagreement in the data, high flow events and a lack of response data, no listings will be pursued. The pH data had flux above and below the standard resulting in four violations. This pattern could potentially be the result of nutrient assimilation throughout the dataset; however, the violation rate did not exceed 10%. Bacteria was a persistent issue across all four years of data collection, both individual and monthly violations resulted in an aquatic recreation use impairment.

New aquatic life impairments were also proposed on the mainstem of Forest Prairie Creek for both fish and macroinvertebrates. FIBI scores on the mainstem of Forest Prairie Creek generally increase moving downstream in the watershed with highest scores observed below the dam. This suggests that stream connectivity is a likely source of stress on Forest Prairie's fish communities. FIBI scores are lowest above the dam where only 2-5 species were captured during MPCA surveys, while species counts below the dam range from 21-24 (barrier located between MPCA biological station 14MN120 and 14MN033). Another dam on Le Sueur Creek is also limiting natural fish migrations from the Minnesota River to these tributary streams. MIBI scores on Forest Prairie Creek show the opposite trend of the fish, with the highest score found in the uppermost station. The higher scoring station was a low gradient site that had a much more robust community relative to all other stations sampled in the watershed. Despite the more diverse community, the majority of individuals found at this station are known to be tolerant of overall stress. Greater diversity could be explained by the presence of taxa known to respond to more persistent flows, suggesting this lower gradient section of stream may be allowing a more diverse macroinvertebrate community to persist. Minnesota Steam Habitat Assessment (MSHA) stream habitat scores range from poor to good across the watershed with higher scores observed at natural reaches further downstream in the Forest Prairie Creek Subwatershed, while lower scores were observed at streams assessed using modified aquatic life use standards. Common habitat stressors identified across the subwatershed include stream bank erosion and instream sedimentation.

Stream chemistry data suggests elevated levels of phosphorous and TSS during high flow periods could also be potential sources of stress to stream biology but are not high enough to warrant new aquatic life use listings on Forest Prairie Creek. High proportions of macroinvertebrates tolerant to elevated nutrients and TSS corroborate this information. Chemistry collected at tributary streams was limited to biological sampling events and thus did not have adequate coverage for assessment; however, single grab samples indicate nearly all assessed tributaries are potential sources of elevated nitrogen and phosphorous to Forest Prairie Creek (only WID -763 and -766 did not have elevated phosphorous levels). Grab samples also suggest that low DO and DO flux may be potential causes of biological stress in CD 42 (-772) and unnamed ditch (-763). Elevated levels of TSS were also noted at JD 4 (-767) and the upstream portion of Forest Prairie Creek (-725). While removing the dam on Forest Prairie Creek would likely improve the health and stability of upstream fish communities, addressing additional non-point stressors would also likely be essential to bring the subwatershed's streams into aquatic life use attainment.

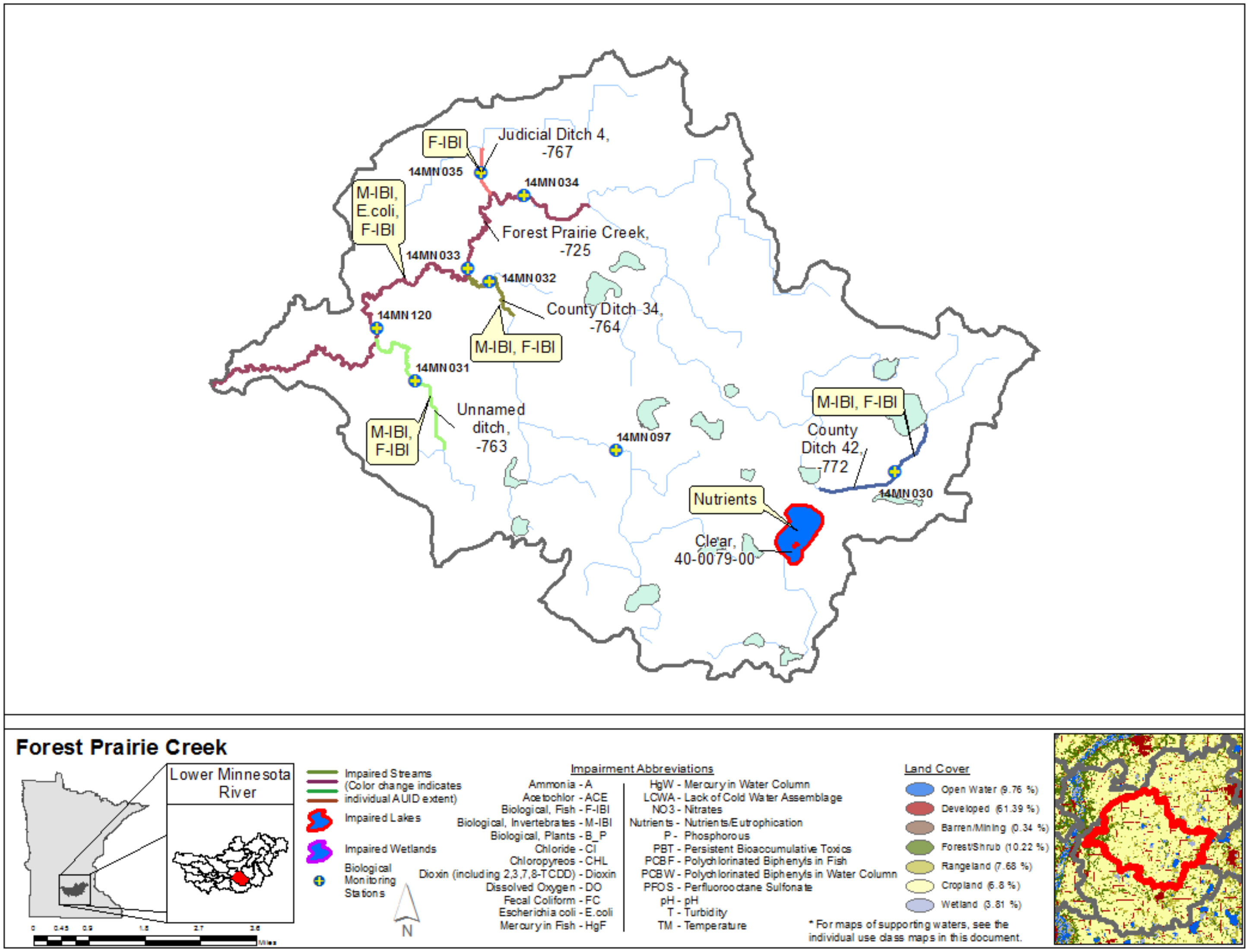


Figure 16. Currently listed impaired waters by parameter and land use characteristics in the Forest Prairie Creek Aggregated 12-HUC.

City of Le Sueur-Minnesota River Aggregated 12-HUC HUC 0702001205-01

The city of Le Sueur (Barney Fry Creek) Subwatershed encompasses a flow through portion of the Minnesota River where the Middle Minnesota River HUC-8 ends and the Lower Minnesota HUC-8 begins. The subwatershed spans 96.6 $mi.^2$, including portions of northeastern Nicollet County, southeastern Sibley County, western Le Sueur County and southwestern Scott County – only land directly adjacent to the Minnesota River. The subwatershed includes several small unnamed direct tributary streams to the Minnesota River and one larger tributary, Barney Fry Creek. Barney Fry starts in a gently rolling agrarian landscape near Norseland and flows west to east towards the dramatic relief and forested bluffs of the Minnesota River valley. As a whole, the subwatershed's landuse is primarily comprised of 62% row crop, 15% forest, 7% rangeland and 6% developed. The largest communities within the watershed lie on the Minnesota River and include portions of Le Sueur and the communities of Henderson, Jessenland, and Blakely.

Table 6. Aquatic life and recreation assessments on stream reaches: City of Le Sueur-Minnesota River Aggregated 12-HUC. Reaches are organized upstream to downstream in the table.

AUID *Reach Name*, *Reach Description*	Biological Station ID	Reach Length (miles)	Use Class	Aquatic Life Indicators: Fish IBI	Invert IBI	Dissolved Oxygen	TSS	Secchi Tube	Chloride	pH	Ammonia -NH_3	Pesticides ***	Eutrophication	**Aquatic Life**	**Aquatic Rec. (Bacteria)**
07020012-793, ***County Ditch 75***, *Unnamed ditch to CD 47A*	14MN080	2.33	2Bm, 3C	EX	MTS	IF	IF	IF	--	IF	IF	--	IF	IMP	--
07020012-792, ***County Ditch 47A***, *Unnamed ditch to CD 75*	14MN081	0.43	2Bm, 3C	EX	MTS	IF	IF	IF	--	IF	IF	--	IF	IMP	--
07020012-602, ***Barney Fry Creek***, *CD 47A to CD 35*	03MN076	4.48	2Bg, 3C	EX	EX	IF	IF	MTS	MTS	MTS	MTS	--	IF	IMP	IMP
07020012-761, ***Unnamed creek***, *Unnamed cr to JD 2*	14MN100	1.56	2Bm, 3C	NA	--	IF	IF	IF	MTS	MTS	MTS	--	IF	IF	IMP
07020012-756, ***Unnamed creek***, *Headwaters to Minnesota R*		2.66	2Bg, 3C	--	--	IF	IF	IF	--	IF	IF	--	IF	IF	IMP

Abbreviations for Indicator Evaluations: **MTS** = Meets Standard; **EX** = Fails Standard; **IF** = Insufficient Information
Abbreviations for Use Support Determinations: **--** = No Data, **NA** = Not Assessed, **IF** = Insufficient Information, **SUP** = Full Support (Meets Criteria); **IMP** = Impaired (Fails Standards)
Key for Cell Shading: = existing impairment, listed prior to 2014 reporting cycle; = new impairment; = full support of designated use; = insufficient information.
Abbreviations for Use Class: **WWg** = Warmwater general, **WWm** = Warmwater modified, **WWe** = Warmwater exceptional, **CWg** = Coldwater general, **CWe** = Coldwater exceptional, **LRVW** = limited resource value water
*Assessments were completed using proposed use classifications changes that have not yet been written into rule.

Summary

County Ditch 47A (-792) and County Ditch 75 (-793) join together to form Barney Fry Creek (-602), both tributaries were assessed using modified tiered aquatic life use standards due to the alterations to their natural drainage in conjunction with the limited potential of their instream biological habitat. New aquatic life use impairments for fish are proposed for both reaches. Both stream reaches were comprised of the same five tolerant fish species and dominated by fathead minnows. The macroinvertebrate community is supporting of the modified use standard at both reaches. Despite meeting the modified standard, the macroinvertebrates at both reaches were dominated by tolerant taxa, most of which are typical of wetland-like conditions, with a high proportion of taxa tolerant of high TSS, and nutrients and low DO. Stream chemistry data was limited to information gathered during biological surveys within both reaches but suggests potential problems with elevated nutrients at CD 75 (-793) and suspended sediments in both reaches. Common habitat concerns include limited stream shading, in stream siltation and limited channel development. Stream bank erosion, present within both watersheds, appears more problematic on CD 47A (-792).

Barney Fry Creek (-602) was also found to be failing aquatic life use standards for both fish and macroinvertebrates. Conditions were compared to the general use standard due to its unaltered state and intact stream habitat. FIBI scores on Barney Fry Creek are 1 to 2 times higher than upstream reaches (-792 and -793), while the MIBI are similarly low to upstream reaches, despite being in a different stream class. Fish population numbers and overall diversity appear to have dropped during 2014 and 2015 visits when compared to 2003 visit, despite this FIBI scores show some improvement overtime as the abundance of tolerant species has declined. Overall, the fish community appears to be dominated by a few tolerant species. The macroinvertebrate data, while showing an impaired condition, shows indication that the reach has Coldwater potential due to Coldwater taxa that were present and abundant blackfly larvae. The presence of Coldwater obligate taxa suggests that there are likely groundwater seeps or unidentified springs present feeding the stream within the Minnesota River bluffs. MSHA habitat scores were generally good, suggesting that stream chemistry may be playing a larger role in observed biological impairments.

The downstream reach of Barney Fry Creek (-602 had the most substantial water chemistry datasets throughout the subwatershed, the majority of Aquatic Life Use (AQL) parameters were easily meeting standard with the exception of nutrient and sediment datasets which both indicated elevated concentrations are present, consistent with observations made in the upstream reaches of Barney Fry Creek. No response data (chlorophyll-a or other measures of productivity) were available to determine if phosphorus is impacting biota in the stream. Total suspended solids (TSS) and Secchi tube (STUBE) datasets for 2 reaches were affected by high flow conditions during the floods in June 2014. Altered hydrology in headwater areas are likely decreasing surface water storage leading to increased frequency and duration of anomalous flow events. Bacteria concentrations were indicative of poor recreational water quality on a reach of Barney Fry Creek and two small direct tributaries to the Minnesota River. Perennial flow is essential to confidently assessing AQL use; many of the small direct tributaries to the Minnesota River do not meet this requirement.

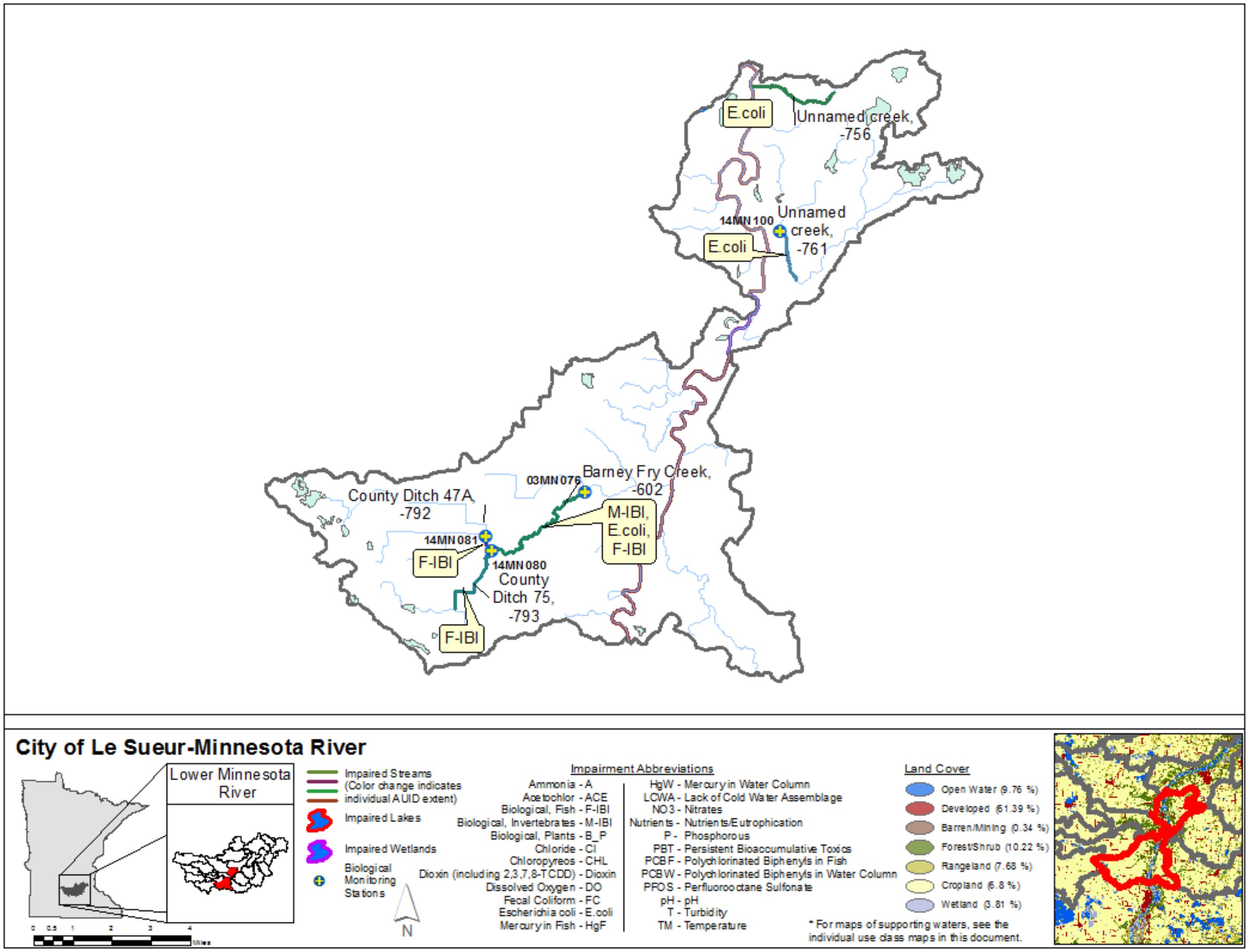


Figure 17. Currently listed impaired waters by parameter and land use characteristics in the City of Le Sueur - Minnesota River Aggregated 12-HUC.

Judicial Ditch 1A Aggregated 12-HUC HUC 0702001203-02

The Judicial Ditch 1A Subwatershed encompasses 77 mi.² of the southern border of Sibley County and north central Nicollet County. Cropland agriculture dominates landuse within the subwatershed at 92.3%. Development is the second largest landuse within the subwatershed at 4.4% and is concentrated near Lafayette the subwatershed's largest community. Little land within the watershed is untouched by anthropogenic alteration, 1.5% remains as wetland, less than 1% is forested and less than 0.1% is open water. Flowing waters within the subwatershed serve as conduits for agricultural drainage and retain little of their natural sinuosity throughout their courses. The headwaters of JD1A begin southeast of Lafayette. JD1A forms as the culmination of two drainage ditches, County Ditch 40A and County Ditch 32A. Flowing northeast, it gains the flow of County Ditch 30A and County Ditch 9 ultimately joins the South Branch Rush River 10 miles south of Arlington on the Sibley Nicollet county border.

Table 7. Aquatic life and recreation assessments on stream reaches: Judicial Ditch 1A Aggregated 12-HUC. Reaches are organized upstream to downstream in the table.

AUID ***Reach Name,*** *Reach Description*	Biological Station ID	Reach Length (miles)	Use Class	Aquatic Life Indicators: Fish IBI	Invert IBI	Dissolved Oxygen	TSS	Secchi Tube	Chloride	pH	Ammonia -NH_3	Pesticides ***	Eutrophication	**Aquatic Life**	**Aquatic Rec. (Bacteria)**	**LRVW standard (Bacteria)**
07020012-783 ***County Ditch 32A,*** *CD 32 to Unnamed ditch*	14MN053	3.38	2Bm, 3C	EX	EX	IF	IF	IF	--	IF	IF	--	IF	IMP	--	--
07020012-509 ***Judicial Ditch 1A,*** *CD 40A to S Br Rush R*	07MN082, 03MN026	10.97	LRVW	NA	NA	MTS	--	--	--	MTS	MTS	--	--	NA	NA	IMP
07020012-801 ***County Ditch 30A,*** *Unnamed ditch to JD 1A*	14MN054	2.19	2Bm, 3C	EX	EX	IF	IF	IF	--	IF	IF	--	IF	IMP	--	--
07020012-784 ***County Ditch 9,*** *Unnamed ditch to JD 1A*	14MN058	2.66	2Bm, 3C	EX	--	IF	IF	IF	--	IF	IF	--	IF	IMP	--	--

Abbreviations for Indicator Evaluations: **MTS** = Meets Standard; **EX** = Fails Standard; **IF** = Insufficient Information

Abbreviations for Use Support Determinations: **--** = No Data, **NA** = Not Assessed, **IF** = Insufficient Information, **SUP** = Full Support (Meets Criteria); **IMP** = Impaired (Fails Standards)

Key for Cell Shading: ☐ = existing impairment, listed prior to 2014 reporting cycle; ☐ = new impairment; ☐ = full support of designated use; ☐= insufficient information.

Abbreviations for Use Class: **WWg** = Warmwater general, **WWm** = Warmwater modified, **WWe** = Warmwater exceptional, **CWg** = Coldwater general, **CWe** = Coldwater exceptional, **LRVW** = limited resource value water

*Assessments were completed using proposed use classifications changes that have not yet been written into rule.

Summary

Water chemistry data is limited in the Judicial Ditch 1A Subwatershed mainly due to the small headwater nature of the reaches. The downstream reach of Judicial Ditch 1A (-509) is considered a “limited resource water” (LRVW) and therefore assessed for secondary contact recreation and to avoid nuisance conditions within the ditch. Bacteria data lead to a listing in 2010 and newer data from 2014 and 2015 confirm the initial listings with two more individual violations. Smaller channelized tributaries have water chemistry datasets associated with collection during biological monitoring visits, violating data, points are limited, potential DO flux issues could warrant stressor identification.

Three tributary ditches that flow into Judicial 1A were assessed using modified tiered aquatic life use standards due to alterations to their natural drainage in conjunction with limited biological potential of their instream habitat. New aquatic life use impairments were proposed for both fish and macroinvertebrates for County Ditch 30A, and County Ditch 32A and a new impairment for fish on County Ditch 9. The mainstem of the subwatershed, Judicial Ditch 1A, was not assessed for aquatic life due to it being designated as a LRVW stream and is not protected for aquatic biology where samples were collected. All reaches were dominated by few tolerant fish species, including brook stickleback, fathead and common carp. Similarly, the macroinvertebrate community was overwhelmingly dominated by tolerant taxa. A very high proportion of agricultural landuse and ditching in each of tributaries is likely driving many of the low biological scores. MSHA habitat scores were consistently low among all stations, with problematic habitat characteristics common in many channelized streams, including a narrow riparian zone, bank erosion, and limited instream habitat and instream sedimentation. Instream chemistry data was limited to data gathered during biological assessments but suggests potential issues with suspended sediment and high levels of nitrogen. A preponderance of macroinvertebrates tolerant to TSS and nitrogen corroborates this potential. Instream sediment concerns were also noted within the stream habitat assessment, which implicated stream bank erosion, instream sedimentation and reduced levels of cover as potential stressors.

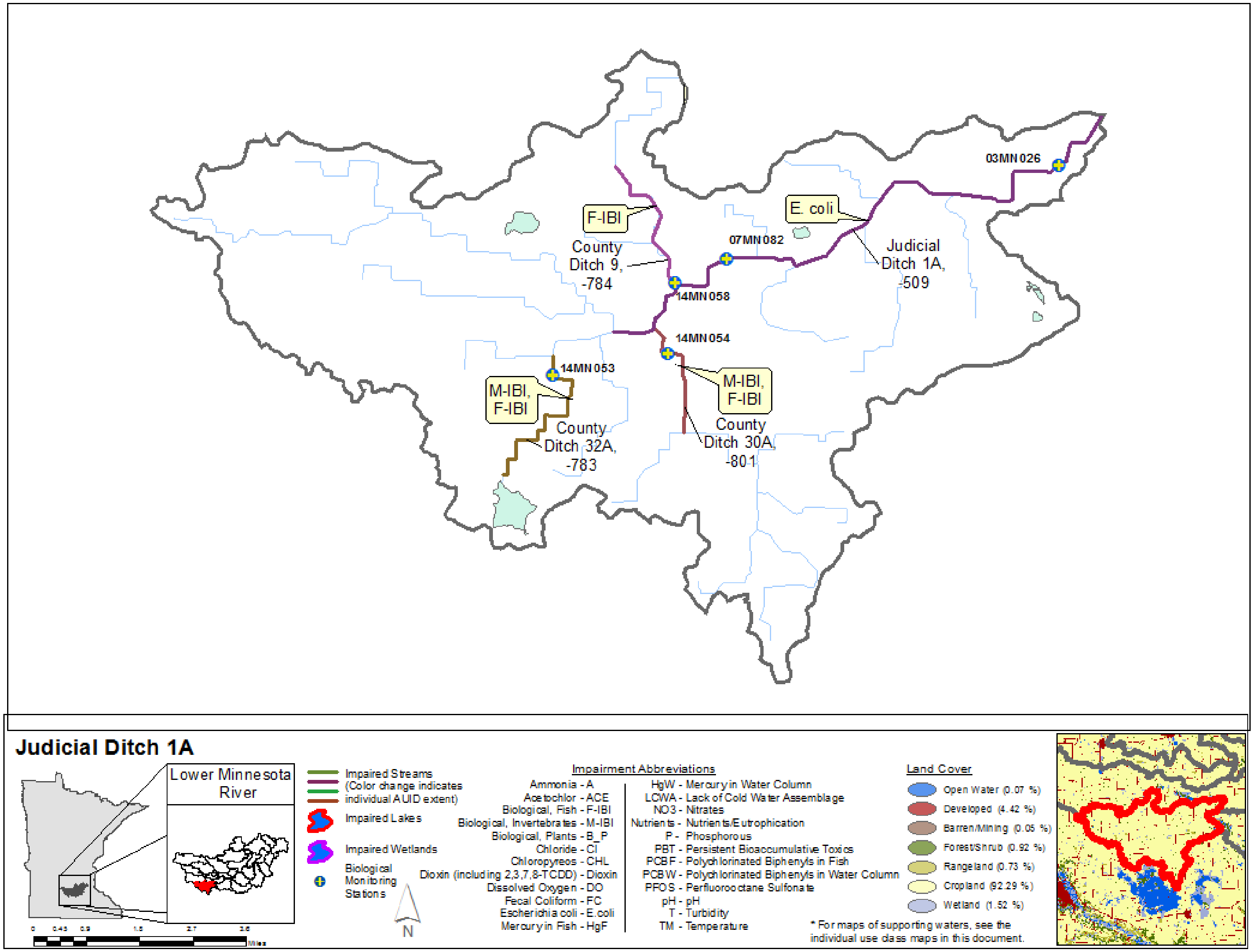


Figure 18. Currently listed impaired waters by parameter and land use characteristics in the Judicial Ditch 1A Aggregated 12-HUC.

South Branch Rush River Aggregated 12-HUC HUC 0702001203-01

The South Branch Rush River Subwatershed includes 107 mi.[2] of southern Sibley and northern Nicollet counties. Row crop agriculture is a prominent feature within the subwatershed's landscape covering 87.9% of its total landuse. Development is the second highest landuse within the subwatershed at 4.7% and includes the small community of Gibbon. Little land within the watershed is untouched by anthropogenic alteration, 2.3 % remains as wetland, 2.9 % is forested and 1.4 % is open water. Flowing waters within the subwatershed serve as conduits for agricultural drainage and retain little of their natural sinuosity throughout their courses. The subwatershed stretches west of Gibbon moving east, falling between the towns of Winthrop and Lafayette. The South Branch Rush River ultimately joins JD1A 10 miles south of Arlington on the Sibley Nicollet county border. Clear Lake, south of Gibbon, provides opportunity for lake recreation in the watershed.

Table 8. Aquatic life and recreation assessments on stream reaches: South Branch Rush River Aggregated 12-HUC. Reaches are organized upstream to downstream in the table.

AUID *Reach Name*, *Reach Description*	**Biological Station ID**	**Reach Length (miles)**	**Use Class**	**Aquatic Life Indicators:** Fish IBI	Invert IBI	Dissolved Oxygen	TSS	Secchi Tube	Chloride	pH	Ammonia -NH_3	Pesticides ***	Eutrophication	**Aquatic Life**	**Aquatic Rec. (Bacteria)**
07020012-785 ***Judicial Ditch 1,*** *CD 4A to CD 13*	14MN089	1.07	2Bm, 3C	MTS	EX	IF	IF	IF	--	IF	IF	--	IF	IMP	--
07020012-636 ***County Ditch 13,*** *Unnamed ditch to JD 1*	14MN088	2.50	2Bm, 3C	MTS	EX	IF	IF	IF	--	IF	IF	--	IF	IMP	--
07020012-825 ***Rush River, South Branch,*** *Unnamed ditch to -94.0478 44.4761*	14MN077, 14MN230, 14MN105	23.14	2Bm, 3C	EX	EX	IF	IF	IF	--	MTS	MTS	--	IF	IMP	IMP
07020012-574 ***Judicial Ditch 6,*** *Unnamed ditch to S Br Rush R*	14MN056	3.20	2Bm, 3C	MTS	--	IF	IF	IF	--	IF	IF	--	IF	SUP	--
07020012-826 ***Rush River, South Branch,*** *-94.0478 44.4761 to Rush R*	97MN012	9.51	2Bg, 3C	EX	EX	IF	IF	MTS	MTS	MTS	MTS	--	IF	IMP	IMP

Abbreviations for Indicator Evaluations: **MTS** = Meets Standard; **EX** = Fails Standard; **IF** = Insufficient Information
Abbreviations for Use Support Determinations: **--** = No Data, **NA** = Not Assessed, **IF** = Insufficient Information, **SUP** = Full Support (Meets Criteria); **IMP** = Impaired (Fails Standards)
Key for Cell Shading: = existing impairment, listed prior to 2014 reporting cycle; = new impairment; = full support of designated use; = insufficient information.
Abbreviations for Use Class: **WWg** = Warmwater general, **WWm** = Warmwater modified, **WWe** = Warmwater exceptional, **CWg** = Coldwater general, **CWe** = Coldwater exceptional, **LRVW** = limited resource value water
*Assessments were completed using proposed use classifications changes that have not yet been written into rule.

Table 9. Lake assessments: South Branch Rush River Aggregated 12-HUC.

Lake Name	DNR ID	Area (acres)	Max Depth (ft)	Assessment Method	Ecoregion	Secchi Trend	Aquatic Life Indicators:			Aquatic Recreation Indicators:			Aquatic Life Use	Aquatic Recreation Use
							Fish IBI	Chloride	Pesticides ***	Total Phosphorus	Chlorophyll-a	Secchi		
Clear	72-0089-00	493	9	Shallow Lake	WCBP	No Evidence of Trend	--	MTS	--	EX	EX	IF	IF	NS

Abbreviations for Ecoregion: DA = Driftless Area, NCHF = North Central Hardwood Forest, NGP = Northern Glaciated Plains, NLF = Northern Lakes and Forests, NMW = Northern Minnesota Wetlands, RRV = Red River Valley, WCBP = Western Corn Belt Plains
Abbreviations for Secchi Trend: D = decreasing/declining trend, I = increasing/improving trend, NT = no detectable trend, -- = not enough data
Abbreviations for Indicator Evaluations: -- = No Data, **MTS** = Meets Standard; **EX** = Exceeds Standard; **IF** = Insufficient Information
Abbreviations for Use Support Determinations: **--** = No Data, **NA** = Not Assessed, **IF** = Insufficient Information, **FS** = Full Support (Meets Criteria); **NS** = Not Support (Impaired, exceeds standard)
Key for Cell Shading: ☐ = existing impairment, listed prior to 2014 reporting cycle; ☐ = new impairment; ☐ = full support of designated use; ☐= insufficient information.

Summary

Lakes

Clear lake is the sole basin in the subwatershed with assessment level data available. Lake assessment method characterizes the basin as a shallow lake (max depth 9’, 100% littoral). The ecoregion standard for aquatic recreation use (AQR) protects lake users from nuisance algal bloom conditions fueled by elevated phosphorus concentrations that degrade recreational use potential. Data was collected in 2014 and 2015; seasonal averages are indicative of poor water quality associated with AQR use impairment. Although the contributing watershed to lake ratio is small, nearly the entire landscape is converted for crop production. Watershed sources of phosphorus and internal loading are likely driving nutrient resuspension, increasing availability for nuisance algal blooms. Parkland on the eastern and northern shorelines indicate recreation potential exists; restoration strategies would be beneficial to future summer time parkland use. Chloride data was available for assessment; concentrations were well below the standard. A complete aquatic life use assessment was not possible without supporting fish IBI data.

Streams

Downstream reaches of South Branch Rush River (-825, -826) were impaired for aquatic recreation use, with elevated bacteria levels noted throughout the reach. River nutrient data from the entire subwatershed indicates elevated nutrient concentrations, response data was either not available or meeting criteria, and as such, no new river nutrient listings resulted. Total suspended solid (TSS) and Secchi tube (STUBE) datasets were most significant on the middle reach of the South Branch Rush River (-825). The TSS violations occurred mainly in June 2007 and 2008, reviewing rainfall records from that time period indicate these violations are short-term deviations linked to high precipitation events, newer TSS data revealed one violation between 2014 and 2015. The STUBE data was not indicative of low clarity that is typically associated with elevated TSS concentrations. While this information does not indicate an impairment on this portion of the Rush River, the downstream subwatershed does have sediment issues and work to improve conditions in the South Branch Subwatershed would benefit the downstream Rush River system.

The main channels of the South Branch Rush River, along with two tributary ditches were assessed for biology using modified tiered aquatic life use standards due to alterations to their natural drainage in conjunction with limited biological potential of their instream habitat. The lowermost station (97MN012), on the main channel with a natural channel, was assessed using general aquatic life standards. New impairments for macroinvertebrates were found throughout the entire watershed, with only a single station, 14MN105, meeting the modified use threshold. The fish community in the tributary ditches met modified use standards, while nearly all stations found throughout the main channel reaches fell below their associated standards. While the ditches in the upper reaches of the watershed met their respective modified standard for fish IBI, fathead minnows and carp dominated the fish communities in both reaches. The presence of young of year walleye was influential enough in both reaches to elevate scores above modified thresholds. New impairments are also proposed for fish on the main reaches of the South Branch Rush River (-825 and -826) where communities were overwhelmingly dominated by intolerant taxa at all but one station on reach -825 (14MN077) where modified standards were met. Other than the station nearest the outlet of the watershed, all stations were found to have highly modified stream channels, abundant in-stream sediment and very little to no riparian cover. This lack of habitat along with predominant agricultural landuse throughout the watershed was reflected in above average stream temperatures, and poor water quality, all of which resulted in a macroinvertebrate community with low diversity, a lack of intolerant taxa, and an abundance of macroinvertebrates tolerant of associated stressors, including TSS, fine sediment and nutrients. The lowermost station (97MN012) had somewhat improved instream conditions, but the overwhelming impact of upstream stressors still resulted in an impaired condition for both assemblages.

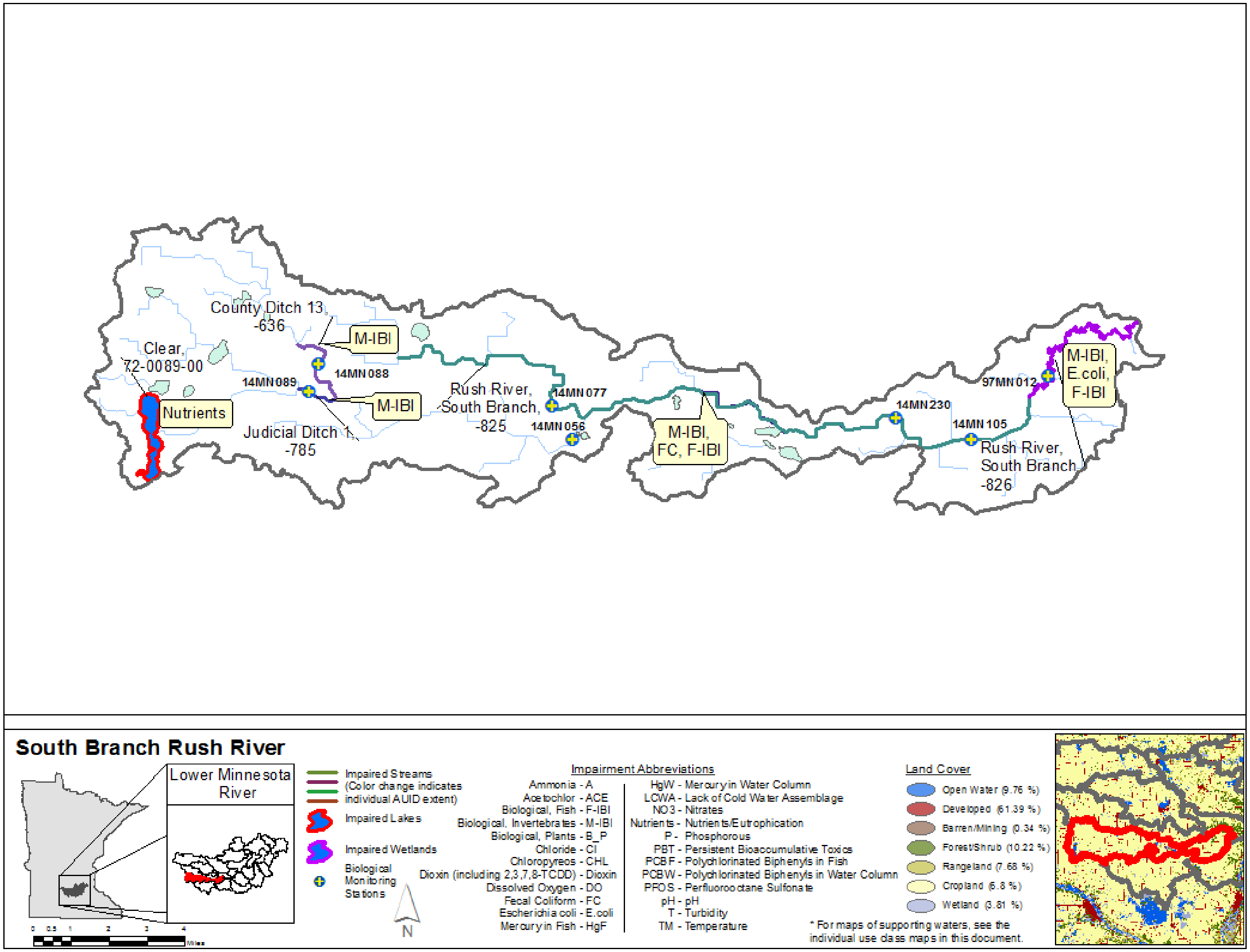


Figure 19. Currently listed impaired waters by parameter and land use characteristics in the South Branch Rush River Aggregated 12-HUC.

Middle Branch Rush River Aggregated 12-HUC HUC 0702001204-02

The Middle Branch Rush River Subwatershed encompasses 87 mi.^{2} of central Sibley County. Agricultural production comprises the majority of the subwatershed's landuse, 88.6% are actively managed for row crop agriculture, while less than 1% is utilized for livestock production. Development in the subwatershed comprises the second highest landuse at 6% of total acres, a majority of which lie within the town of Winthrop. Little land within the watershed is untouched by anthropogenic alteration, 2.7% remains as wetland, 1.1% is forested and 0.4 % is open water. Flowing waters within the subwatershed serve as conduits for agricultural drainage and retain little of their natural sinuosity throughout their courses. The headwaters of the Middle Branch Rush River start on the western edge of Sibley County, approximately 5 miles northwest of Gibbon as County Ditch 49. Along its course, east it gains the flow of several agricultural drainage ditches, the largest of which are County Ditch 44 and County Ditch 42. The Middle Branch Rush River joins the North Branch Rush River 6 miles south of Arlington forming the mainstem of the Rush River.

Table 10. Aquatic life and recreation assessments on stream reaches: Middle Branch Rush River Aggregated 12-HUC. Reaches are organized upstream to downstream in the table.

AUID ***Reach Name,*** *Reach Description*	Biological Station ID	Reach Length (miles)	Use Class	Aquatic Life Indicators: Fish IBI	Invert IBI	Dissolved Oxygen	TSS	Secchi Tube	Chloride	pH	Ammonia -NH_3	Pesticides ***	Eutrophication	**Aquatic Life**	**Aquatic Rec. (Bacteria)**	**LRVW Standard (Bacteria)**
07020012-677 ***County Ditch 49,*** *Unnamed ditch to CD 22*	14MN074	1.27	2Bm, 3C	EX	EX	IF	IF	IF	--	IF	IF	--	IF	IMP	--	--
07020012-674 ***County Ditch 11,*** *Unnamed ditch to CD 22*	14MN075	4.02	2Bm, 3C	MTS	--	IF	IF	IF	--	IF	IF	--	IF	SUP	--	--
07020012-675 ***County Ditch 22,*** *CD 49 to CD 11*	14MN087	2.61	2Bm, 3C	MTS	MTS	IF	IF	IF	--	IF	IF	--	IF	SUP	--	--
07020012-586 ***Rush River, Middle Branch (CD 23 and 24),*** *Unnamed ditch to T112 R30W S13, east line*	14MN085	7.18	2Bm, 3C	EX	EX	IF	IF	MTS	--	IF	IF	--	IF	IMP	--	--
07020012-786 ***County Ditch 44,*** *Headwaters to M Br Rush R*	14MN076	5.74	2Bm, 3C	EX	EX	IF	IF	IF	--	IF	IF	--	IF	IMP	--	--
07020012-551 ***County Ditch 42,*** *Headwaters to T113 R29W S31, south line*	14MN220	6.02	2Bm, 3C	MTS	EX	IF	IF	IF	--	IF	IF	--	IF	IMP	--	--
07020012-550 ***Rush River, Middle Branch (CD 23 and 24),*** *CD 42 to Rush R*	07MN081, 01MN012, 14MN121	18.35	LRVW	NA	NA	MTS	--	--	--	MTS	MTS	--	--	NA	NA	IMP

Abbreviations for Indicator Evaluations: **MTS** = Meets Standard; **EX** = Fails Standard; **IF** = Insufficient Information

Abbreviations for Use Support Determinations: **--** = No Data, **NA** = Not Assessed, **IF** = Insufficient Information, **SUP** = Full Support (Meets Criteria); **IMP** = Impaired (Fails Standards)

Key for Cell Shading: = existing impairment, listed prior to 2014 reporting cycle; = new impairment; = full support of designated use; = insufficient information.

Abbreviations for Use Class: **WWg** = Warmwater general, **WWm** = Warmwater modified, **WWe** = Warmwater exceptional, **CWg** = Coldwater general, **CWe** = Coldwater exceptional, **LRVW** = limited resource value water

*Assessments were completed using proposed use classifications changes that have not yet been written into rule.

Summary

The most extensive water chemistry dataset is available on the downstream reach of Middle Branch Rush River (-550, a limited resource value water)). Standards for LRVWs are designed to protect for secondary contact (wading) and nuisance conditions. A LRVW assessment had previously occurred in 2009, resulting in an impairment based on both individual and monthly mean bacteria violations; newer data from 2014 and 2015 confirms the initial impairment. The next upstream reach(-586) was previously considered to be meeting aquatic life use in 2009 based on a large turbidity, total suspended solid (TSS) and Secchi tube datasets. More recent TSS data was limited, an extensive Secchi tube dataset was indicative of good water clarity typically associated with low sediment loads. Small channelized headwaters streams have limited datasets, elevated nutrients and sediment concentrations were noted but more investigation would be needed to develop reliable datasets. Limited chemical datasets rely on biological data to accurately assess these reaches for aquatic life use support.

All reaches in the Middle Branch Rush River Watershed, including both the mainstem reach and tributary ditches were assessed using modified tiered aquatic life use standards due to alterations to their natural drainage in conjunction with limited biological potential of their instream habitat. The three stations associated with the lowermost reach of the watershed (-550) were not assessed for aquatic life due to the reach being designated as a LRVW where stream biological indicators are not protected. The overwhelming influence of channel modification, along with a predominant agricultural landuse, can have significant impacts on biological communities. Despite this being the trend throughout this subwatershed, three reaches (-675, -674, -551), support the modified use thresholds for one or both biological assemblages; however, it is likely modification is still having impacts downstream as the modified use standards are very low. Fish communities were supporting on each of the three reaches, while macroinvertebrates were supporting at reach -647 and were below the threshold at reach -551; -reach -675 was not sampled for macroinverbrates. The common factor among these reaches was that they had the highest stream habitat scores in the subwatershed. For a stream to support a robust biological assemblage, it needs good quality habitat, good water quality, and stable hydrological conditions. All reaches throughout the watershed showed either elevated nutrient or TSS levels at the time of fish sampling, the fact that these streams had higher quality habitat, suggests that continued maintenance of stream habitat may be key in maintaining healthy biology. The remaining streams in the watershed (-586, -677, -786), failed to meet modified aquatic life standards for both assemblages at all stations sampled. Fish and macroinvertebrate communities on these reaches were dominated by primarily tolerant taxa. Dominant fish taxa included johnny darter, brook stickleback, creek chub, bigmouth shiner and sand shiner. MSHA habitat scores were low among these reaches, with likely stressors being low stream shading, bank erosion, lack of riparian buffer, limited coarse substrates and sparse habitat cover. Elevated nutrient and TSS values are corroborated by a predominance of macroinvertebrate individuals tolerant of the associated stressors.

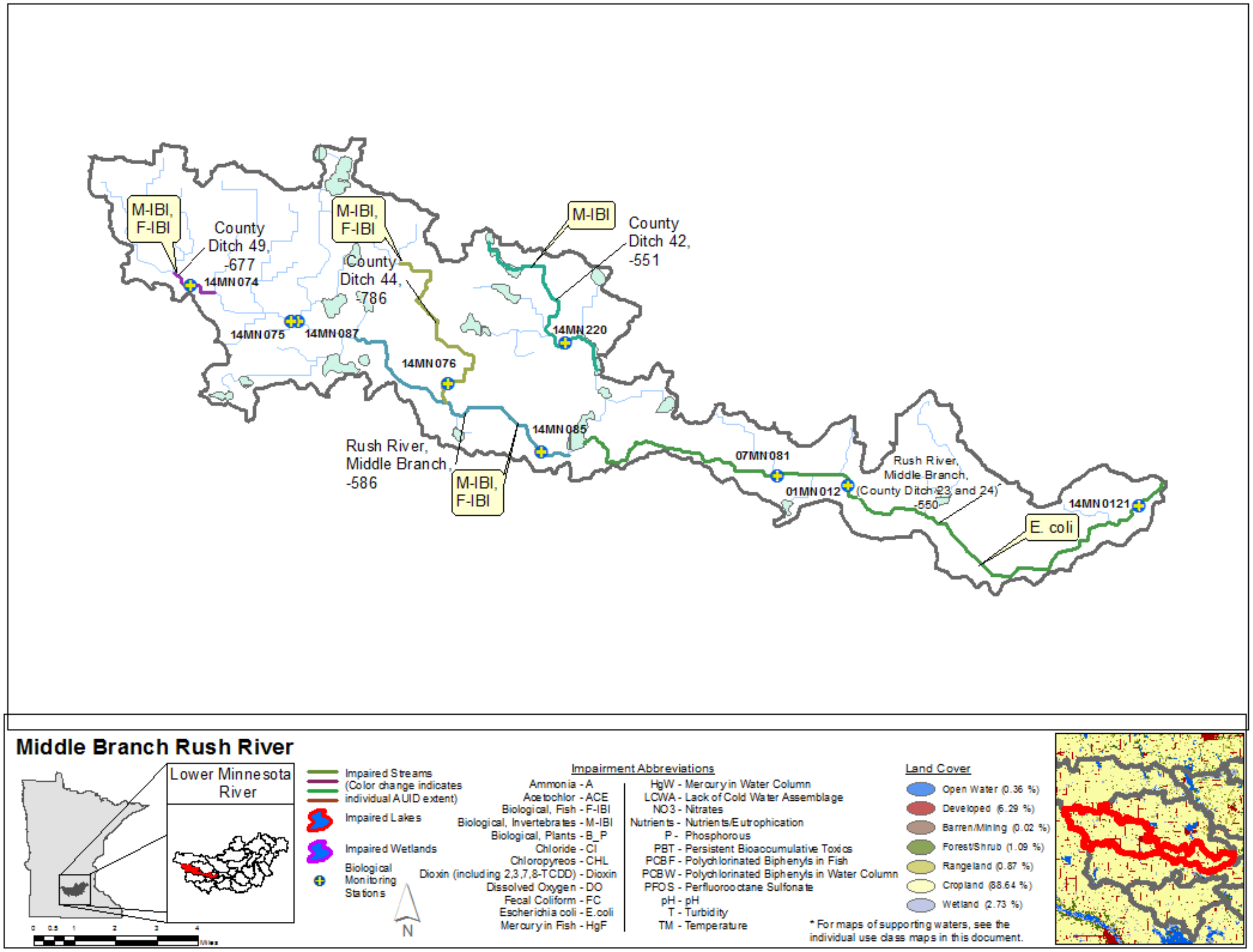


Figure 20. Currently listed impaired waters by parameter and land use characteristics in the Middle Branch Rush River Aggregated 12-HUC.

North Branch Rush River Aggregated 12-HUC — HUC 0702001202-01

The North Branch Rush River Subwatershed encompasses 99 $mi.^2$ of southern McLeod County and central to south central Sibley County. The drainage's landuse is primarily employed in agricultural production, with 85% residing within row crop agriculture and 2% utilized for rangeland. Gaylord is the largest community in the subwatershed and includes the majority of its 6% developed acres. Little land within the watershed is untouched by anthropogenic alteration, 2.8% remains as wetland, 1.4% are forested and 2.7% are open water. Flowing waters within the subwatershed serve as conduits for agricultural drainage and retain little of their natural sinuosity throughout their courses. North Branch Rush River (Judicial Ditch 18), County Ditch 18 and an Unnamed Ditch north of Titlow Lake comprise the headwaters of the subwatershed north and northwest of Gaylord. These channelized streams converge on the north side of Gaylord at Titlow Lake. The North Branch Rush River continues at Titlow's outlet to the east of the lake, where a control structure maintains lake levels and may be a potential barrier to fish migration. County Ditch 56 joins the river to the southeast before joining the Middle Branch Rush River 6 miles south of Arlington forming the mainstem of the Rush River.

Table 11. Aquatic life and recreation assessments on stream reaches: North Branch Rush River Aggregated 12-HUC. Reaches are organized upstream to downstream in the table.

AUID *Reach Name,* *Reach Description*	Biological Station ID	Reach Length (miles)	Use Class	Aquatic Life Indicators: Fish IBI	Invert IBI	Dissolved Oxygen	TSS	Secchi Tube	Chloride	pH	Ammonia -NH_3	Pesticides ***	Eutrophication	**Aquatic Life**	**Aquatic Rec. Bacteria**	**LRVW Standard (Bacteria)**
07020012-555 ***Rush River, North Branch (Judicial Ditch 18),*** *Headwaters to Titlow Lk*	14MN084, 14MN055	14.81	2Bm, 3C	EX	EX	IF	IF	MTS	--	MTS	IF	--	IF	IMP	IMP	--
07020012-791 ***County Ditch 18,*** *Headwaters to CD 40*	14MN060	13.48	2Bm, 3C	EX	--	IF	IF	IF	--	IF	IF	--	IF	IMP	--	--
07020012-714 ***County Ditch 18,*** *CD 40 to Titlow Lk*		0.54	2Bg, 3C	--	--	IF	MTS	MTS	--	MTS	--	--	IF	IF	IMP	--
07020012-713 ***Unnamed ditch,*** *Headwaters to Titlow Lk*		1.27	2Bg, 3C	--	--	NA	NA	NA	--	NA	--	--	NA	NA	IMP	--
07020012-556 ***Rush River, North Branch (County Ditch 55),*** *Titlow Lk to T113 R28W S35, south line*	14MN052	3.81	2Bm, 3C	EX	EX	IF	IF	IF	--	IF	MTS	--	IF	IMP	--	--
07020012-610 ***Unnamed ditch (County Ditch 55),*** *Headwaters (Altnow Lk 72-0039-00) to N Br Rush R*	14MN050	2.85	2Bm, 3C	MTS	--	IF	IF	MTS	--	IF	IF	--	IF	SUP	--	--
07020012-558 ***Rush River, North Branch (County Ditch 55),*** *Unnamed ditch to T112 R27W S17, east line*	03MN027	1.60	LRVW	NA	NA	MTS	--	--	--	IF	MTS	--	--	NA	NA	IMP

07020012-790 ***County Ditch 56,*** *Headwaters to Unnamed ditch*	14MN083	4.66	2Bm, 3C	MTS	EX	IF	IF	IF	--	IF	IF	--	IF	IMP	--	--
07020012-788 ***Unnamed ditch,*** *Unnamed ditch to Unnamed ditch*	14MN102	1.59	2Bm, 3C	EX	EX	IF	IF	IF	--	IF	IF	--	IF	IMP	--	--

Abbreviations for Indicator Evaluations: **MTS** = Meets Standard; **EX** = Fails Standard; **IF** = Insufficient Information
Abbreviations for Use Support Determinations: **--** = No Data, **NA** = Not Assessed, **IF** = Insufficient Information, **SUP** = Full Support (Meets Criteria); **IMP** = Impaired (Fails Standards)
Key for Cell Shading: = existing impairment, listed prior to 2014 reporting cycle; = new impairment; = full support of designated use; = insufficient information.
Abbreviations for Use Class: **WWg** = Warmwater general, **WWm** = Warmwater modified, **WWe** = Warmwater exceptional, **CWg** = Coldwater general, **CWe** = Coldwater exceptional, **LRVW** = limited resource value water
*Assessments were completed using proposed use classifications changes that have not yet been written into rule.

Table 12. Lake assessments: North Branch Rush River Aggregated 12-HUC.

							Aquatic Life Indicators:			Aquatic Recreation Indicators:				
Lake Name	**DNR ID**	**Area (acres)**	**Max Depth (ft)**	**Assessment Method**	**Ecoregion**	**Secchi Trend**	Fish IBI	Chloride	Pesticides ***	Total Phosphorus	Chlorophyll-a	Secchi	**Aquatic Life Use**	**Aquatic Recreation Use**
Titlow	72-0042-00	849	4	Shallow Lake	WCBP	Insufficient Data	--	IF	--	EX	EX	EX	IF	NS

Abbreviations for Ecoregion: DA = Driftless Area, NCHF = North Central Hardwood Forest, NGP = Northern Glaciated Plains, NLF = Northern Lakes and Forests, NMW = Northern Minnesota Wetlands, RRV = Red River Valley, WCBP = Western Corn Belt Plains
Abbreviations for Secchi Trend: D = decreasing/declining trend, I = increasing/improving trend, NT = no detectable trend, -- = not enough data
Abbreviations for Indicator Evaluations: -- = No Data, **MTS** = Meets Standard; **EX** = Exceeds Standard; **IF** = Insufficient Information
Abbreviations for Use Support Determinations: **--** = No Data, **NA** = Not Assessed, **IF** = Insufficient Information, **FS** = Full Support (Meets Criteria); **NS** = Not Support (Impaired, exceeds standard)
Key for Cell Shading: = existing impairment, listed prior to 2014 reporting cycle; = new impairment; = full support of designated use; = insufficient information.

Summary

Lakes

Titlow Lake is the sole basin in the subwatershed with assessment level data available. The ecoregion standard for aquatic recreation use (AQR) protects lake users from nuisance algal bloom conditions fueled by elevated phosphorus concentrations that degrade recreational use potential. Titlow was previously listed impaired for AQR use in 2010 based on grossly violating seasonal averages for total phosphorus, chlorophyll-a and Secchi disk, newer data collected in 2014 confirming poor water quality for recreational use. Bathymetry work was completed in 2015; the shallow nature of the basin was confirmed with a mean depth of 2.6 feet. Shallow lake basins have higher potential for mixing frequently throughout the summer months during wind driven events, resuspending nutrients locked in lake bottom sediments back up in the water column increasing the likelihood for nuisance algae blooms. Flow through tributaries are likely playing a role in external loading to the basin. Chloride data was collected in the summer of 2014 and did not appear to be a likely stressor to aquatic communities.

Streams

The headwaters reach of North Branch Rush River (-555) had the most complete water chemistry datasets available in the subwatershed. Three total suspended solids (TSS) data points from 2008 violate standard, a more robust dataset is needed to confidently assess. Nutrient data was grossly elevated across the subwatershed but response data was not available to make a complete river nutrient assessment. Bacteria concentrations were persistently elevated throughout this entire subwatershed, resulting in three new listings and an existing impairment confirmed by newer data on a limited resource value reach. The limited resource value reach (-558) when compared against appropriate criteria still had five borderline pH violations, considering the weak nature of exceedance this did not trigger a new impairment. Only one DO violation occurred, but taking a closer look at the DO dataset revealed significant swings in concentrations are likely a stressor to aquatic life. Other headwaters reaches (-791, -713, -714, -555, -556) to the North Branch Rush River and Titlow Lake exhibited a similar DO flux situation.

The North Branch Rush River and its tributary ditches were all assessed using modified tiered aquatic life use standards due to alterations to their natural drainage in conjunction with limited biological potential of their instream habitat. New aquatic life use impairments are proposed for macroinvertebrates for every station sampled throughout the subwatershed. Macroinvertebrate samples showed low diversity and dominance of tolerant taxa throughout reaches sampled. Similarly, the health of the fish community was very low throughout the subwatershed, with four of five assessable reaches scoring below the lower confidence limits of the modified use threshold. A single standout, site 14MN083, met the modified use standard. Despite scoring above the standard, site 14MN083 showed a similar fish assemblage to other sites. Fish samples throughout the watershed were disproportionately represented by tolerant forms, including: bigmouth shiner, fathead minnow, common carp, johnny darter and creek chub. A high proportion of agricultural landuse, and heavily modified stream channels, has resulted in low stream habitat scores throughout the watershed. Common problems observed at all stations that are often associated with unhealthy biological communities include a lack of riparian buffer and very little in-stream shading, high sedimentation leading to high embeddedness and a lack of instream habitat, poor sinuosity from stream channelization, channel instability and high bank erosion leading to poor habitat. High phosphorus levels and above average TSS levels were common across the subwatershed, with particularly high phosphorus levels along with elevated DO readings found in the upper reach of the North Branch Rush River main channel (-555). A preponderance of macroinvertebrate taxa tolerant to high nutrients and TSS throughout the subwatershed corroborates the associated high nutrient and TSS readings.

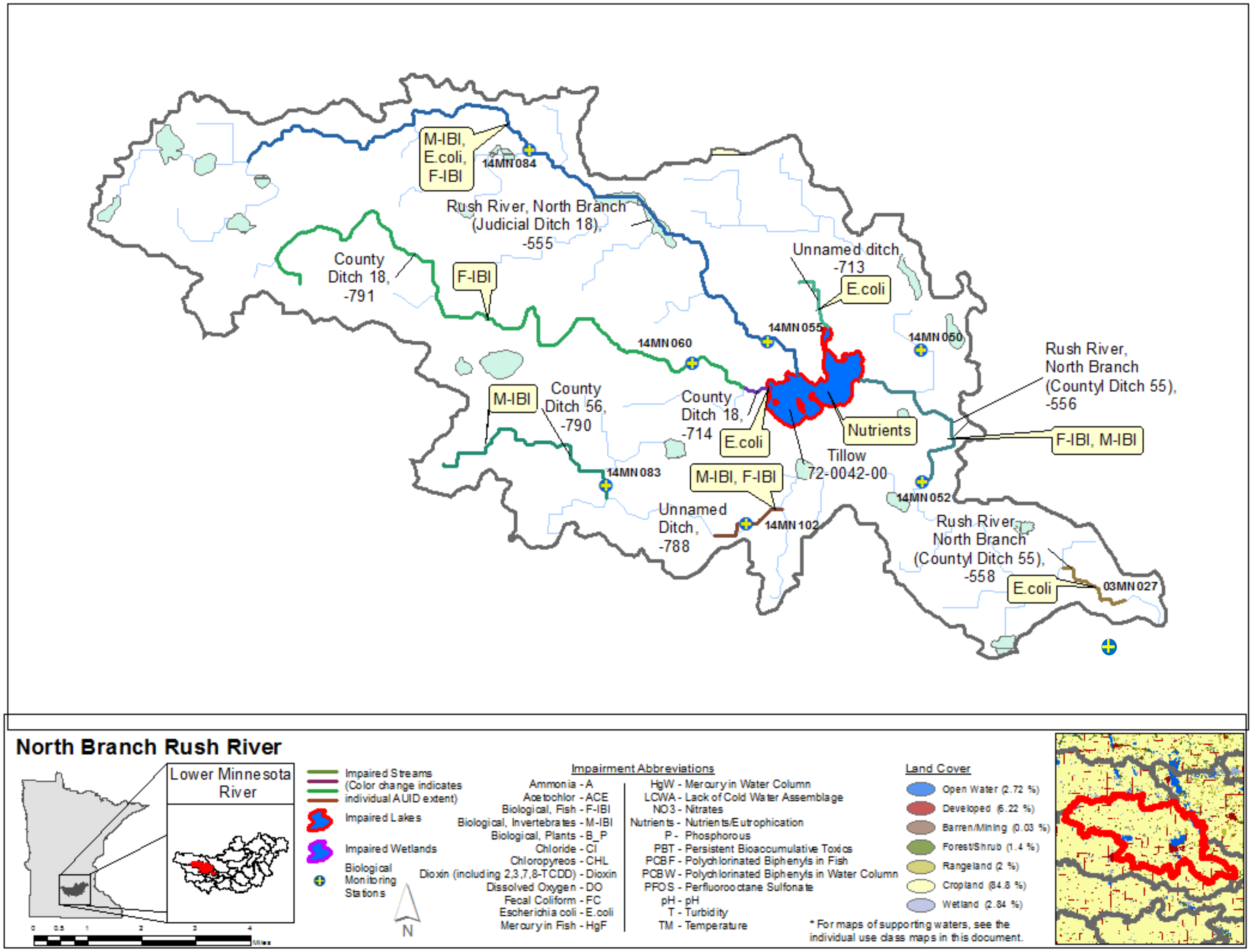


Figure 21. Currently listed impaired waters by parameter and land use characteristics in the North Branch, Rush River Aggregated 12-HUC.

Rush River Aggregated 12-HUC HUC 0702001204-01

The Rush River Subwatershed is the culmination of its three branches (North, Middle and South), lying in southeastern Sibley County, the watershed spans 32 mi.[2]. The North and Middle Branches converge to form the mainstem of the Rush River, five miles south of Arlington. Moving East the Rush River gains the flow of County Ditch 50. Five miles upstream of where the Rush River meets the Minnesota River, the Rush is joined by its South Fork. In this subwatershed, the Rush River regains its natural sinuosity as the river cuts deep into the bluffs of the Minnesota River valley, gaining gradient and flow as it descends to the Minnesota River. This dramatic change in topography has allowed the Rush River to maintain its natural character, decreasing the lands utility for row crop agriculture. While 67% of the subwatershed is managed for row crop agriculture, primarily focused in the subwatersheds north and western uplands, nearly 20% remains forested. Rangeland encompasses 7.7% of the watershed followed by developed acres at 4.2%. There are no lakes within the subwatershed.

Table 13. Aquatic life and recreation assessments on stream reaches: Rush River Aggregated 12-HUC. Reaches are organized upstream to downstream in the table.

AUID *Reach Name*, *Reach Description*	Biological Station ID	Reach Length (miles)	Use Class	Aquatic Life Indicators: Fish IBI	Invert IBI	Dissolved Oxygen	TSS	Secchi Tube	Chloride	pH	Ammonia -NH_3	Pesticides ***	Eutrophication	**Aquatic Life**	**Aquatic Rec. (Bacteria)**
07020012-548 ***Rush River,*** *M Br Rush R to S Br Rush R*	14MN082, 14MN061	11.54	2Bg, 3C	EX	EX	IF	IF	IF	--	IF	IF	--	IF	IMP	--
07020012-796 ***County Ditch 50,*** *Co Rd 62 to Rush R*	14MN062	1.62	2Bg, 3C	EX	EX	IF	IF	IF	--	IF	IF	--	IF	IMP	--
07020012-521 ***Rush River,*** *S Br Rush R to Minnesota R*	90MN110	8.22	2Bg, 3C	EX	MTS	IF	EX	EX	MTS	IF	MTS	--	IF	IMP	IMP

Abbreviations for Indicator Evaluations: **MTS** = Meets Standard; **EX** = Fails Standard; **IF** = Insufficient Information
Abbreviations for Use Support Determinations: **--** = No Data, **NA** = Not Assessed, **IF** = Insufficient Information, **SUP** = Full Support (Meets Criteria); **IMP** = Impaired (Fails Standards)
Key for Cell Shading: = existing impairment, listed prior to 2014 reporting cycle; = new impairment; = full support of designated use; = insufficient information.
Abbreviations for Use Class: **WWg** = Warmwater general, **WWm** = Warmwater modified, **WWe** = Warmwater exceptional, **CWg** = Coldwater general, **CWe** = Coldwater exceptional, **LRVW** = limited resource value water
*Assessments were completed using proposed use classifications changes that have not yet been written into rule.

Summary

Rush River (-521, -548)

Water quality on the downstream reaches of the Rush River are indicative of altered hydrology and human disturbance in the contributing headwater areas. Both downstream reaches (- 521, -548) were previously assessed and listed impaired in 2010 for aquatic life use based on turbidity data, newer data from multiple stations across the entire assessment period is available on the downstream reach (-521) still indicating gross violation of total suspended solids and Secchi tube criteria; bank and bed instability was visible throughout the river corridor. A previous listing in 2002 for aquatic recreation use, based on fecal coliform data for the downstream reach (-521), was clearly confirmed by newer bacteria data collected across nearly all of the 10-year assessment window. The listing will remain, as a persistent problem still exists; while a TMDL effort is already underway, continued monitoring will be useful to track temporal change. Dissolved oxygen (DO) datasets were the most complete on the downstream Rush River reach, although only one violation occurred of the 5 mg/L criteria, a wide range in values observed indicates DO flux could be a potential stressor to explore. Nutrient data revealed phosphorus concentrations well above river nutrient criteria, chlorophyll-a data was not confirming the response potential to excessive nutrients, a river nutrient impairment was not triggered at that time, and other variables (DO flux, periphyton, BOD) could be a better measure response. Chloride data collected in 2014 and 2015 on the downstream reach (-521) indicated it is likely not a stressor to aquatic life, but concentrations are elevated (up to 90 mg/L).

A new aquatic life impairment is proposed for fish on both reaches of the mainstem of the Rush River based IWM assessment data which corroborates historic datasets, with consistent results across all years, beginning in 1990, through 2014. Macroinvertebrate results meet requirements at the lower stations (-521) but fall below general use thresholds at the upper stations (-548). Fish community results at site 90MN110 show high diversity throughout time despite low IBI scores. A high proportion of tolerant taxa was found at all stations; dominance by tolerant species can pull an IBI score down, despite high taxa counts. Taxa dominant throughout the reach include fathead minnow, bigmouth shiner, emerald shiner, sand shiner, and spotfin shiner. Fair stream habitat scores were encountered throughout the reach, suggesting specific habitat parameters, with negative scoring, not large enough to cause poor overall habitat scores, or poor water chemistry conditions, are contributing to impaired fish and macroinvertebrate communities. A consistent pattern of bank erosion, limited stream habitat, low stream shading and dominance of agriculture along with a history of high suspended sediment and nutrients are likely impacting the biological communities in the reach. Stressor investigation into excessive sedimentation of in-stream habitat would likely be useful. The potential for high phosphorus loading is also present. Macroinvertebrate indicators showing a high proportion of taxa tolerant of elevated nutrients and suspended sediment corroborate a history of agricultural impacts.

County Ditch 50 (-796)

Both fish and macroinvertebrate assemblages were not supporting of the general aquatic life use threshold in County Ditch 50. Both assemblages scored below the threshold, and lower confidence limits, indicating degraded biological communities with a potential for future attainment of the threshold. The fish community lacked dominance of tolerant taxa found elsewhere in the subwatershed, but had lower overall diversity. While MSHA habitat scores were fair, channel stability issues could be influencing biological, along with overall watershed stressors, such as upstream channelization and agricultural landuse. Nutrient data gathered during biological visits on the reach suggest that problems associated with high levels of nutrients (phosphorus and nitrogen) may also be likely biological stressors.

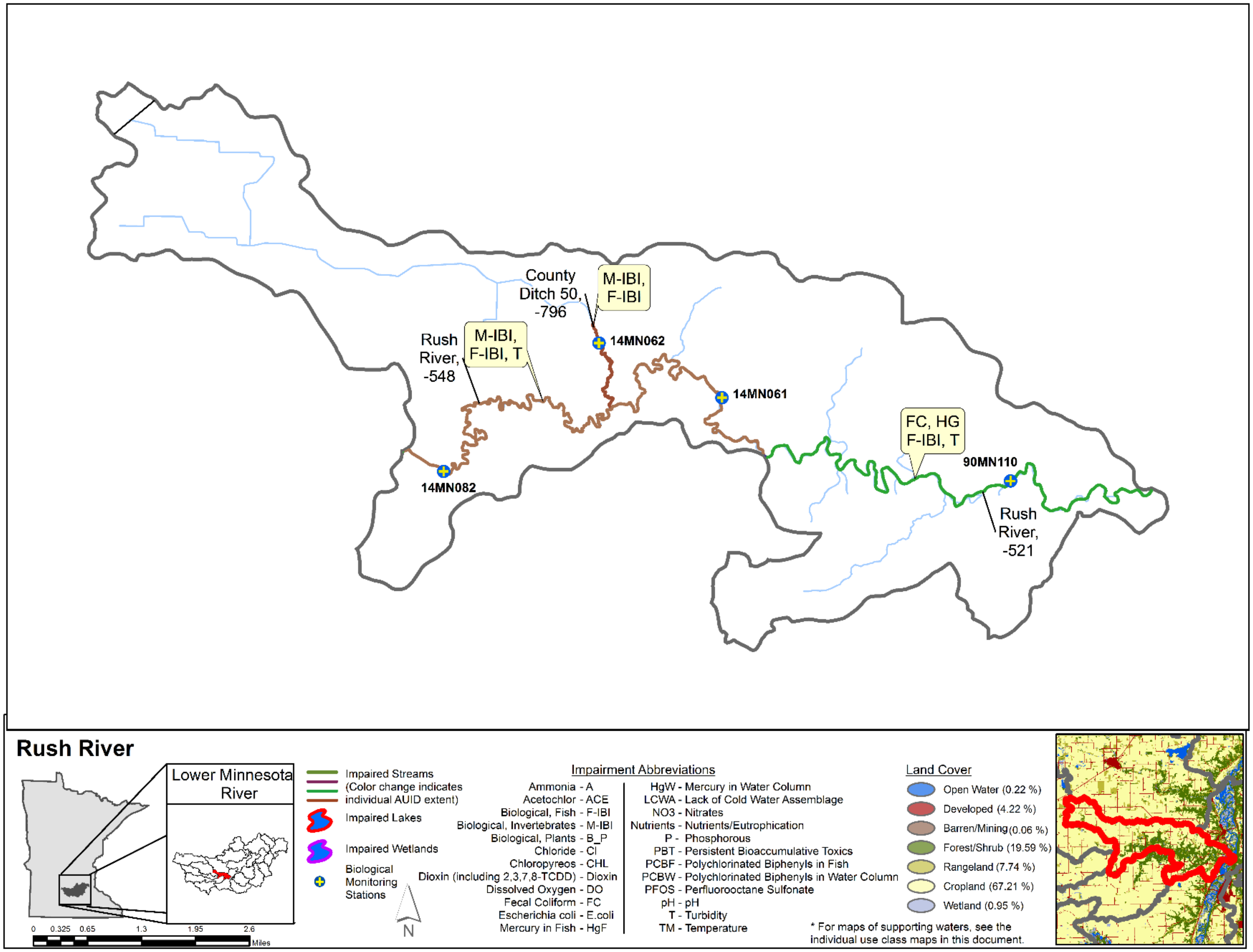


Figure 22. Currently listed impaired waters by parameter and land use characteristics in the Rush River Aggregated 12-HUC.

High Island Creek 10-HUC HUC 0702001206

High Island Creek 10-HUC is the culmination of the Upper and Lower High Island Creek aggregated 12-HUC subwatersheds encompassing 241 mi.2 of the Lower Minnesota 8-HUC. High Island Creek begins as Judicial Ditch 11 in the western reaches of the subwatershed, six miles south of Hector in Renville County. Flowing east, JD 11 enters the northwestern edge of Sibley County. Just after entering McLeod County, JD 11 gains the flow of Judicial Ditch 15, at which the flowage is, renamed High Island Creek. High Island Creek continues east, gaining the flow of CD 39 and flowing through Baker Lake. An earthen rock dam near the outlet of the lake could limit fish passage during low flows. High Island reenters Sibley County one mile southwest of New Auburn near High Island Lake, during high flow events High Island Lake discharges to the creek. High Island Creek continues in a southeasterly direction towards Arlington. East of Arlington channelized High Island Creek transitions back to its natural meanders quickly gaining gradient as it flows east. About five miles downstream from Arlington a dam limited fish migration on High Island Creek until flooding events in June 2014 naturally removed the impoundment, restoring connectivity to the creek. High Island continues it is decent through the Minnesota River bluffs, ultimately discharging to the Minnesota one mile northwest of Jessenland. Along its course, High Island Creek gains the flow of many small unnamed flowages and agricultural drainage ditches. Agriculture dominates landuse in the subwatershed, 81% is managed for row crop agriculture while 4.5% is used for pasturing livestock. Development in the subwatershed is low at 4.8% and is concentrated in Arlington and New Auburn. Natural landuse in the subwatershed is limited, 4% is forested, and 3% lies in wetlands and 2% in open water. Forested acres are concentrated in the lowest reaches of High Island Creek where dramatic relief limits the lands utility for agriculture. High Island Lake is the watershed’s largest lake at 1,328 acres and is an important recreational resource for the region.

Table 14. Aquatic life and recreation assessments on stream reaches: High Island Creek 10-HUC. Reaches are organized upstream to downstream in the table.

Aggregated HUC 12	AUID *Reach Name,* *Reach Description*	Biological Station ID	Reach Length (miles)	Use Class	Aquatic Life Indicators: Fish IBI	Invert IBI	Dissolved Oxygen	TSS	Secchi Tube	Chloride	pH	Ammonia -NH_3	Pesticides ***	Eutrophication	Aquatic Life	Aquatic Rec. (Bacteria)
Upper High Island Creek	**07020012-590** ***Judicial Ditch 11,*** *CD 103 to CD 10*	14MN072	13.82	2Bm, 3C	EX	--	IF	IF	IF	--	MIF	IF	--	IF	IMP	--
Upper High Island Creek	**07020012-593** ***Judicial Ditch 11,*** *CD 10 to JD 24*	14MN071	3.86	2Bm, 3C	EX	EX	IF	IF	IF	--	IF	IF	--	IF	IMP	--
Upper High Island Creek	***07020012-682,*** ***Judicial Ditch 15,*** CD 31 to High Island Creek	14MN070	3.07	2Bm	EX	EX	--	--	--	--	--	--	--	IF	IMP	--
Upper High Island Creek	**07020012-591** ***Judicial Ditch 24,*** *Headwaters to JD 11*	14MN069	6.68	2Bm, 3C	MTS	--	IF	IF	IF	--	IF	IF	--	IF	SUP	--
Upper High Island Creek	**07020012-653** ***High Island Creek,*** *JD 15 to Bakers Lk*	07MN083, 14MN067	7.10	2Bm, 3C	EX	EX	IF	EX**	MTS	--	IF	IF	--	IF	IMP	IMP**
Upper High Island Creek	**07020012-594** ***Unnamed creek (County Ditch 30),*** *Headwaters to Bakers Lk*		1.35	2Bg, 3C	--	--	IF	--	MTS	--	IF	--	--	--	IF	--
Upper High Island Creek	**07020012-683** ***County Ditch 39,*** *Unnamed ditch to High Island Cr*	14MN068	2.87	2Bm, 3C	MTS	EX	IF	IF	IF	--	IF	IF	--	IF	NS	--
Upper High Island Creek	**07020012-837** ***High Island Creek,*** *Bakers Lk to -94.2538 44.6574*		5.60	2Bg, 3C	--	--	IF	--	IF	--	IF	--	--	--	IF	IMP

Upper High Island Creek	**07020012-838** ***High Island Creek,*** *-94.2538 44.6574 to Unnamed cr*	14MN122	4.54	2Bg, 3C	EX	EX	IF	IF	MTS	MTS	MTS	MTS	--	IF	IMP	IMP
Lower High Island Creek	**07020012-834** **High Island Creek,** -94.0936 44.6181 to Minnesota R	97MN007, 14MN049, 15MN301, 15MN302, 14MN116	22.48	2Bg, 3C	EX	EX	IF	EX	EX	MTS	MTS	MTS		IF	IMP	IMP
Lower High Island Creek	**07020012-794** **Judicial Ditch 12,** Headwaters to High Island Creek	14MN048	4.31	2Bm, 3C	EX	--	IF	IF	IF	--	IF	IF		IF	IMP	--
Lower High Island Creek	**07020012-588** **High Island Ditch 2,** Unnamed cr to High Island Cr	14MN045	1.85	2Bm, 3C	MTS	--	IF	EX**	IF	--	IF	IF		IF	IMP	IMP**
Lower High Island Creek	**07020012-831** **Buffalo Creek (County Ditch 59),** HIgh Island Ditch 5 to 276th St /CR 65	14MN109	4.50	2Bm, 3C	MTS	MTS	IF	IF	IF	--	IF	IF		IF	SUP	--
Lower High Island Creek	**07020012-832** **Buffalo Creek,** 276th St /Co Rd 65 to High Island Cr	90MN111	6.21	2Bg, 3C	EX	EX	IF	EX	EX	--	IF	IF		IF	IMP	IMP

Abbreviations for Indicator Evaluations: **MTS** = Meets Standard; **EX** = Fails Standard; **IF** = Insufficient Information
Abbreviations for Use Support Determinations: **--** = No Data, **NA** = Not Assessed, **IF** = Insufficient Information, **SUP** = Full Support (Meets Criteria); **IMP** = Impaired (Fails Standards)
Key for Cell Shading: = existing impairment, listed prior to 2014 reporting cycle; = new impairment; = full support of designated use; = insufficient information.
Abbreviations for Use Class: **WWg** = Warmwater general, **WWm** = Warmwater modified, **WWe** = Warmwater exceptional, **CWg** = Coldwater general, **CWe** = Coldwater exceptional, **LRVW** = limited resource value water
*Assessments were completed using proposed use classifications changes that have not yet been written into rule.
**Existing impairment, insufficient new information was available to confirm or contest the existing listing.

Table 15. Lake assessments: High Island Creek 10-HUC.

Aggregated 12 HUC	WD/WMO	Lake Name	DNR ID	Area (acres)	Max Depth (ft)	Assessment Method	Ecoregion	Secchi Trend	Aquatic Life Indicators:			Aquatic Recreation Indicators:			Aquatic Life Use	Aquatic Recreation Use
									Fish IBI	Chloride	Pesticides ***	Total Phosphorus	Chlorophyll-a	Secchi		
Upper High Island	**High Island**	Round Grove	43-0116-00	280	7	Shallow Lake	WCBP	Insufficient Data	--	MTS	--	MTS	MTS	MTS	IF	FS
Lower High Island	**High Island**	Silver	72-0013-00	632	9	Shallow Lake	WCBP	Insufficient Data	--	MTS	--	EX	EX	MTS	IF	NS
Lower High Island	**High Island**	High Island	72-0050-01	1328	9	Shallow Lake	WCBP	No Evidence of Trend	--	MTS	--	EX	EX	EX	IF	NS

Abbreviations for Ecoregion: DA = Driftless Area, NCHF = North Central Hardwood Forest, NGP = Northern Glaciated Plains, NLF = Northern Lakes and Forests, NMW = Northern Minnesota Wetlands, RRV = Red River Valley, WCBP = Western Corn Belt Plains

Abbreviations for Secchi Trend: D = decreasing/declining trend, I = increasing/improving trend, NT = no detectable trend, -- = not enough data

Abbreviations for Indicator Evaluations: -- = No Data, **MTS** = Meets Standard; **EX** = Exceeds Standard; **IF** = Insufficient Information

Abbreviations for Use Support Determinations: **--** = No Data, **NA** = Not Assessed, **IF** = Insufficient Information, **FS** = Full Support (Meets Criteria); **NS** = Not Support (Impaired, exceeds standard)

Key for Cell Shading: ☐ = existing impairment, listed prior to 2014 reporting cycle; ☐ = new impairment; ☐ = full support of designated use; ☐= insufficient information.

Summary

Lakes

Three shallow lake basins in this subwatershed had assessment level data available. The ecoregion standard for aquatic recreation use (AQR) protects lake users from nuisance algal bloom conditions fueled by elevated phosphorus concentrations that degrade recreational use potential. High Island Lake near New Auburn is a flow through basin on High Island Creek, with assessment data available from 2008, 2014 and 2015. Seasonal averages calculated for nutrient and response datasets all greatly exceeded criteria, with very few individual samples in the summer index period that even come close to criteria, indicating poor recreational water quality was persistently occurring throughout the open water months. The large fetch and shallow nature of the basin is conducive to numerous wind driven mixing events throughout the open water months, resuspending nutrients locked in lake bottom sediments back into surface waters fueling nuisance algal blooms. The contributing watershed is heavily invested in agricultural production, immediate riparian zones are especially sensitive areas, both internal loading and surface water inputs are driving poor recreational water quality. Silver Lake has data for assessment parameters from 2014 and 2015, with grossly violating nutrient and chlorophyll-a dataset that were indicative of poor recreational water quality. The Secchi dataset did not indicate a similar pattern, during some sampling visits algae community was dominated by Aphanizomenon, a needle like consolidate algae growth that typically does not negatively impacted water clarity as many other algae communities would, which could explain the clarity seen on the lake. Round Grove Lake just south of Stewart had data available from 2014 and 2015 with short periods of elevated nutrient concentrations but overall generally meeting ecoregion standards. Response data chlorophyll-a and Secchi clarity was reflective of relatively good recreational water quality, indicating the basin as meeting AQR use standard. Dense, diverse vegetation growth noted at all sampling visits was likely playing a large role in nutrient uptake from the surface waters, decreasing the availability for nuisance algae blooms and indirectly increasing water clarity overall. In an already highly altered watershed, Round Grove could be considered vulnerable to increased human disturbance given the proximity to impairment criteria and would be a priority for protection efforts. Chloride data was available on all three lakes basin mentioned above and did not appear to be a stressor to aquatic communities at this time.

Streams

Reaches of High Island Creek had existing water chemistry impairments for both AQR and aquatic life (AQL) use listed during past assessment periods, many of these existing impairments were on reaches that were split during this assessment process. The most upstream reach of High Island Creek (-653) had previous turbidity and fecal coliform impairments, recent data is insufficient to make a new assessment, as such the existing listing will persist. The next downstream reach (-837, -838) had evidence of continued impairment for recreation based on the elevated bacteria concentrations present. The furthest downstream child reach of High Island Creek (-834) had signals of poor water quality from multiple different parameters. Small problems beginning upstream in this subwatershed were exponentially worse prior the confluence with the Minnesota River. Any existing turbidity impairment was confirmed by clear signals from both TSS and STUBE datasets of poor water quality for AQL use. A similar situation was clear with AQR use on this downstream reach, new data confirmed the existing recreation impairment due to elevated bacteria levels. Buffalo Creek (-832) had previous aquatic recreation and life use impairments based on fecal coliform and turbidity data. Newer data for both parameters revealed similar patterns of elevated bacteria and sediment concentrations. Elevated phosphorus concentrations were common throughout this subwatershed, response data was either unavailable or not indicating the expected response, no river eutrophication impairments resulted.

Upper High Island Creek

As with many watersheds in the Minnesota River Basin, the majority of streams in Upper High Island Creek have been channelized for agricultural drainage. This channel modification, along with stream habitat scores not supportive of high biological potential, have resulted in most stream reaches being proposed to be designated as modified use. The only reach in the Upper High Island Creek Watershed designated as general aquatic life use, is the reach immediately upstream of High Island Lake (-838). Despite this stream being given a higher aquatic life use potential, it failed to meet aquatic life standards for both fish and macroinvertebrate communities. Streams meeting modified use thresholds are supportive of their designated biological standard, but still do not meet the biological expectations of a healthy, natural stream. Of the six reaches designated as modified use within the subwatershed, two were able to meet modified use standard for the fish community (-683, -591), while four fell below the modified use standard. All sites within the watershed, even those meeting standards, showed a trend of dominance by tolerant fish taxa, with commonly abundant taxa including bigmouth shiner, white sucker and fathead minnow. All four reaches that were sampled for macroinvertebrates failed to meet modified use standards. Common macroinvertebrate community characteristics among these reaches included, low overall taxa richness, dominance of tolerant individuals, a lack of sensitive macroinvertebrate taxa and a lack of macroinvertebrate that require stable flows and coarse substrates. An additional source of stress impacting the fish community comes from legacy impacts of an impoundment further down in the adjacent HUC-12 subwatershed, Lower High Island Creek.

Agricultural subwatersheds with a preponderance of highly modified channels tend to show a similar trend in biological stressors. Common potential stressors found throughout the subwatershed include; sparse in-stream habitat (-591 was not sampled for macroinvertebrates due to a lack of habitat), bank erosion, a narrow riparian zone and resultant lack of stream shading, channel instability, embeddedness of coarse substrates, and a ubiquitous channel form due to stream channelization. In addition to common physical stressors, common water quality problems tend to also be found in highly modified, agricultural watersheds. Water quality issues found in this watershed include high suspended sediment lows, high levels of nutrients, and the potential for high DO flux. One reach in the subwatershed (-653) had a previous impairment for turbidity that was corroborated with updated TSS information.

Lower High Island Creek

Similar to Upper High Island Creek, three of five assessed stream reaches in the Lower High Island Creek Subwatershed have been channelized for agricultural drainage and are being proposed to be designated as modified use. Of the three modified reaches sampled, only one was sampled for macroinvertebrates due to water levels dropping to a level that prevented a sample from being collected, which suggests potential problems with hydrologic stability in the watershed. Two of the three modified reaches were supporting of the modified use threshold, with one new listing at the most upstream reach in the watershed (-794). All of the modified reaches, including impaired and non-impaired reaches, show similar signs of stress, including limited in-stream habitat, poor stream shading, problems with stream stability and excess sedimentation. Tolerant forms were dominant at all modified reaches, including bigmouth shiner, common carp, fathead minnow and white sucker. Despite two of the modified reaches meeting their respective aquatic life use goals, it should be understood that these reaches still do not meet the biological expectations of a healthy, natural stream.

The two reaches in the Lower High Island Creek Watershed designated as general aquatic life use, are the reaches at mouth of Buffalo Creek and the mouth of High Island Creek. Despite these reaches being given a higher aquatic life use potential, both failed to meet aquatic life standards for both fish and macroinvertebrate communities. The single station sampled on Buffalo Creek failed to meet aquatic life thresholds for both assemblages, while two of the five reaches sampled on the main channel of the Rush River were above the general use threshold for one or both assemblages. The Buffalo Creek station was sampled eight times over the course of 15 years, and the fish community was overwhelmingly dominated by tolerant taxa across all sample years, including brassy minnow, blacknose dace, creek chub and central stoneroller.

Both of the stations that passed thresholds (15MN302, 14MN116) were located below the historic dam on the Rush River. The dam has been shown to block at least 27 fish species from upstream habitats in the High Island Creek drainage. The dam was compromised during June 2014, and the MPCA, along with the DNR, is studying the rate of fish migration on High Island Creek to upstream habitats, including reaches in the Upper High Island Creek Subwatershed. In addition to having better fish and macroinvertebrate assemblages, the stations sampled below the dam also had better stream habitat scores, although habitat scores ranged higher (good to fair) for all stations sampled in the reaches with naturally meandering channels. Despite higher average habitat scores, there were still prevalent problems related to bank erosion, in-stream sedimentation and overall channel stability.

Suspended sediment and elevated nutrients (nitrogen, phosphorus) has also been shown to be a prevalent problem throughout the entire High Island Creek Watershed, with the reach located at the mouth of the having an impairment for TSS. A prevalence of macroinvertebrates tolerant of high levels of bedded and suspended sediment, validate these measured values. In order to begin addressing biological health in Lower High Island Creek, it will be necessary to address sediment contributions in the upstream watershed, by both improving bank stabilization, and potentially moving towards stabilizing hydrologic patterns by better managing water storage.

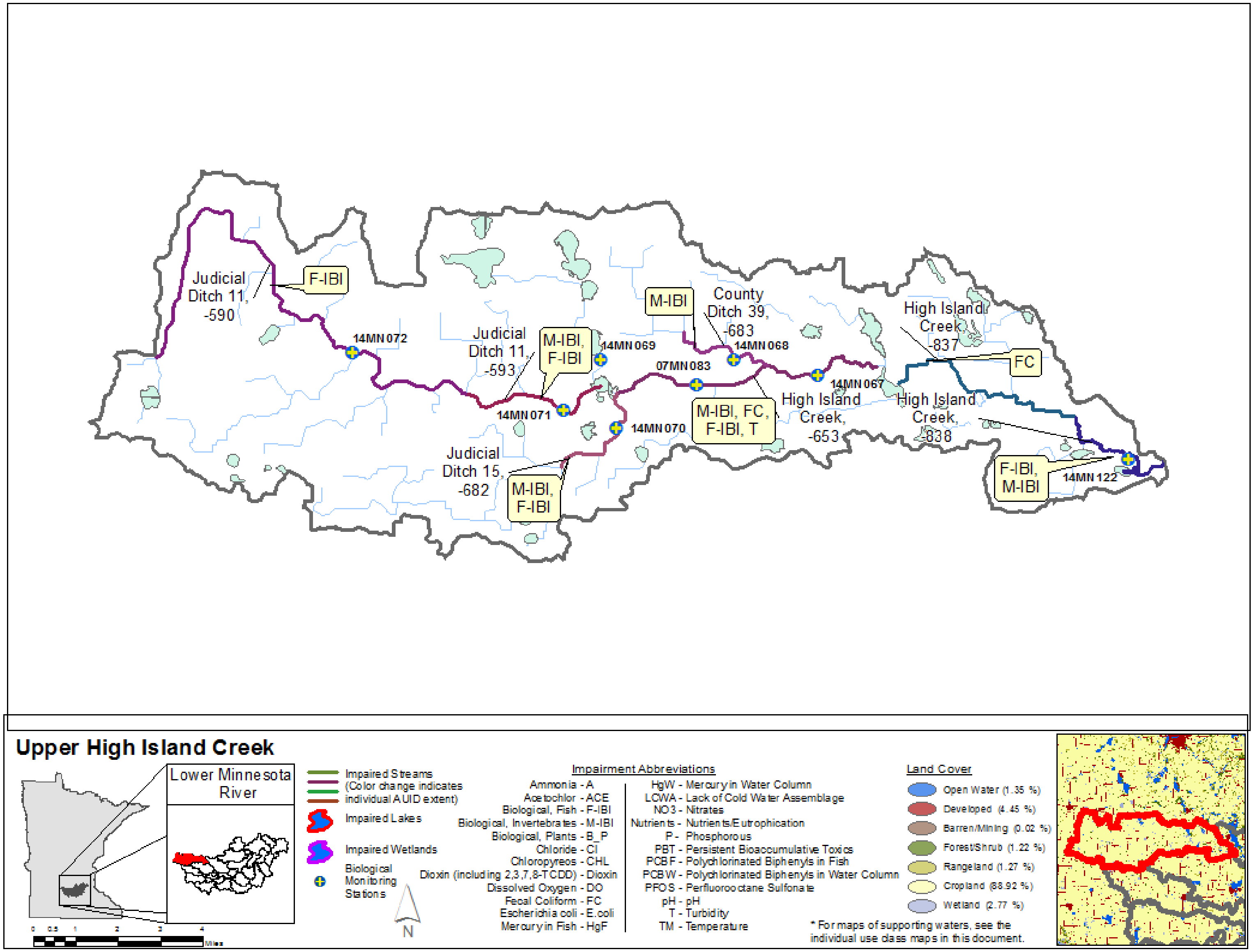


Figure 23. Currently listed impaired waters by parameter and land use characteristics in theUpper High Island Creek Aggregated 12-HUC.

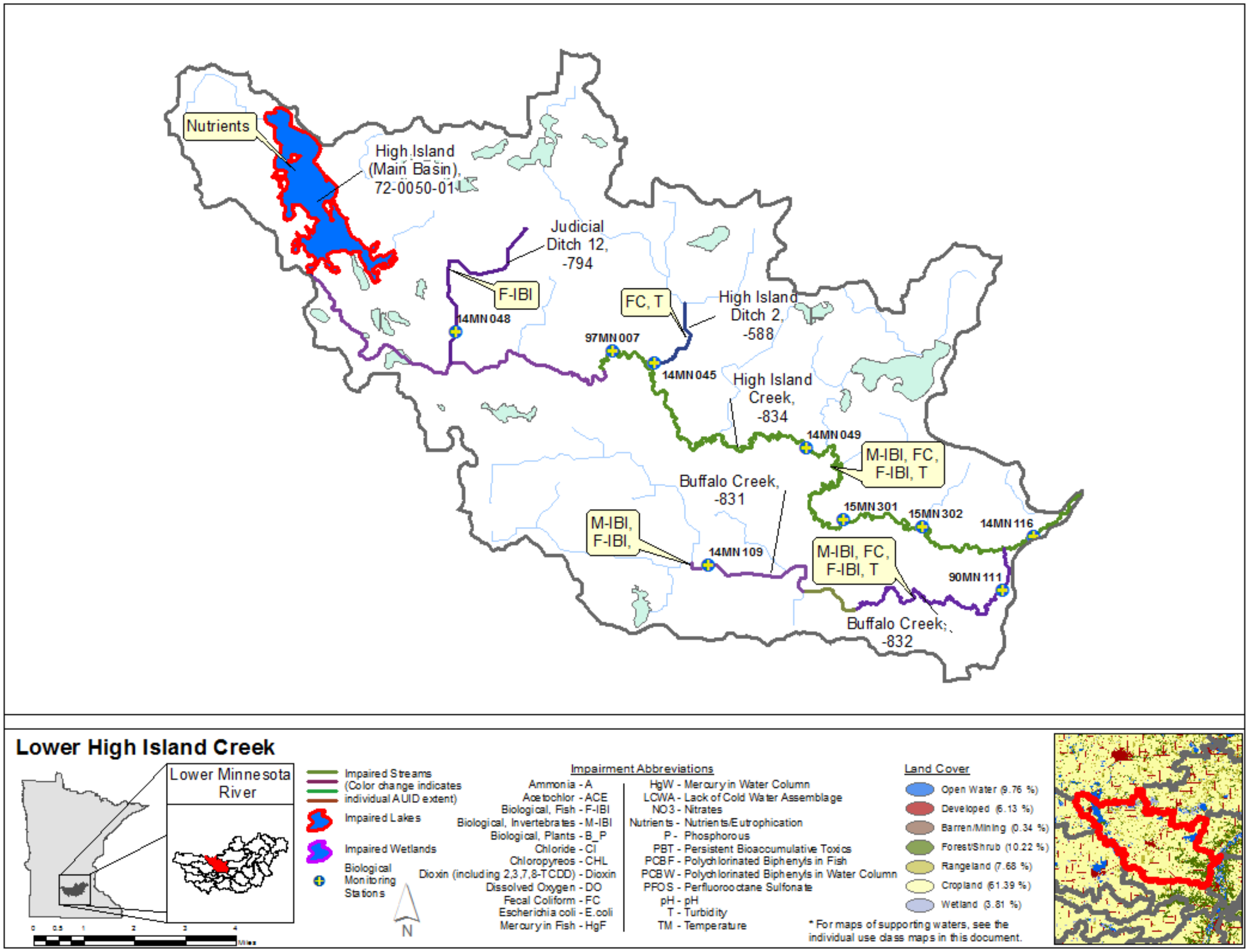


Figure 24. Currently listed impaired waters by parameter and land use characteristics in the Lower High Island Creek Aggregated 12-HUC.

Bevens Creek Aggregated 12-HUC

HUC 0702001207-01

The Bevens Creek Subwatershed spans 133.5 mi.^{2} of northeastern Sibley County and southern Carver County. The subwatershed is predominately rural in nature, a majority of the subwatershed's land is employed in agricultural landuse, and 65% is managed for cropland while 12.7 % is utilized as pasture for livestock. Bevens Creek begins near the rural community of Green Isle, starting as a channelized agricultural drainage, flowing through Mud Lakes and Washington Lake before veering northeast. Along its course it gains the flow of several unnamed agricultural drainages and the outflow of the community of Norwood Young America. Half way through its course Bevens Creek transitions to its natural meanders and gains gradient as it moved towards the Minnesota River bluffs. Approximately three miles upstream of its confluence with the Minnesota River, it is joined by its principle tributary, Silver Creek, one mile west of East Union. About 8% of the subwatershed remains forested; these acres are observed primarily long the Bevens and Silver Creek riverine corridors in the eastern most reaches of the watershed, where rugged topography limits the lands utility for agricultural land uses. Few wetland acres remain in the watershed, with only 2.8% of the overall landuse retained for that purpose. A majority of the wetland acres in the subwatershed are located in Bevens headwaters.

Table 16. Aquatic life and recreation assessments on stream reaches: Bevens Creek Aggregated 12-HUC. Reaches are organized upstream to downstream in the table.

AUID ***Reach Name,*** *Reach Description*	Biological Station ID	Reach Length (miles)	Use Class	Aquatic Life Indicators: Fish IBI	Invert IBI	Dissolved Oxygen	TSS	Secchi Tube	Chloride	pH	Ammonia -NH_3	Pesticides ***	Eutrophication	**Aquatic Life**	**Aquatic Rec. (Bacteria)**	**LRVW Standard (Bacteria)**
07020012-843 ***Bevens Creek,*** *Headwaters (Washington Lk 72-0017-00) to 154th St*	14MN042	4.12	2Bm, 3C	MTS	EX	IF	MTS	MTS	--	MTS	MTS	--	EX	IMP	IMP	--
07020012-844 ***Bevens Creek,*** *154th St to -93.8615 44.7265*		2.89	2Bg, 3C	--	--	--	MTS	MTS	--	--	--	--	IF	IF	IMP	--
07020012-533 ***Unnamed ditch,*** *T115 R26W S14, north line to CD 4A*	14MN114	2.54	LRVW	NA	NA	IF	--	--	--	IF	IF	--	--	NA	--	IMP

07020012-845 ***Bevens Creek,*** *-93.8615 44.7265 to -93.8455 44.7327*	14MN038	1.01	2Bm, 3C	EX	MTS	IF	IF	IF	--	IF	IF	--	IF	IMP	--	--
07020012-846 ***Bevens Creek,*** *-93.8455 44.7327 to Unnamed cr*		1.35	2Bg, 3C	--	--	--	EX	--	--	--	--	--	--	IMP	--	--
07020012-847 ***Bevens Creek,*** *Unnamed cr to -93.7156 44.7438*		9.48	2Bg, 3C	--	--	--	EX	IF	--	--	--	--	IF	IMP	IMP	--
07020012-848 ***Bevens Creek,*** *-93.7156 44.7438 to Silver Cr*	15EM014	4.94	2Bg, 3C	EX	EX	IF	EX	IF	IF	MTS	MTS	--	EX	IMP	IMP	--
07020012-629 ***Judicial Ditch 22,*** *Unnamed cr to Silver Cr*	14MN094	1.72	2Bm, 3C	NA	NA	IF	IF	MTS	--	IF	IF	--	IF	NA	IMP	--
07020012-813 ***Silver Creek,*** *-93.769 44.687 to Bevens Cr*	14MN095, 14MN203	8.61	2Bg, 3C	EX	EX	IF	EX	EX	MTS	MTS	MTS	EX	IF	IMP	IMP	--
07020012-514 ***Bevens Creek,*** *Silver Cr to Minnesota R*	90MN114	3.62	2Bg, 3C	EX	EX	IF	EX	MTS	MTS	MTS	MTS	IF	IF	IMP	IMP	--

Abbreviations for Indicator Evaluations: **MTS** = Meets Standard; **EX**= Fails Standard; **IF** = Insufficient Information

Abbreviations for Use Support Determinations: **--** = No Data, **NA** = Not Assessed, **IF** = Insufficient Information, **SUP** = Full Support (Meets Criteria); **IMP** = Impaired (Fails Standards)

Key for Cell Shading: = existing impairment, listed prior to 2014 reporting cycle; = new impairment; = full support of designated use; = insufficient information.

Abbreviations for Use Class: **WWg** = Warmwater general, **WWm** = Warmwater modified, **WWe** = Warmwater exceptional, **CWg** = Coldwater general, **CWe** = Coldwater exceptional, **LRVW** = limited resource value water

*Assessments were completed using proposed use classifications changes that have not yet been written into rule.

Table 17. Lake assessments: Bevens Creek Aggregated 12-HUC.

WD/WMO	Lake Name	DNR ID	Area (acres)	Max Depth (ft)	Assessment Method	Ecoregion	Secchi Trend	Aquatic Life Indicators: Fish IBI	Aquatic Life Indicators: Chloride	Aquatic Life Indicators: Pesticides ***	Aquatic Recreation Indicators: Total Phosphorus	Aquatic Recreation Indicators: Chlorophyll-a	Aquatic Recreation Indicators: Secchi	Aquatic Life Use	Aquatic Recreation Use
Carver	Maria	10-0058-00	118	6	Shallow Lake	NCHF	Insufficient Data	--	IF	--	EX	EX	EX	IF	NS
--	Washington	72-0017-00	464	4	Shallow Lake	WCBP	Insufficient Data	--	--	--	EX	IF	IF	--	IF

Abbreviations for Ecoregion: DA = Driftless Area, NCHF = North Central Hardwood Forest, NGP = Northern Glaciated Plains, NLF = Northern Lakes and Forests, NMW = Northern Minnesota Wetlands, RRV = Red River Valley, WCBP = Western Corn Belt Plains

Abbreviations for Secchi Trend: D = decreasing/declining trend, I = increasing/improving trend, NT = no detectable trend, -- = not enough data

Abbreviations for Indicator Evaluations: -- = No Data, **MTS** = Meets Standard; **EX** = Exceeds Standard; **IF** = Insufficient Information

Abbreviations for Use Support Determinations: **--** = No Data, **NA** = Not Assessed, **IF** = Insufficient Information, **FS** = Full Support (Meets Criteria); **NS** = Not Support (Impaired, exceeds standard)

Key for Cell Shading: = existing impairment, listed prior to 2014 reporting cycle; = new impairment; = full support of designated use; = insufficient information.

Summary

Lakes

Two lake basins in the Bevens Creek Subwatershed were reviewed for aquatic recreation use. The ecoregion standard for aquatic recreation use (AQR) protects lake users from nuisance algal bloom conditions fueled by elevated phosphorus concentrations that degrade recreational use potential. All basins in the subwatershed can be characterized as shallow lakes. Maria was previously listed impaired in 2004; newer data collected in 2012 and 2014 indicated high phosphorus concentrations, nuisance algal blooms and poor water clarity are still occurring on a regular basis. Shallow lake basins are often driven by numerous mixing events throughout the open water months, re-suspending nutrients locked into sediment into the water column increasing availability for suspended algae growth. Washington had nutrient data indicating impairment, response data was unreliable for assessment purposes and failed to meet minimum data requirements, collection of more response data would allow for a confident assessment in the future. Considering the land use and lake bathymetry throughout this subwatershed, the potential for poor water quality is high. Aquatic life use data was limited to five chloride samples on Maria, no elevated concentrations were observed, aquatic community data would be needed to make a complete assessment.

Silver Creek (-813)

A reach of Silver Creek was split during this assessment effort to accommodate Tiered Aquatic Life Uses (TALU) criteria, resulting in carry forward decisions on past listings of fecal coliform bacteria (AQR) and TSS (AQL). New biological impairments were identified for both assemblages on Silver Creek. Results for both fish and macroinvertebrates fell below the lower confidence limits of the general aquatic life use impairment threshold, suggesting a severely impaired biological community. Despite the presence of natural channel conditions, very low numbers of fish were collected at each visit, resulting in low-end scoring. Macroinvertebrate richness was somewhat elevated at site 14MN203, but not enough to overcome the effect of the lack of intolerant taxa and dominance of tolerant forms on the IBI score. The carry-over turbidity listing was corroborated with current TSS data; very high phosphorus values suggest a contribution to downstream loading, but response data is limited within the reach, preventing a nutrient listing. Fluctuating DO values indicate a possible biological stress from DO flux. Poor stream habitat scores, impacted primarily by stream instability measurements (bank erosion, embeddedness of coarse substrates, absence of instream habitat cover, ubiquitous stream channel (90% run), limited sinuosity) suggests that efforts to stabilize within-reach and upstream channel conditions could improve biological conditions. High agricultural landuse within the Silver Creek system is likely contributing to high phosphorus and TSS loading and possibly impacting downstream channel conditions.

Bevens Creek, Upper Reach (-845, -843), Mid Reach (-846), Lower Reach (-514, -848)

Total suspended solids (TSS) concentrations were a clear issue across Bevens Creek and the greater subwatershed; with a number of existing TSS listings, landuse and altered hydrology are likely playing a large role on Bevens Creek (-846, -848, -514). River nutrient data was available on multiple reaches of Bevens Creek, excessive phosphorus was consistently noted, response only observed on the reach prior to the confluence with Silver Creek, resulting in a river eutrophication impairment. High bacteria concentrations were identified during a 2002 assessment in the lower reaches of Bevens Creek (-514, -848) and persist during this assessment cycle.

An upper reach of Bevens Creek was split during this assessment effort to accommodate TALU criteria, resulting in carry forward decisions on past listings. The upper reaches of Bevens Creek (-845 and -843) were assessed using modified tiered aquatic life use standards due to alterations to their natural drainage in conjunction with limited biological potential of their instream habitat. These reaches showed different responses from each biological assemblage, with -843 showing a supporting fish community and non-supporting macroinvertebrate community, while -845 showed the opposite. Despite a passing score at each reach, both fish and macroinvertebrates communities were dominated by tolerant taxa. Poor stream habitat scores and the associated habitat-related stressors typical of modified agricultural watersheds are likely impacting fish and macroinvertebrates within the reach, as well as downstream reaches. Stressors of note in the reach include low shade, bank erosion, narrow riparian zone, embeddedness of coarse substrates and limited channel development. Water quality samples takes across several years had a few DO readings below standards, suggesting a potential for DO related stress.

Fish and macroinvertebrate communities were found to be non-supporting of the general aquatic life use standard at both reaches in the lower portions of Bevens Creek. Fish data results from the MRAP project (1990, 2010), as well as current IWM data suggest a consistently poor quality fish community, with no clear trend in condition. Fish diversity was relatively high for both reaches, but a dominance of tolerant forms is keeping the FIBI score low. A perched culvert above site 15EM014 is likely acting as a fish barrier during low flow conditions and the associated lack of fish migration could be limiting the fish community. Relatively high quality habitat at both reaches is not having the positive impact typically seen; suggesting upstream influences on water quality and hydrology are impacting biological communities. A low abundance of tolerant macroinvertebrate taxa, as well as taxa typical of streams with healthy coarse substrates and stable flow conditions, could not overcome the overall impact of upstream stressors on the MIBI score. A carryover turbidity impairment was corroborated with current TSS readings. Macroinvertebrate taxa tolerant of TSS were present, but not above average in abundance, suggesting the high quality habitat and stable flows are keeping the macroinvertebrate community relatively intact.

Water chemistry data was available on numerous small tributaries within this subwatershed. Total suspended solids (TSS) concentrations were a clear issue across the subwatershed where data was present. A number of limited resource waters within the subwatershed had data available, although biological data does not have expectations developed for this stream tier, water chemistry criteria does apply protecting for secondary contact and aesthetics, resulting in a listing for limited resource value water use (-533). Bacteria was a persistent problem throughout the subwatershed, resulting in eight aquatic recreation use impairments at this time. Of those eight, two are older fecal coliform impairments that will carry forward to child reaches.

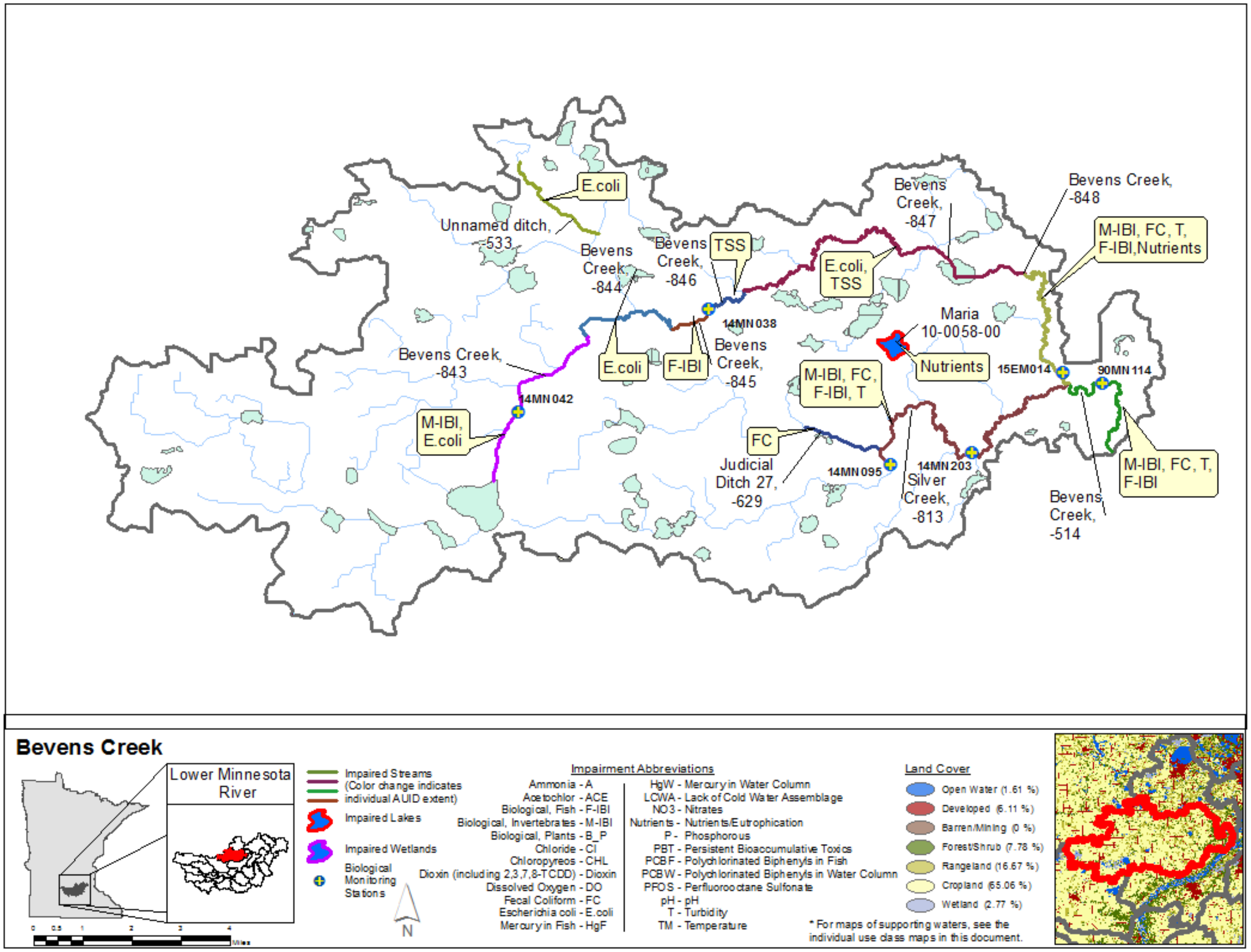


Figure 25. Currently listed impaired waters by parameter and land use characteristics in the Bevens Creek Aggregated 12-HUC.

Carver Creek Aggregated 12-HUC

HUC 0702001210-01

The Carver Creek Subwatershed spans nearly 83 mi.^{2} of Carver County. The subwateshed is water rich; more than 9% is covered by open water, including several lakes: Lake Waconia, Lake Patterson, and Hydes, Rice, Winkler and Miller Lakes and Carver Creek and its tributaries. Four percent of the subwatershed is wetland. Carver Creek is 31 miles in length, comprised of two primary headwaters branches, one flowing south from Lake Waconia and another flowing west to east starting a few miles northwest of Norwood Young America. Carver Creek's branches converge approximately two miles southeast of Waconia, where it continues in an easterly direction and descends into the Minnesota Valley National Wildlife Refuge, draining to the Minnesota River just south of Carver. Agrarian landuse currently dominates the subwatershed's landscape, nearly 41% is employed in crop production while 24% provides pasture for livestock; future predictions by the Metropolitan Council suggest a future decline in agricultural landuse and an increase in urban and residential development as pressures increase from the growing TCMA. Current development covers 11% of the subwatershed's total area and is concentrated near the city of Waconia. Population estimates suggest a 76.9% increase in population in Carver County from 2010 to year 2040, equaling nearly 70,000 people (Carver County, 2016). Ten percent of the watershed is presently forested. Forested acres in the watershed are primarily concentrated in the southeastern portion of the watershed along the Carver Creek stream corridor and in the steep bluffs of the Minnesota River valley.

Table 18. Aquatic life and recreation assessments on stream reaches: Carver Creek Aggregated 12-HUC. Reaches are organized upstream to downstream in the table.

				Aquatic Life Indicators:												
AUID ***Reach Name*****,** *Reach Description*	**Biological Station ID**	**Reach Length (miles)**	**Use Class**	Fish IBI	Invert IBI	Dissolved Oxygen	TSS	Secchi Tube	Chloride	pH	Ammonia -NH_3	Pesticides ***	Eutrophication	**Aquatic Life**	**Aquatic Rec. (Bacteria)**	**LRVW Standard (Bacteria)**
07020012-565 **Unnamed ditch,** T115 R25W S16, west line to Winkler Lk	03MN060	2.94	LRVW	NA	NA	IF			--	IF	IF	--	--	NA	NA	IMP
07020012-805 ***Carver Creek,*** *Headwaters to MN Hwy 284*		10.48	2Bg, 3C	--	--	--	--	--	--	--	--	--	--	--	SUP	--
07020012-568 ***Unnamed creek,*** *Benton Lk to Carver Cr*		2.03	2Bg, 3C	--	--	--	NA	NA	--	--	--	--	NA	NA	IMP	--

07020012-907 ***Unnamed creek,*** *(Goose Lake Inlet) to Goose Lk (10-0089-00)*		0.26	2Bg, 3C	--	--	--	NA	NA	--	--	--	--	NA	NA	IMP	--
07020012-618 ***Unnamed creek,*** *Goose Lk (10-0089-00) to Unnamed wetland*		0.86	2Bg, 3C	--	--	--	IF	IF	--	--	--	--	IF	IF	IMP	--
07020012-619 ***Unnamed creek (Lake Waconia Inlet),*** *Unnamed wetland to Lk Waconia*		1.57	2Bg, 3C	--	--	--	NA	NA	--	--	--	--	NA	NA	IMP	--
07020012-623 ***Unnamed creek,*** *Lk Waconia to Burandt Lk*		0.50	2Bg, 3C	--	--	--	NA	--	--	--	--	--	NA	NA	SUP	--
07020012-527 **Unnamed ditch,** Burandt Lk to Unnamed cr		2.49	2Bg, 3C	--	--	EX**	MTS	MTS	--	--	--	--	IF	IMP	IMP	--
07020012-621 ***Unnamed creek,*** *Reitz Lk to Unnamed cr*	14MN041	1.84	2Bm, 3C	MTS	MTS	NA	NA	NA	--	NA	NA	--	NA	SUP	IMP	--
07020012-622 ***Unnamed creek,*** *Unnamed cr to Carver Cr (CD 2 & 3)*	14MN040	1.18	2Bm, 3C	MTS	MTS	IF	IF	IF	--	IF	IF	--	IF	SUP	--	--
07020012-806 ***Carver Creek,*** *MN Hwy 284 to Minnesota R*	03MN030, 14MN039	20.97	2Bg, 3C	EX	EX	IF	EX	IF	MTS	IF	MTS	--	EX	IMP	IMP	--
07020012-526 ***Unnamed creek,*** Headwaters to Carver Cr		2.07	2Bg, 3C	--	--	--	IF	MTS	--	--	--	--	IF	SUP	IMP	--

Abbreviations for Indicator Evaluations: **MTS** = Meets Standard; **EX** = Fails Standard; **IF** = Insufficient Information
Abbreviations for Use Support Determinations: **--** = No Data, **NA** = Not Assessed, **IF** = Insufficient Information, **SUP** = Full Support (Meets Criteria); **IMP** = Impaired (Fails Standards)
Key for Cell Shading: = existing impairment, listed prior to 2014 reporting cycle; = new impairment; = full support of designated use; = insufficient information.
Abbreviations for Use Class: **WWg** = Warmwater general, **WWm** = Warmwater modified, **WWe** = Warmwater exceptional, **CWg** = Coldwater general, **CWe** = Coldwater exceptional,
LRVW = limited resource value water
*Assessments were completed using proposed use classifications changes that have not yet been written into rule.
**Existing impairment, insufficient new information was available to confirm or contest the existing listing.

Table 19. Lake assessments: Carver Creek Aggregated 12-HUC.

WD/WMO	Lake Name	DNR ID	Area (acres)	Max Depth (ft)	Assessment Method	Ecoregion	Secchi Trend	Aquatic Life Indicators: Fish IBI	Aquatic Life Indicators: Chloride	Aquatic Life Indicators: Pesticides ***	Aquatic Recreation Indicators: Total Phosphorus	Aquatic Recreation Indicators: Chlorophyll-a	Aquatic Recreation Indicators: Secchi	Aquatic Life Use	Aquatic Recreation Use
Carver	Miller	10-0029-00	138	14	Shallow Lake	NCHF	No Evidence of Trend	--	--	--	EX	EX	EX	--	NS
Carver	Reitz	10-0052-00	89	36	Deep Lake	NCHF	Increasing Trend	--	IF	--	EX	EX	MTS	IF	NS
Carver	Waconia	10-0059-00	3069	37	Deep Lake	NCHF	Increasing Trend	EX	MTS	--	IF	EX	MTS	NS	IF
Carver	Winkler	10-0066-00	77	--	Shallow Lake	NCHF	No Evidence of Trend	--	--	--	EX	EX	EX	--	NS
Carver	Benton	10-0069-00	47	--	Shallow Lake	NCHF	Decreasing Trend	--	--	--	EX	EX	EX	--	NS
Carver	Meuwissen	10-0070-00	24	--	Shallow Lake	NCHF	Insufficient Data	--	--	--	IF	IF	IF	--	IF
Carver	Rutz	10-0080-00	54	13	Shallow Lake	NCHF	No Evidence of Trend	--	--	--	EX	EX	IF	--	NS
Carver	Burandt	10-0084-00	86	24	Deep Lake	NCHF	Increasing Trend	--	--	--	MTS	EX	MTS	--	NS
Carver	Hydes	10-0088-00	212	18	Deep Lake	NCHF	No Evidence of Trend	--	--	--	EX	EX	EX	IF	NS
Carver	Goose	10-0089-00	250	10	Shallow Lake	NCHF	No Evidence of Trend	--	--	--	EX	EX	EX	--	NS

Abbreviations for Ecoregion: DA = Driftless Area, NCHF = North Central Hardwood Forest, NGP = Northern Glaciated Plains, NLF = Northern Lakes and Forests, NMW = Northern Minnesota Wetlands, RRV = Red River Valley, WCBP = Western Corn Belt Plains

Abbreviations for Secchi Trend: D = decreasing/declining trend, I = increasing/improving trend, NT = no detectable trend, -- = not enough data

Abbreviations for Indicator Evaluations: -- = No Data, **MTS** = Meets Standard; **EX** = Exceeds Standard; **IF** = Insufficient Information

Abbreviations for Use Support Determinations: **--** = No Data, **NA** = Not Assessed, **IF** = Insufficient Information, **FS** = Full Support (Meets Criteria); **NS** = Not Support (Impaired, exceeds standard)

Key for Cell Shading: ☐ = existing impairment, listed prior to 2014 reporting cycle; ☐ = new impairment; ☐ = full support of designated use; ☐= insufficient information.

Summary

Lakes

Ten Lakes in the Carver Creek Subwatershed were reviewed for aquatic recreation (AQR) use assessment. The ecoregion standard for aquatic recreation use (AQR) protects lake users from nuisance algal bloom conditions fueled by elevated phosphorus concentrations that degrade recreational use potential. Nearly all lake basins were previously listed impaired for AQR use based on nutrient, algal and clarity datasets, these lakes include Miller, Reitz, Winkler, Benton, Rutz, Burandt, Hydes and Goose. Burandt Lake was listed in 2004 based on all AQR parameters exceeding criteria, more recently collected data from 2010 through 2013 is revealed a noticeable improvement in overall water quality, although nuisance algae blooms appeared to be persisting. New data collection after 2013 would be advantageous to tracking current water quality and potentially explore a delisting if water quality continues to improve; at this point on the ground, activities in the contributing watershed could be restoring water quality. Reitz Lake previously listed in

2002 had newer nutrient and algae data collected between 2010 through 2013 that suggested poor water is persisting, although a long-term Secchi disk trend indicated increasing clarity over the course of the dataset. New data since 2013 would be helpful to monitor current conditions; restoration strategies would be useful in this area considering the increasing trend in water clarity is already noticeable. Waconia is one of the more popular, recreationally used lakes in this subwatershed and the entire Lower Minnesota River Watershed as a whole. Lake Waconia is at the verge of impairment phosphorus is at the standard, response variables conflict; nuisance blooms are occurring at a high frequency than expected. Local government units are aware of the vulnerability of the basin with respect to AQR standards and work will continue to prevent further degradation into an impaired status as the basin may be near a tipping point. Invasive species introduction (zebra mussels) could be playing a role in the observed Secchi transparency improving trend. Further monitoring, paired with protection efforts are recommended on this popular resource.

Aquatic life data was available on three basins, only Waconia has fish IBI data available. One fish community survey was collected in 2014 on Waconia, with a resulting score not meeting criteria, reflecting a stressed fish community within the basin. High biomass of tolerant Common Carp and low biomass of top carnivores were a few contributing factors to the low IBI score. The only intolerant species captured was regularly stocked Muskellunge, low diversity of native species was observed as well. An older vegetation survey conducted indicated Waconia had a healthy plant population. Chloride did not appear to be a stressor in the subwatershed despite having close proximity to impervious surfaces (roads, parking lots, sidewalks) which can send potential road maintenance related chloride signal.

Streams

Many stations with water chemistry data in this subwatershed appeared to be linked to targeted TMDL related activities, in some cases this results in unrepresentative stream datasets for an aquatic life use (AQL) assessment. Five small inlet or outlet tributaries in this subwatershed were not assessed for aquatic life use for this reason. At the same time, AQR use assessment is appropriate wherever recreation contact could potentially occur, meaning many of the same small tributaries were assessed for AQR use when bacteria data existed. This resulted in six confirmed or new AQR impairments across the subwatershed driven by persistently high bacteria concentrations.

Carver Creek (-806) had existing impairments for sediment and bacteria. New data confirmed both impairments, with aquatic life use and aquatic recreation uses being impaired. In addition**,** phosphorus and response parameters (chlorophyll-a and biological oxygen demand) signaled that eutrophication was also impacting aquatic life and a new listing was added. A new aquatic life use impairment for both fish and macroinvertebrates was identified on the mainstem of Carver Creek, assessed using general use standards. FIBI and MIBI results decrease moving downstream on Carver Creek. Despite this, fish and macroinvertebrate results on the upstream stations 14MN040 and 14MN041 meet modified aquatic life use standards. FIBI results from the upstream tributary emanating out of Lake Waconia are above general use standards, suggesting that outflow from the western branch may likely be a greater source contributor to observed downstream stress. Historical data from the outlet station on Carver Creek also suggests temporal decline in quality from 2003 to 2015. Failing biological communities observed were overwhelmingly dominated by tolerant individuals from a few species. High phosphorous and instream sediment levels were observed in conjunction with biological visits on the mainstem of Carver Creek, with highest levels observed at the upstream most station (14MN039); a preponderance of macroinvertebrates tolerant of elevated phosphorus and sediment levels at this location corroborates these observations. This, along with relatively good MSHA stream habitat scores observed at the downstream station, suggests that biological stress within the watershed is likely derived from stream water chemistry.

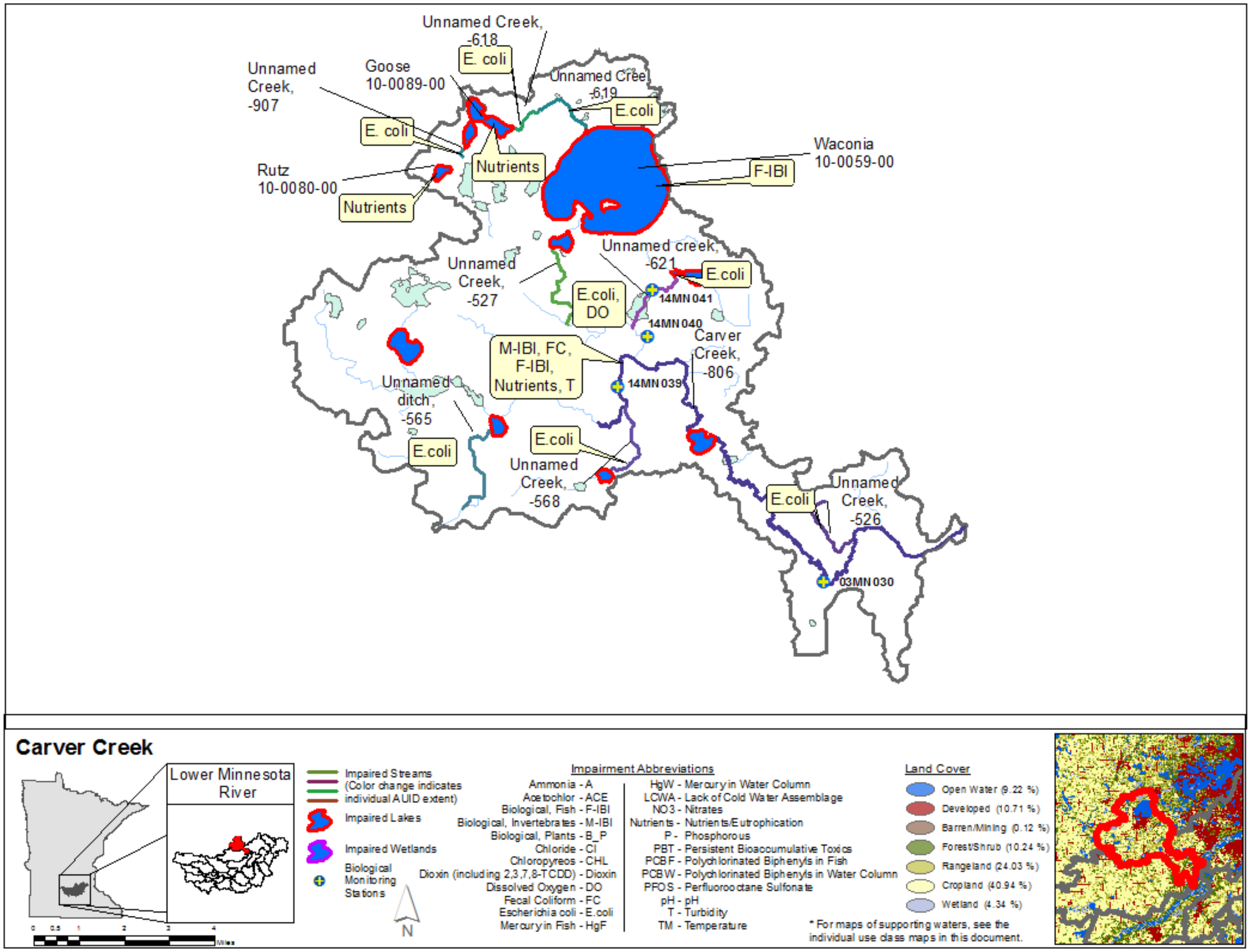


Figure 26. Currently listed impaired waters by parameter and land use characteristics in the Carver Creek Aggregated 12-HUC.

City of Belle Plaine-Minnesota River Aggregated 12-HUC HUC 0702001209-01

The City of Belle Plaine Subwatershed encompasses 87.6 mi.[2] of the Lower Minnesota HUC-8 predominately covering portions of southwestern Scott County and a small piece of eastern Sibley County. The subwatershed is a flow through section of the Minnesota River, starting at the termination of City of Le Sueur Subwatershed near Blakely, flowing past the growing community of Belle Plaine and into the City of Mendota Heights Subwatershed near Chaska. Direct tributary streams draining to the Minnesota River within the watershed include Robert, Brewery and Big Possum creeks. Agricultural landuse predominates the subwatershed, 43% is cropland and nearly 15% is rangeland. More than 20% of the watershed remains forested, a majority of these acres are observed along the Minnesota River valley corridor in protected areas of the Minnesota Valley National Wildlife Refuge and Minnesota Valley State Recreation Area as well as steep bluff lands within the valley where utility for agricultural landuse is limited. Only 7.6% of the watershed is currently developed but this number is on the rise. Imminent development pressures from greater Belle Plaine will likely result in a future landuse transition in the watershed from agricultural acres being converted to urban and residential development as the TCMA continues to expand into rural Scott County.

Table 20. Aquatic life and recreation assessments on stream reaches: City of Belle Plain-Minnesota River Aggregated 12-HUC. Reaches are organized upstream to downstream in the table.

AUID *Reach Name*, *Reach Description*	Biological Station ID	Reach Length (miles)	Use Class	Aquatic Life Indicators: Fish IBI	Invert IBI	Dissolved Oxygen	TSS	Secchi Tube	Chloride	pH	Ammonia -NH_3	Pesticides ***	Eutrophication	**Aquatic Life**	**Aquatic Rec. (Bacteria)**
07020012-753 ***Unnamed creek,*** *Headwaters to Unnamed cr*		0.65	2Bg, 3C	--	--	IF	IF	IF	--	IF	IF	--	IF	IF	IMP
07020012-749 ***Big Possum Creek,*** *Unnamed cr to Minnesota R*		0.25	2Bg, 3C	--	--	IF	IF	IF	--	IF	IF	--	IF	IF	IMP
07020012-798 ***Unnamed creek,*** *Unnamed cr to Minnesota R*	14MN047	3.20	2Bg, 3C	EX	EX	IF	IF	IF	--	IF	IF	--	IF	IMP	--

07020012-830, ***Unnamed creek (Brewery Creek),*** *US Hwy 169 to Minnesota R*	00MN007	1.52	2Bg, 3C	EX	EX	IF	MTS	MTS	--	MTS	MTS	--	MTS	IMP	IMP
07020012-575 ***Robert Creek,*** *Unnamed cr to Unnamed cr (at Belle Plaine Sewage Ponds)*	91MN112, 00MN013	4.65	2Bg, 3C	EX	EX	IF	EX	EX	MTS	IF	MTS	--	IF	IMP	IMP
07020012-746 ***Unnamed creek,*** *Headwaters to Unnamed cr*		0.55	2Bg, 3C	--	--	IF	MTS	MTS	--	IF	IF	--	MTS	IF	IMP

Abbreviations for Indicator Evaluations: **MTS** = Meets Standard; **EX** = Fails Standard; **IF** = Insufficient Information
Abbreviations for Use Support Determinations: **--** = No Data, **NA** = Not Assessed, **IF** = Insufficient Information, **SUP** = Full Support (Meets Criteria); **IMP** = Impaired (Fails Standards)
Key for Cell Shading: = existing impairment, listed prior to 2014 reporting cycle; = new impairment; = full support of designated use; = insufficient information.
Abbreviations for Use Class: **WWg** = Warmwater general, **WWm** = Warmwater modified, **WWe** = Warmwater exceptional, **CWg** = Coldwater general, **CWe** = Coldwater exceptional, **LRVW** = limited resource value water
*Assessments were completed using proposed use classifications changes that have not yet been written into rule.

Summary

Robert Creek (575)

A new aquatic life use impairment is proposed for both fish and macroinvertebrates on Robert Creek. While both FIBIs and MIBIs appear to be increasing compared to historical data collected in 2000 and 2001, new data suggests that IBI scores for both assemblages are still struggling to meet standards, hovering near the impairment threshold. Fish and macroinvertebrate communities were generally disproportionately dominated by tolerant species. Robert Creek (-575) had assessable datasets for nearly all water chemistry parameters, most notable were bacteria and total suspended solids (TSS) datasets indicating poor water quality for aquatic recreation and aquatic life use. The TSS data reveals long periods of deviation from impairment criteria, the Secchi tube (STUBE) data confirms the high sediment loads with associated with low water clarity. Heavy sedimentation can cover vital spawning and feeding habitat, negatively impacting aquatic life. MSHA stream habitat results were fair and indicate biological stress may be attributed to limited habitat availability and impacts related to both stream bank erosion and instream sedimentation, which substantiate newly listed TSS impairment for aquatic life use. More investigation may be warranted to determine whether or not runoff from the adjacent gravel mining operation is impacting the biological community. Persistently high bacteria concentrations can negatively affect recreational use, both individual and monthly means violations will trigger an aquatic recreation use impairment at this time.

Unnamed Creek “Brewery Creek” (830)

Biological assessments for both fish and macroinvertebrates in 2016 indicate a new aquatic life use impairment for Brewery Creek. Survey data from 2000 suggests the fish community was at the threshold in 2000, meeting standards, but has since shown a decreasing trend in FIBI, falling below standards but within lower confidence limits. Fish surveys also show a dramatic decrease in overall population size in recent years as well. Tolerant individuals disproportionately dominated all samples. The presence of Coldwater macroinvertebrate indicator taxa, as well as cold instantaneous temperatures at time of chemistry sampling, suggest that this stream has Coldwater potential and could possibly be an impaired Coldwater stream. Poor habitat and the prevalence of severe bank erosion within Brewery Creek, could be limiting the community. Brewery Creek had minor violations in the TSS and STUBE datasets, analysis on dates of exceedances appear to be linked to high rainfall events. Instream siltation may be connected to limited infiltration of storm water. While chemical assessments do not implicate stream chemistry impairments for aquatic life, storm events have been shown to cause spikes in suspended sediment levels. Additional stress to the fish community may be attributed to perched culverts limiting longitudinal stream connectivity and fish migration. Bacteria concentrations are indicative of poor recreational water quality, with both monthly mean and individual exceedances in the dataset.

Unnamed Creek (798)

A new aquatic life use impairment for both fish and macroinvertebrates has been proposed for an Unnamed Creek on the northwest side of the Minnesota River near the community of Blakely. Results for both fish and macroinvertebrates were within lower confidence limits of the impairment threshold, suggesting a vulnerable aquatic community. The fish community was dominated by tolerant taxa and included only a single sensitive species. Similarly, the macroinvertebrate community is dominated by tolerant forms, without any intolerant taxa present. Additionally, the macroinvertebrate community has a disproportionately large number of taxa tolerant of stream nutrients, even though a strong nutrient signal was not apparent in the grab sample. Instream chemistry data is limited to data gathered during biological assessments but suggests potential issues with suspended sediment. Instream sediment concerns were also noted within the stream habitat assessment, which implicated stream bank erosion, channel stability, instream sedimentation and reduced levels of cover as potential stressors.

Many of the other waterbodies with water chemistry data in this subwatershed are direct tributaries to the Minnesota River, through data analysis and public input it appears perennial water flow is not regularly the case, which does not lend to representative riverine conditions needed for aquatic life criteria comparison. With that said, aquatic recreation criteria still apply if water exists to recreate in, resulting in three new aquatic recreation use impairments based on bacteria data.

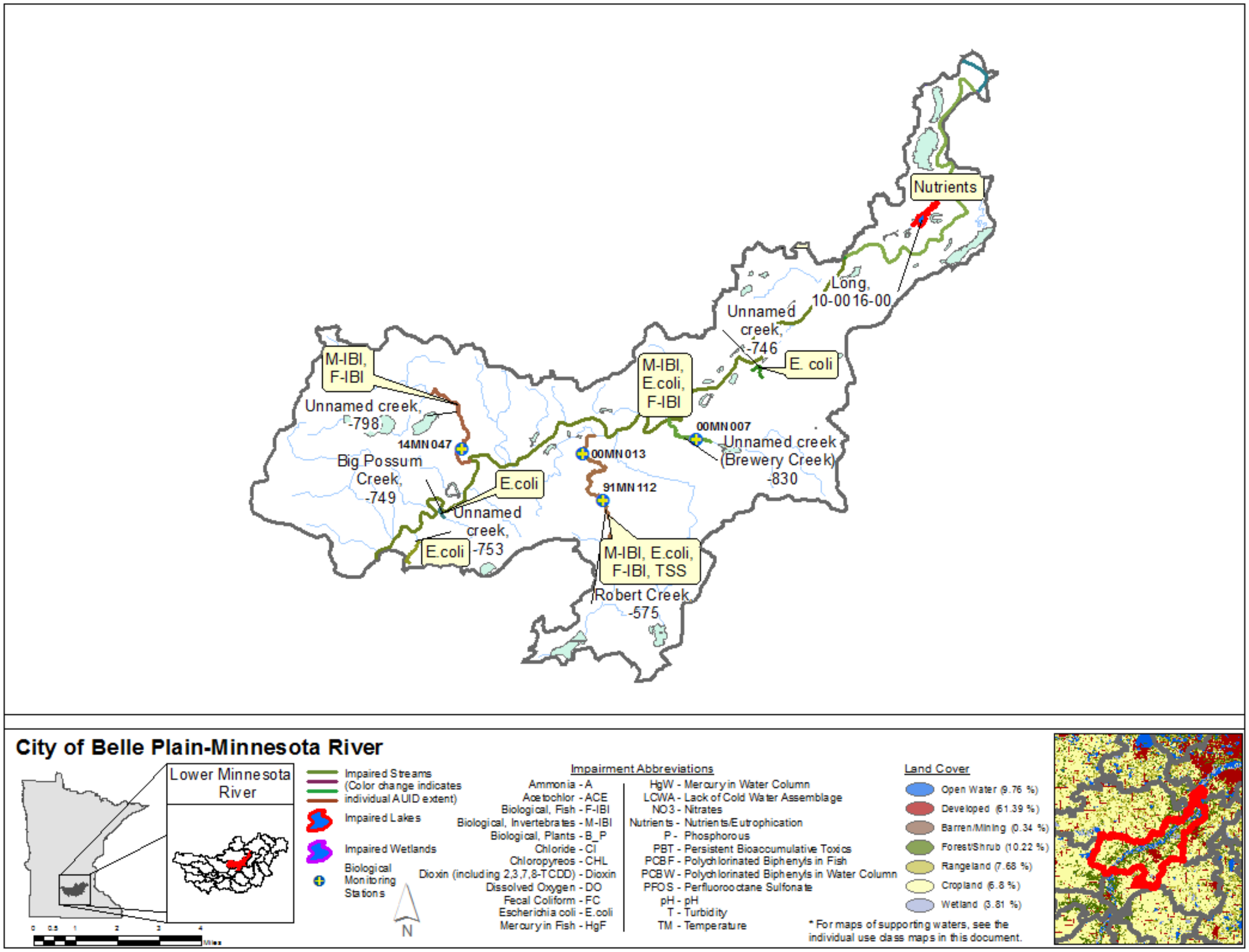


Figure 27. Currently listed impaired waters by parameter and land use characteristics in the City of Belle Plaine - Minnesota River Aggregated 12-HUC.

Sand Creek 10-HUC HUC 0702001208

Sand Creek HUC-10 Subwatershed encompasses 274 mi.2 and the entirety of the Sand Creek drainage including Sand Creek, Raven Stream, and Porter Creek Aggregated HUC-12 Subwatersheds. Agricultural landuse dominates the subwatershed, with 50.5% managed for row crop production and nearly 25% employed as rangeland. Agricultural lands are concentrated in the southern regions of the watershed and shift towards more range, forested and developed acres moving north towards the watershed's outlet. Jordan, New Prague, and Lonsdale are the largest communities in the subwatershed and comprise a majority of it is nearly 7% developed acres. The subwatershed lies in the fringe of the southwestern TCMA and is home to many farms, small acreages, and a growing population of commuters to the Twin Cities. As population to the region continues to grow, landuse within the northern and eastern most reaches of the subwatershed are projected to shift from agricultural uses towards increases in residential and urban development. Natural landuse persists within the subwatershed, 11.4% remains forested, 3.8% remains as wetland and 2.9% is occupied open water. This subwatershed has a number of moderate to small, shallow lakes including Pepin, Sanborn, Cedar, and Pleasant. Natural areas are prevalent near the watershed's outlet as it enters the Minnesota Valley National Wildlife Refuge and surround its lakes and wetlands.

Raven Stream's headwaters lie in northeastern Le Sueur County and southwestern Scott County. Raven Stream begins with two branches, the West Branch starts two miles northwest of Heidelberg and the East Branch starts roughly three miles north of Montgomery. Both branches flow north merging a few miles northwest of New Prague where they transition to Raven Stream ultimately joining Sand Creek about four miles North of New Prague, one mile upstream of Porter Creek's confluence with Sand Creek.

Porter Creek's headwaters begin in southeastern Scott County near the small community of Cedar Lake and flows in a northwesterly direction. The small subwatershed has several small lakes and wetlands, which are interconnected with the creek. Porter Creek joins Sand Creek one mile northwest of Raven Stream's confluence with Sand Creek and a few miles southeast of Jordan.

The headwaters of Sand Creek start in northwestern Le Sueur and northeastern Rice County, just west of the rural community of Lonsdale. Its headwaters are laden with small pothole lakes and wetlands that are interconnected and discharge to Sand Creek. While channelized in its headwaters, Sand Creek quickly transitions back to its natural meanders flowing northwest towards Jordan, gaining the flow of Raven Stream and Porter Creek. Sand Creek gains gradient as it descends the Minnesota River bluff and enters Jordan. An old milldam in the heart of Jordan impedes natural fish migration on Sand Creek. Upon leaving Jordan Sand Creek's gradient decreases as it moves through the Minnesota River's floodplain in the Minnesota Valley National Wildlife Refuge, ultimately discharging to the Minnesota River one mile southeast of Carver.

Table 21. Aquatic life and recreation assessments on stream reaches: Sand Creek 10-HUC. Reaches are organized upstream to downstream in the table.

Aggregated HUC 12	AUID *Reach Name,* *Reach Description*	Biological Station ID	Reach Length (miles)	Use Class	Aquatic Life Indicators:										Aquatic Life	Aquatic Rec. (Bacteria)
					Fish IBI	Invert IBI	Dissolved Oxygen	TSS	Secchi Tube	Chloride	pH	Ammonia -NH_3	Pesticides ***	Eutrophication		
Porter Creek	**07020012-815** ***Porter Creek,*** *Fairbanks Ave to 250th St E*		7.92	2Bg, 3C	--	--	IF	EX	MTS	MTS	MTS	IF	--	IF	IMP	--
Porter Creek	**07020012-849** ***Unnamed creek,*** *Unnamed ditch to -93.4251 44.6206*	14MN078	1.13	2Bm, 3C	EX	--	IF	IF	IF		IF	IF	--	IF	IMP	--
Porter Creek	**07020012-817** ***Porter Creek,*** *Langford Rd/MN Hwy 13 to Sand Cr*	99MN004	10.45	2Bg, 3C	EX	EX	MTS	EX	MTS	MTS	MTS	MTS	--	EX	IMP	IMP
Raven Stream	**07020012-842** ***Raven Stream, West Branch,*** *270th St to E Br Raven Str*	14MN133, 14MN132,	6	2Bg, 3C	EX	EX	IF	MTS	MTS	MTS	MTS	MTS	--	IF	IMP	IMP
Raven Stream	**07020012-738** ***County Ditch 3,*** *Unnamed ditch to CD 10*	14MN135	1.30	2Bg, 3C	MTS	MTS	IF	IF	IF		IF	IF	--	IF	SUP	--
Raven Stream	**07020012-628** ***County Ditch 10,*** *CD 3 to Raven Str*	14MN134	2.10	2Bm, 3C	MTS	EX	IF	MTS	MTS	MTS	MTS	MTS	--	IF	IMP	IMP
Raven Stream	**07020012-819** ***Raven Stream, East Branch,*** *-93.6106 44.5532 to 255th St W*	14MN131	2.77	2Bm, 3C	MTS	MTS	IF	MTS	MTS	EX	MTS	IF	--	IF	IMP	--
Raven Stream	**07020012-822** ***Unnamed creek,*** *RR bridge to E Br Raven Str*	03MN029	0.98	2Bg, 3C	EX	EX	IF	IF	IF	--	IF	IF	--	IF	IMP	--

Sand Creek	**07020012-773** **County Ditch 48,** Headwaters to Eggert Lk	14MN029	3.41	2Bg, 3C	NA	NA	IF	IF	IF	--	IF	IF	--	NA	NA	--
Sand Creek	**07020012-839,** ***Sand Creek,*** *T112 R23W S23, south line to -93.5454 44.5226*	14MN119	3.12	2Bm, 3C	EX	MTS	IF	EX	IF	EX	MTS	IF	--	EX	IMP	--
Sand Creek	**07020012-840,** ***Sand Creek,*** *-93.5454 44.5226 to Raven Str*	07MN056, 14MN129	17.60	2Bg, 3C	EX	EX	IF	EX	IF	EX	MTS	IF	--	EX	IMP	--
Sand Creek	**07020012-684** **Unnamed creek,** Unnamed cr to Sand Cr	14MN128	2.03	2Bm, 3C	MTS	MTS	NA	MTS	MTS	MTS	MTS	IF	--	IF	SUP	--
Sand Creek	**07020012-538** **Sand Creek,** Raven Str to Porter Cr	07MN055, 90MN116	1.77	2Bg, 3C	EX	--	IF	IF	EX	--	IF	IF	--	IF	IMP	--
Sand Creek	**07020012-513** **Sand Creek,** Porter Cr to Minnesota R	01MN044, 00MN006, 07MN033, 07MN034	13.39	2Bg, 3C	EX	EX	IF	EX	MTS	EX	MTS	MTS	IF	EX	IMP	IMP
Sand Creek	**07020012-732** **Unnamed creek,** Headwaters to Sand Cr	10EM103	9.04	2Bg, 3C	EX	EX	IF	IF	IF		IF	IF	--	IF	IMP	--
Sand Creek	**07020012-579** **Unnamed creek (Picha Creek),** Unnamed cr to Unnamed cr	01MN058, 14MN200	3.98	2Bg, 3C	EX	EX	IF	IF	IF	--	MTS	IF	--	IF	IMP	--
Sand Creek	**07020012-580** **Unnamed creek (Picha Creek),** Unnamed cr to Sand Cr	15EM078, 14MN096	0.97	2Bg, 3C	EX	--	IF	MTS	MTS	MTS	MTS	IF	--	IF	IMP	--

Abbreviations for Indicator Evaluations: **MTS** = Meets Standard; **EX** = Fails Standard; **IF** = Insufficient Information
Abbreviations for Use Support Determinations: **--** = No Data, **NA** = Not Assessed, **IF** = Insufficient Information, **SUP** = Full Support (Meets Criteria); **IMP** = Impaired (Fails Standards)
Key for Cell Shading: ☐ = existing impairment, listed prior to 2014 reporting cycle; ☐ = new impairment; ☐ = full support of designated use; ☐= insufficient information.
Abbreviations for Use Class: **WWg** = Warmwater general, **WWm** = Warmwater modified, **WWe** = Warmwater exceptional, **CWg** = Coldwater general, **CWe** = Coldwater exceptional,
LRVW = limited resource value water
*Assessments were completed using proposed use classifications changes that have not yet been written into rule.

Table 22. Lake assessments: Sand Creek 10-HUC.

Aggregated HUC 12	WD/ WMO	Lake Name	DNR ID	Area (acres)	Max Depth (ft)	Assessment Method	Ecoregion	Secchi Trend	Aquatic Life Indicators: Fish IBI	Aquatic Life Indicators: Chloride	Aquatic Life Indicators: Pesticides ***	Aquatic Recreation Indicators: Total Phosphorus	Aquatic Recreation Indicators: Chlorophyll-a	Aquatic Recreation Indicators: Secchi	Aquatic Life Use	Aquatic Recreation Use
Sand Creek	--	Sanborn	40-0027-00	309	4	Shallow Lake	NCHF	Insufficient Data	--	--	--	EX	EX	EX	--	NS
Raven Stream	--	Pepin	40-0028-00	392	12	Shallow Lake	NCHF	Insufficient Data	--	MTS	--	EX	EX	EX	IF	NS
Sand Creek	--	LeMay	66-0056-00	66	--	Shallow Lake	NCHF	Insufficient Data	--	--	--	IF	--	IF	--	IF
Sand Creek	--	Cody	66-0061-00	245	10	Shallow Lake	NCHF	Insufficient Data	NA	--	--	EX	EX	EX	NA	NS
Sand Creek	--	Phelps	66-0062-00	291	6	Shallow Lake	NCHF	Insufficient Data	NA	IF	--	EX	EX	EX	NA	NS
Sand Creek	--	Hatch	66-0063-00	64	--	Shallow Lake	NCHF	Insufficient Data	--	--	--	EX	EX	EX	--	NS
Porter Creek	Scott	St. Catherine	70-0029-00	118	7	Shallow Lake	NCHF	Insufficient Data	--	--	--	EX	EX	EX	--	NS
Porter Creek	Scott	Nash	70-0043-00	50	--	Shallow Lake	NCHF	Insufficient Data	--	--	--	--	--	IF	--	IF
Porter Creek	Scott	McMahon	70-0050-00	121	13	Shallow Lake	NCHF	Increasing Trend	MTS	IF	--	IF	EX	MTS	FS	FS
Porter Creek	Scott	Cynthia	70-0052-00	189	10	Shallow Lake	NCHF	Insufficient Data	--	--	--	EX	EX	EX	--	NS
Sand Creek	Scott	Cedar	70-0091-00	788	15	Shallow Lake	NCHF	Decreasing Trend	NA	IF	--	EX	EX	EX	NA	NS
Porter Creek	Scott	Pleasant	70-0098-00	276	5	Shallow Lake	NCHF	Insufficient Data	--	IF	--	EX	EX	EX	IF	NS
Sand Creek	Scott	Mill Pond	70-0113-00	17	6	Shallow Lake	NCHF	Insufficient Data	--	--	--	--	--	MTS	--	IF
Raven Stream	Scott	Mitchell	70-0128-00	19	--	Shallow Lake	NCHF	Insufficient Data	--	--	--	IF	IF	IF	--	IF

Abbreviations for Ecoregion: DA = Driftless Area, NCHF = North Central Hardwood Forest, NGP = Northern Glaciated Plains, NLF = Northern Lakes and Forests, NMW = Northern Minnesota Wetlands, RRV = Red River Valley, WCBP = Western Corn Belt Plains

Abbreviations for Secchi Trend: D = decreasing/declining trend, I = increasing/improving trend, NT = no detectable trend, -- = not enough data

Abbreviations for Indicator Evaluations: -- = No Data, **MTS** = Meets Standard; **EX** = Exceeds Standard; **IF** = Insufficient Information

Abbreviations for Use Support Determinations: **--** = No Data, **NA** = Not Assessed, **IF** = Insufficient Information, **FS** = Full Support (Meets Criteria); **NS** = Not Support (Impaired, exceeds standard)

Key for Cell Shading: = existing impairment, listed prior to 2014 reporting cycle; = new impairment; = full support of designated use; = insufficient information.

Summary

Lakes

Fourteen lake basins within the Sand Creek Subwatershed had assessment level data available to review Aquatic Recreation use (AQR). The ecoregion standard for AQR use protects lake users from nuisance algal bloom conditions fueled by elevated phosphorus concentrations that degrade recreational use potential. Cedar Lake was the only existing AQR impairment, previously listed in 2002 based on all parameters violating criteria, more recently data was available from multiple years of the assessment period, still indicating poor recreational water quality and a decreasing clarity trend. A TMDL is underway to address watershed inputs and internal loading to the system. Locally popular lake basins benefit from grass root efforts to restore recreational water quality. McMahon Lake was previously listed impaired in 2002 based on exceeding nutrient and chlorophyll-a datasets. Local efforts including best management practice implementation (native vegetation restoration, shoreline stabilization, curly leaf pondweed management) in the lake's watershed, the recreational water quality has clearly rebounded in the recent years. More recent data was brought forth by local parties following public meetings, further indicating improvement in all three assessment datasets since 2010. The lake is now considered restored and meeting recreational use. Eight basins were deemed to be in poor recreation water quality during this assessment cycle, mainly shallow basins with large fetch that are conducive to numerous mixing events in the water column throughout the open water months. Shallow lake basins with small flow through tributaries can often act as sinks for upstream nutrient and sediment inputs, further increasing the potential for elevated nutrient concentrations and nuisance algae blooms to perpetually occur.

Four lakes basins within the subwatershed had fish community information available for assessment from DNR. Two of these basins, Cody and Phelps, recently experience partial or complete winterkills that altered the fish community structure, not lending to a confident assessment of aquatic life use based on fish community data. Two sampling events from Cody portray the effects of winterkill, in 2005 Common Carp and Black Bullhead dominated trap nets, sampling in 2015 followed a winterkill; the survey revealed no Common Carp and few Black Bullhead along with high density of young insectivore Bluegill, nearly the same situation occurred with data on Phelps Lake. Cedar Lake had a fish community survey from 2015, which was deemed not assessable due to the manipulation of water levels, which affected connectivity, fish movement, lake substrates, aquatic vegetation patterns and habitat quality. McMahon Lake had data from 2010 and 2015, both clearly meeting criteria for supporting aquatic life use. A meeting FIBI score was attributed to low numbers of tolerant species, high proportion of insectivore biomass (Bluegill), and high proportion of top carnivore biomass (Northern Pike, Black Crappie). A vegetation survey from McMahon Lake indicated the plant community is likely degraded. Chloride data was available on six lake basins, not one of which indicated concentrations were elevated to the point of potentially stressing aquatic life.

Streams

Sand Creek

As with many streams in the Lower Minnesota River Watershed, Sand Creek has two distinct dimensions, channelized headwaters and natural channels where the main channel and its tributaries begin to descend into the river valley. New aquatic life use impairments were identified for the two headwater reaches that were assessed using modified use standards; one reach failed to meet standards for MIBI, while the other failed to meet standards for FIBI. In addition to lacking quality, in-stream habitat, both of these reaches had water quality stressors that were likely having impacts on the biological communities. County Ditch 30 (-839) had impairments for chloride, TSS and a proposed impairment for river eutrophication. Fish diversity was low, and dominated by tolerant species, including brook stickleback, fathead minnow and central mudminnow. The macroinvertebrate community was also dominated by tolerant forms, including square gilled mayflies, net-spinning caddisflies and side swimmers. Water quality issues will have to be addressed in these upstream reaches for the restoration of aquatic communities, both within-reach and in downstream reaches.

The remaining four reaches on the Sand Creek main-channel and its small, downstream tributaries, were assessed for aquatic life using the general use threshold. New aquatic life impairments are proposed for all four reaches, as both fish and macroinvertebrate communities failed to meet general use thresholds on each of the natural reaches. Habitat scores ranged from fair to good at all reaches. Despite relatively high habitat scores, channel stability and an abundance of fine substrates is likely having an impact on some reaches. Water quality problems are serving as stressors on the mainstem of Sand Creek, as there are either existing or proposed impairments for chloride and TSS, and very high nutrients are prevalent, but no data exists to eutrophication in the stream. A fish barrier on Sand Creek, between sites 07MN033 and 00MN006 is preventing natural fish migration in the watershed, as there are 20 fish species found below the barrier that are not found upstream. Removal or modification of this structure to allow fish passage could have significant impacts on upstream fish communities. The two primary tributaries to Sand Creek, Porter Creek and Raven Stream, join with Sand Creek near station 07MN055, both of these streams are known to carry high nutrient and sediment loads, making restoration of reaches downstream of these confluences a more complicated, watershed-wide effort. Since much of this watershed is comprised of natural stream channels, habitat conditions are potentially supportive of healthy biological communities, and in order to increase FIBI and MIBI scores throughout the chloride, nutrient and suspended sediment must be addressed.

The upstream portions of Sand Creek (-839, -840) were initially listed as impaired for aquatic life use (AQL) in 2010 based on violating chloride and TSS datasets; new data confirms both impairments, with several of the chloride concentrations exceeding the acute standard. Seasonal averages for nutrient and chlorophyll-a datasets were well in excess of the standard, indicating that eutrophication was also impacting aquatic life. The reach of Sand Creek (-538) between Raven Stream and Porter Creek was previously listed impaired in 2010 based on violating turbidity and Secchi tube (STUBE) datasets. Further downstream to the confluence with the Minnesota River, Sand Creek (-513) exhibits the effects of the poor water quality from multiple impaired upstream tributaries. Both turbidity and chloride impairments were listed previous to this assessment cycle. Recent TSS data confirms the initial impairment with many violations in the last three years. Chloride monitoring has been limited, only occurred in the winter 2014 since the initial listing; more monitoring will be needed in the future determine if improvements have been made. A large metropolitan chloride project is underway and could likely impact chloride spikes in Sand Creek during the winter months. In addition, bacteria data on the downstream reach triggered a listing for aquatic recreation use.

Porter Creek

Porter Creek (-815, -817) was previously listed for turbidity; newer data confirmed the existing impairment. The downstream reach of Porter Creek (-817) had clear eutrophication issues, with a seasonal average for causative variable phosphorus over four times more than criteria, chlorophyll-a revealed a noticeable response to elevated nutrient concentrations, a river eutrophication listing was triggered.

New biological impairments were identified for both biological assemblages at the watershed’s outlet station (99MN004), as well as a new fish impairment on an upstream reach (14MN078) assessed using modified use standards. The upstream station is channelized and heavily modified; low FIBI scores are reflective of poor habitat conditions observed onsite and a fish community comprised entirely of tolerant species, with significant dominance of brook stickleback. Upstream basins potentially have a significant impact on water quality of downstream reaches. The predominately agricultural and highly modified systems of the assessed and unassessed reaches upstream of the lower reach of Porter Creek validate this potential. Despite having high quality stream habitat, site 99MN004 has biological communities dominated by tolerant taxa. Fish diversity is high at this location, but the impact of tolerant taxa has an overwhelming influence on the IBI score. A high number of macroinvertebrate taxa indicative of high quality substrates, and stable flows is reflective of the higher quality habitat, but the influence of poor water quality appears to be preventing higher scores. Turbidity and eutrophication are likely having an influence on overall biological health, and addressing these impairments will likely be necessary if restoration of the biological community is to be achieved.

Raven Stream

The majority of stream reaches sampled for biology in the Raven Stream Subwatershed were natural stream channels, and the general aquatic life use standard was applied for assessments. The aquatic life use of a stream is determined by its potential to support a healthy biological community based on stream habitat and channel morphology. It does not consider upstream landuse, water quality or hydrological conditions. Natural streams that have upstream conditions that are commonly associated with poor stream health often have a difficult time meeting aquatic life use goals, despite the potential to do so, and this was the case in the Raven Stream Subwatershed. Of the four natural channel reaches sampled, three were identified as impaired, with FIBI and MIBI scores well below the general aquatic life use threshold. High values for phosphorus and suspended sediment (TSS) were measured throughout these impaired reaches, and very high chloride levels were measured consistently near the outlet of the watershed. These reaches were dominated by tolerant fish (fathead minnow, creek chub and bigmouth shiner) and macroinvertebrate taxa (midges, net-spinning caddisflies, and square gill mayflies). The stream reach that passed the general use criteria (14MN135) was a channelized stream that had an intact riparian zone and instream habitat that was good enough to allow the fish and macroinvertebrate communities to thrive. The presence of several lakes in the upstream watershed may be having a positive impact on this site, by allowing for more stable hydrologic conditions. Two reaches in the subwatershed were assessed using modified use criteria. Both of these reaches scored very well for fish IBI, scoring very near or above the general use threshold. MIBI scores were below the threshold at site 14MN134 (MIBI 28.15) and above at site 14MN131 (MIBI 31.96). Both of the modified stations were on reaches bracketed by natural channels, which may be contributing to higher FIBI scores and the passing MIBI score.

Poor water quality was observed throughout this subwatershed. Reaches on both East and West Branch Raven Stream have existing impairments. The West Branch Raven Stream had an existing recreation impairment due to excess, with newer data confirming elevated bacteria concentrations. DO data was collected from a site impacted by wetland conditions; biology will be the better indicator of aquatic life support. The East Branch Raven Stream was listed for chloride in 2010, no newer chloride data has been collected since the initial listing. The chloride issue was also present downstream in Raven Stream (-716), which was also previously listed impaired in 2010 based on chloride violations; newer data confirmed the existing impairment. Total suspended solid (TSS) and Secchi tube data had a few short-term violations clearly linked to anomalous rainfall events, sediment concentrations quickly dissipated, resulting in no listing for TSS. Bacteria was persistently high, with three monthly mean violations, resulting in a new aquatic recreation use impairment.

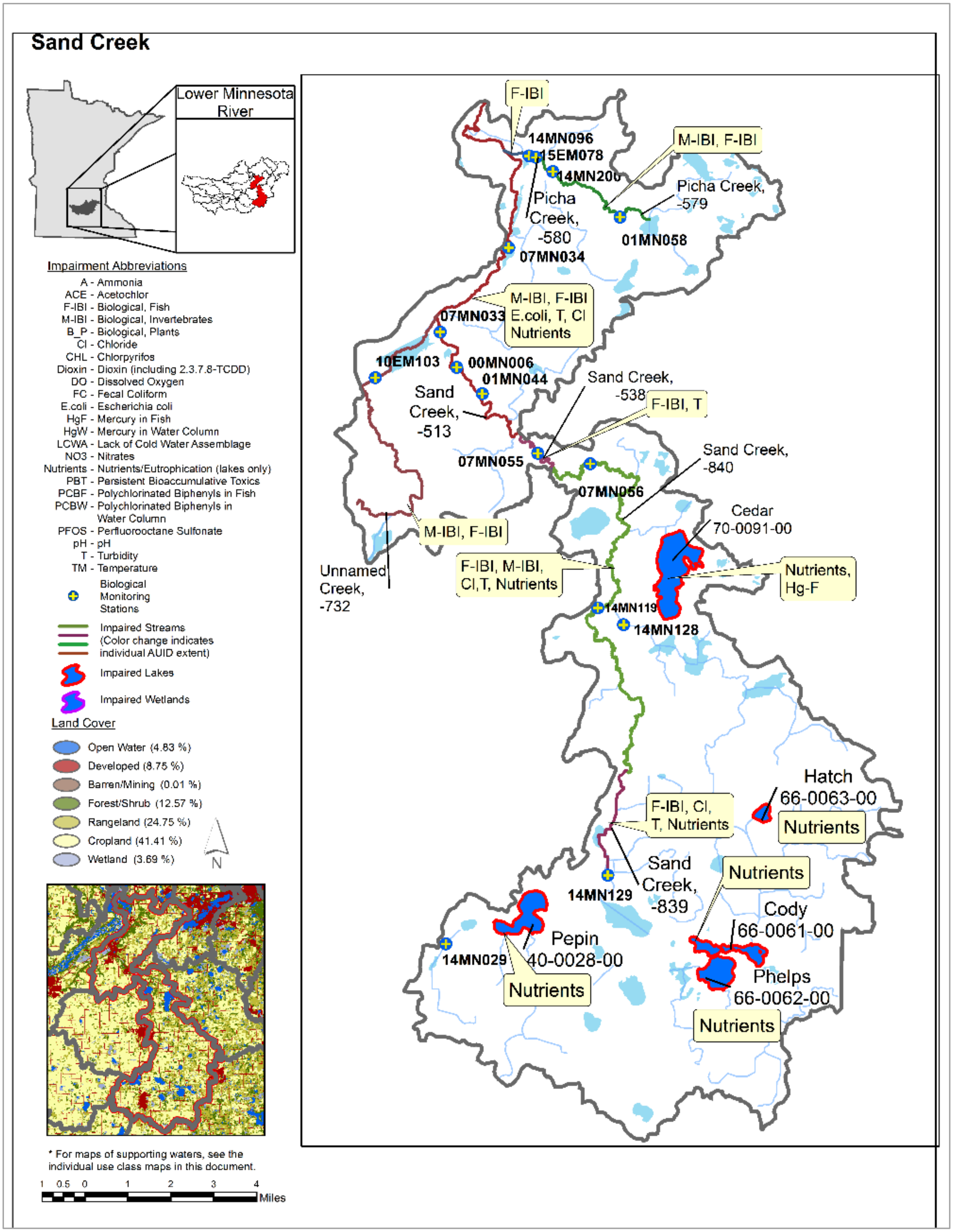


Figure 28. Currently listed impaired waters by parameter and land use characteristics in the Sand Creek Aggregated 12-HUC.

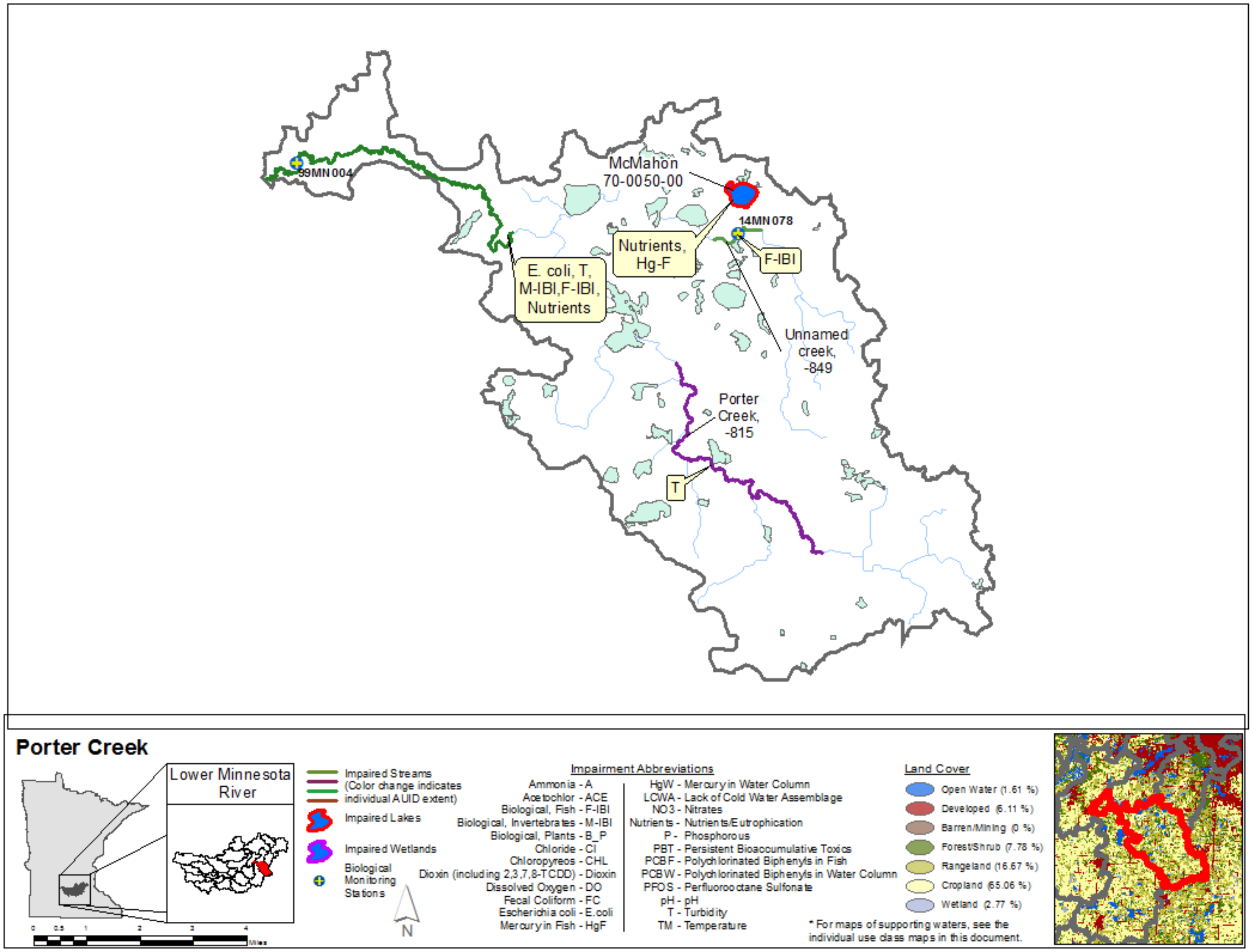


Figure 29. Currently listed impaired waters by parameter and land use characteristics in the Porter Creek Aggregated 12-HUC.

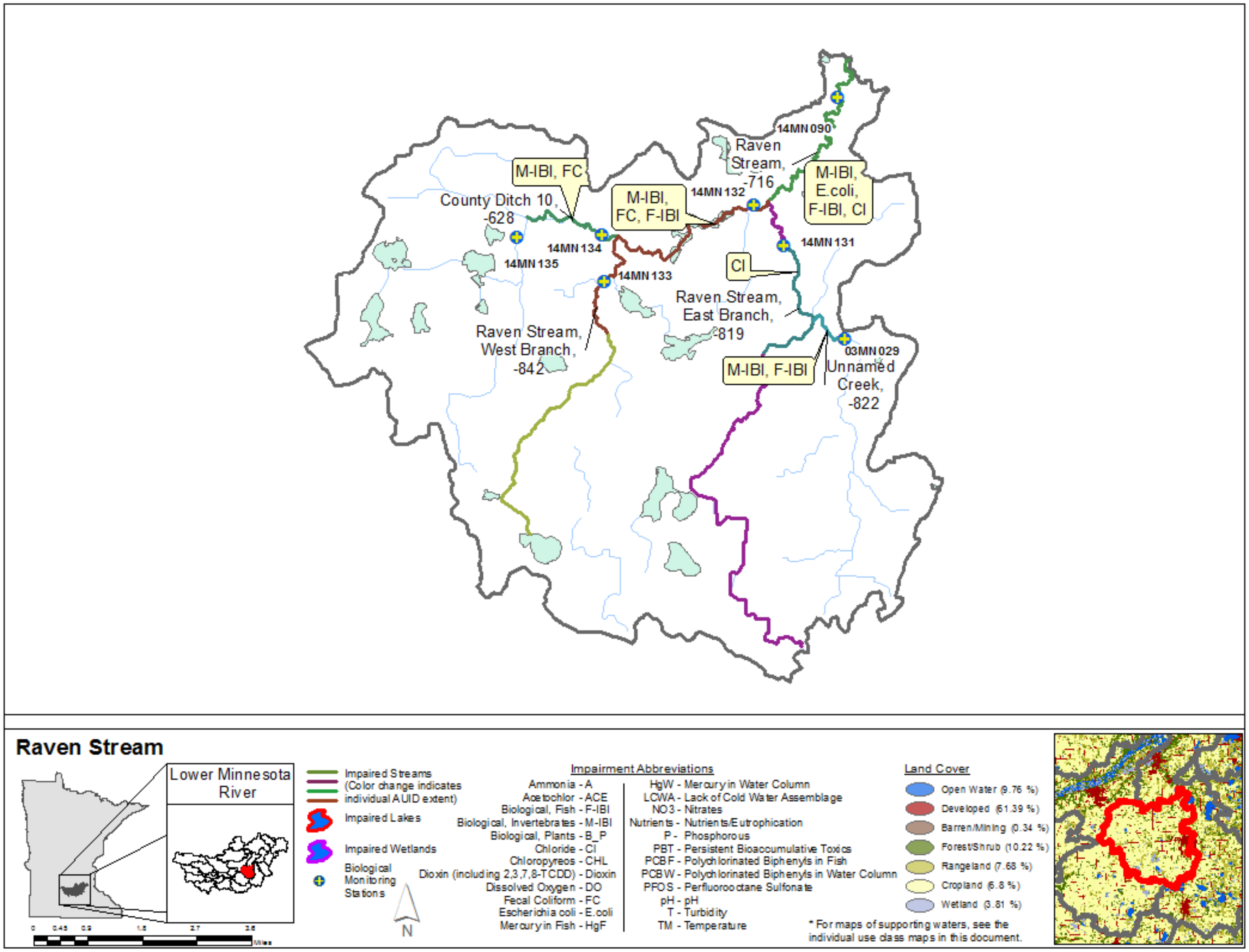


Figure 30. Currently listed impaired waters by parameter and land use characteristics in the Raven Stream Aggregated 12-HUC.

City of Mendota Heights-Minnesota River Aggregated 12-HUC HUC 0702001211-01

This subwatershed spans 224 $mi.^2$ and is a collection of direct tributary streams to the Minnesota River, including portions of Carver, Hennepin, Scott and Dakota counties. On the northern side of the Minnesota River, moving west to east, the watershed includes the drainages of Chaska, East, Assumption, Riley and Purgatory Creeks, stretching from Chaska to Eden Prairie. On the southern side of the river lies Eagle Creek, in Savage. The eastern section of the subwatershed includes the downstream most reaches of the Minnesota River drainage. This watershed contains a high density of moderate to small lakes, including Riley, Lotus, Crystal, and O'Dowd. Lying within the southwestern TCMA, the subwatershed's landuse is 61% developed. Approximately 14% of the watershed remains in agricultural landuse a majority of which is on the watershed's western edge, west of Chaska and Shakopee and will likely face future development pressures as the metro area continues to expand. Ten percent of the watershed remains natural (forest and wetland), a bulk of the open space lies within the bluff lands of the Minnesota River valley and the Minnesota Valley National Wildlife Refuge.

The bluffs of the Minnesota River valley give rise to many springs within the subwatershed; notable springs include Boiling Springs in Savage, a sacred site to the Mdewakanton Sioux Tribe and Fredrick-Miller Spring an artesian well in Eden Prairie. Calcareous fens, including Savage and Seminary Fen, are unique features within the bluffs of the lower Minnesota River valley. Calcareous fens are given special protection by the DNR because they are very uncommon and provide habitat for numerous rare plant species. Assumption Creek flows through the Seminary Fen Scientific and Natural Area and is fed by its cool waters. Both Assumption Creek and Eagle Creek are designated trout streams.

Table 23. Aquatic life and recreation assessments on stream reaches: City of Mendota Heights-Minnesota River Aggregated 12-HUC. Reaches are organized upstream to downstream in the table.

WD/WMO	AUID *Reach Name,* *Reach Description*	Biological Station ID	Reach Length (miles)	Use Class	Aquatic Life Indicators: Fish IBI	Invert IBI	Dissolved Oxygen	TSS	Secchi Tube	Chloride	pH	Ammonia -NH_3	Pesticides ***	Eutrophication	**Aquatic Life**	**Aquatic Rec. (Bacteria)**
Carver	**07020012-528** ***Unnamed creek,*** *Headwaters to Minnesota R*		2.01	2Bg, 3C	--	--	--	IF	IF	--	--	--	--	IF	--	IMP
Carver	**07020012-803** ***Chaska Creek,*** *US Hwy 212 to Creek Rd*	00MN010	1.73	2Bg, 3C	EX	EX	IF	IF	IF	--	IF	IF	--	IF	IMP	NA
Carver	**07020012-835,** ***Unnamed Creek,*** *Gaystock Lk to Unnamed Ck*	14MN126	2.16	2Bm	MTS	--	--	--	--	--	--	--	--	--	SUP	--
Carver	**07020012-804** ***Chaska Creek,*** *Creek Rd to Minnesota R*		1.45	2Bg, 3C	--	--	--	IF	MTS	--	--	--	--	IF	IF	IMP
Carver	**07020012-581** ***Unnamed creek (East Creek),*** *Unnamed cr to Minnesota R*	14MN201, 14MN125	3.09	2Bg, 3C	EX	EX	IF	EX	MTS	--	IF	IF	--	IF	IMP	IMP
Carver	**07020012-582** ***Unnamed creek (Assumption Creek),*** *Headwaters to Minnesota R*	99MN007	2.78	1B, 2Ag, 3B	EX	MTS	IF	IF	IF	--	IF	IF	--	IF	IMP	--
Riley-Purgatory-Bluff	**07020012-710** ***Bluff Creek,*** *Headwaters to Rice Lk*	00MN009, 00MN008	7.17	1B, 2Ag*, 3B	EX	MTS*	IF	EX	EX	MTS	MTS	MTS	--	IF	IMP	IF
Riley-Purgatory-Bluff	**07020012-511** ***Riley Creek,*** *Riley Lk to Minnesota R*	14MN124	4.98	2Bg, 3C	EX	EX	IF	EX	EX	MTS	IF	IF	MTS	MTS	IMP	IMP

Riley-Purgatory-Bluff	**07020012-828** ***Purgatory Creek,*** *Staring Lk to Minnesota R*	14MN204	6.10	2Bg, 3C	MTS	EX	IF	IF	MTS	MTS	MTS	MTS	--	IF	IMP	IMP
Lower MN River	**07020012-519** ***Eagle Creek,*** *Headwaters to Minnesota R*	14MN108	2.22	1B, 2Ag, 3B	MTS	MTS	IF	MTS	MTS	MTS	MTS	MTS	--	MTS	SUP	IMP

Abbreviations for Indicator Evaluations: **MTS** = Meets Standard; **EXS** = Fails Standard; **IF** = Insufficient Information
Abbreviations for Use Support Determinations: **--** = No Data, **NA** = Not Assessed, **IF** = Insufficient Information, **SUP** = Full Support (Meets Criteria); **IMP** = Impaired (Fails Standards)
Key for Cell Shading: ▢ = existing impairment, listed prior to 2014 reporting cycle; ▢ = new impairment; ▢ = full support of designated use; ▢= insufficient information.
Abbreviations for Use Class: **WWg** = Warmwater general, **WWm** = Warmwater modified, **WWe** = Warmwater exceptional, **CWg** = Coldwater general, **CWe** = Coldwater exceptional,
LRVW = limited resource value water
*Assessments were completed using proposed use classifications changes that have not yet been written into rule.

Table 24. Lake assessments: City of Mendota Heights Aggregated 12-HUC.

WD/WMO	Lake Name	DNR ID	Area (acres)	Max Depth (ft)	Assessment Method	Ecoregion	Secchi Trend	Aquatic Life Indicators: Fish IBI	Aquatic Life Indicators: Chloride	Aquatic Life Indicators: Pesticides ***	Aquatic Recreation Indicators: Total Phosphorus	Aquatic Recreation Indicators: Chlorophyll-a	Aquatic Recreation Indicators: Secchi	**Aquatic Life Use**	**Aquatic Recreation Use**
Carver	Jonathan	10-0217-00	21	--	Shallow Lake	NCHF	No Evidence of Trend	--	--	--	EX	EX	EX	--	NS
Carver	Unnamed	10-0218-00	19	19	Deep Lake	NCHF	No Evidence of Trend	--	--	--	EX	EX	EX	--	NS
Lower Minnesota	Brickyard Clayhole	10-0225-00	13	43	Deep Lake	NCHF	No Evidence of Trend	--	--	--	MTS	MTS	MTS	--	FS
Carver	Firemen's Clayhole	10-0226-00	8	--	Deep Lake	NCHF	--	--	--	--	MTS	MTS	MTS	--	FS
Carver	Big Woods	10-0249-00	--	--	Shallow Lake	NCHF	--	--	--	--	--	--	EX	--	IF
Riley-Purgatory-Bluff	Rice Marsh	10-0001-00	70	--	Shallow Lake	NCHF	Insufficient Data	--	MTS	--	EX	EX	MTS	IF	NS
Riley-Purgatory-Bluff	Riley	10-0002-00	289	50	Deep Lake	NCHF	No Evidence of Trend	EX	MTS	--	EX	EX	MTS	NS	NS
Lower Minnesota (Carver)	Courthouse	10-0005-00	11	57	Deep Lake	NCHF	Increasing Trend	--	MTS	--	IF	MTS	MTS	IF	FS
Riley-Purgatory-Bluff	Lotus	10-0006-00	237	29	Deep Lake	NCHF	No Evidence of Trend	EX	IF	--	EX	EX	MTS	NS	NS
Riley-Purgatory-Bluff	Lucy	10-0007-00	85	18	Shallow Lake	NCHF	Decreasing Trend	--	MTS	--	IF	EX	IF	IF	IF
Riley-Purgatory-Bluff	Ann	10-0012-00	111	45	Deep Lake	NCHF	No Evidence of Trend	IF	MTS	--	MTS	MTS	MTS	IF	FS
Riley-Purgatory-Bluff	Susan	10-0013-00	82	17	Shallow Lake	NCHF	No Evidence of Trend	--	MTS	--	EX	EX	MTS	IF	NS
Carver	Hazeltine	10-0014-00	152	6	Shallow Lake	NCHF	Decreasing Trend	--	--	--	EX	EX	EX	--	NS

Carver	Bavaria	10-0019-00	166	60	Deep Lake	NCHF	Decreasing Trend	EX	--	--	MTS	MTS	MTS	NS	FS
Carver	Gaystock	10-0031-00	46	--	Shallow Lake	NCHF	Insufficient Data	--	--	--	EX	EX	EX	--	NS
Carver	McKnight	10-0216-00	22	--	Shallow Lake	NCHF	Increasing Trend	--	--	--	EX	EX	EX	--	NS
Gun Club	Bur Oaks Pond	19-0259-00	21	--	Shallow Lake	NCHF	No Evidence of Trend	--	--	--	MTS	MTS	MTS	--	FS
Gun Club	Unnamed	19-0290-00	6	--	Shallow Lake	NCHF	--	--	--	--	--	--	EX	--	IF
Black Dog	Wood Park	19-0024-00	11	14	Shallow Lake	NCHF	Decreasing Trend	--	--	--	MTS	IF	IF	--	IF
Black Dog	Keller	19-0025-00	55	7	Shallow Lake	NCHF	No Evidence of Trend	--	MTS	--	EX	EX	IF	IF	NS
Black Dog	Crystal	19-0027-00	298	37	Deep Lake	NCHF	No Evidence of Trend	MTS	MTS	--	MTS	EX	MTS	FS	NS
Black Dog	Twin	19-0028-00	--	--	Shallow Lake	NCHF	--	--	--	--	MTS	MTS	MTS	--	FS
Black Dog	Lee	19-0029-00	20	14	Shallow Lake	NCHF	Increasing Trend	--	--	--	MTS	MTS	MTS	--	FS
Black Dog	Earley	19-0033-00	27	--	Shallow Lake	NCHF	Increasing Trend	--	--	--	MTS	MTS	MTS	--	FS
Gun Club	Unnamed	19-0036-00	11	--	Shallow Lake	NCHF	Insufficient Data	--	--	--	MTS	IF	MTS	--	FS
Gun Club/Lower Minnesota	Unnamed	19-0053-00	9	--	Shallow Lake	NCHF	--	--	--	--	MTS	MTS	MTS	--	FS
Gun Club	Unnamed	19-0054-00	10	--	Shallow Lake	NCHF	--	--	--	--	IF	MTS	MTS	--	IF
Gun Club	Lemay	19-0055-00	38	15	Shallow Lake	NCHF	No Evidence of Trend	--	--	--	EX	EX	MTS	--	NS
Gun Club	Fish	19-0057-00	31	34	Shallow Lake	NCHF	No Evidence of Trend	--	MTS	--	MTS	MTS	MTS	IF	FS
Gun Club	Blackhawk	19-0059-00	32	10	Shallow Lake	NCHF	No Evidence of Trend	--	--	--	MTS	MTS	MTS	--	FS
Gun Club	Bald	19-0061-00	10	--	Shallow Lake	NCHF	Insufficient Data	--	--	--	IF	MTS	MTS	--	IF
Gun Club	Unnamed	19-0062-00	25	--	Shallow Lake	NCHF	No Evidence of Trend	--	--	--	MTS	MTS	MTS	--	FS
Gun Club	Unnamed	19-0063-00	13	12	Shallow Lake	NCHF	Increasing Trend	--	--	--	MTS	MTS	MTS	--	FS
Gun Club	Unnamed	19-0064-00	9	--	Shallow Lake	NCHF	--	--	--	--	EX	EX	MTS	--	NS
Gun Club	Holland	19-0065-00	34	55	Deep Lake	NCHF	No Evidence of Trend	--	MTS	--	MTS	IF	MTS	IF	FS
Gun Club	Quigley	19-0066-00	12	19	Deep Lake	NCHF	Decreasing Trend	--	--	--	EX	EX	IF	--	NS
Gun Club	Thomas	19-0067-00	39	6	Shallow Lake	NCHF	Increasing Trend	--	--	--	MTS	IF	MTS	--	FS
Gun Club	Pitts	19-0068-00	12	--	Shallow Lake	NCHF	Increasing Trend	--	--	--	EX	MTS	MTS	--	IF
Gun Club	Gerhardt	19-0069-00	13	--	Shallow Lake	NCHF	No Evidence of Trend	--	--	--	--	--	EX	--	IF
Gun Club	Jensen	19-0071-00	54	--	Shallow Lake	NCHF	Decreasing Trend	--	--	--	MTS	IF	MTS	--	FS
Gun Club	O'Brien	19-0072-00	38	10	Shallow Lake	NCHF	Insufficient Data	--	--	--	MTS	IF	MTS	--	FS
Gun Club	McDonough	19-0076-00	18	8	Shallow Lake	NCHF	No Evidence of Trend	--	--	--	MTS	IF	MTS	--	FS
Gun Club	Unnamed	19-0077-00	13	--	Shallow Lake	NCHF	Increasing Trend	--	--	--	EX	EX	EX	--	NS
Gun Club	Augusta	19-0081-00	33	33	Deep Lake	NCHF	No Evidence of Trend	--	--	--	EX	IF	EX	--	NS

Gun Club	Lemay	19-0082-00	25	--	Shallow Lake	NCHF	Increasing Trend	--	--	--	MTS	MTS	MTS	--	FS
Lower Minnesota River	Unnamed	19-0128-00	29	43	Deep Lake	NCHF	Insufficient Data	--	--	--	MTS	--	MTS	--	FS
Gun Club	Unnamed	19-0136-00	20	--	Shallow Lake	NCHF	Insufficient Data	--	--	--	MTS	EX	MTS	--	FS
Gun Club	Hilltop Pond	19-0148-00	6	--	Shallow Lake	NCHF	--	--	--	--	NA	NA	NA	--	NA
Gun Club	Cedar Pond	19-0150-00	2	--	Shallow Lake	NCHF	--	--	--	--	--	--	IF	--	IF
Gun Club	Unnamed	19-0153-00	8	--	Deep Lake	NCHF	--	--	--	--	MTS	MTS	MTS	--	FS
Gun Club	Unnamed	19-0156-00	2	--	Shallow Lake	NCHF	--	--	--	--	--	--	EX	--	IF
Gun Club	East Thomas	19-0161-00	9	--	Shallow Lake	NCHF	--	--	--	--	MTS	IF	MTS	--	FS
Black Dog	Lac Lavon	19-0446-00	61	32	Deep Lake	NCHF	No Evidence of Trend	--	--	--	MTS	MTS	MTS	--	FS
Gun Club	Unnamed	19-0454-00	2	--	Shallow Lake	NCHF	--	--	--	--	--	--	IF	--	IF
Riley-Purgatory-Bluff	Hyland	27-0048-00	81	12	Shallow Lake	NCHF	No Evidence of Trend	--	--	--	EX	EX	MTS	--	NS
Riley-Purgatory-Bluff	Duck	27-0069-00	42	--	Shallow Lake	NCHF	Insufficient Data	--	IF	--	MTS	MTS	MTS	--	--
Riley-Purgatory-Bluff	Mitchell	27-0070-00	110	18	Shallow Lake	NCHF	Increasing Trend	MTS	--	--	MTS	IF	MTS	FS	FS
Riley-Purgatory-Bluff	Round	27-0071-00	30	37	Deep Lake	NCHF	Insufficient Data	--	--	--	IF	IF	IF	--	IF
Riley-Purgatory-Bluff	Red Rock	27-0076-00	72	16	Shallow Lake	NCHF	No Evidence of Trend	--	MTS	--	IF	IF	MTS	IF	FS
Riley-Purgatory-Bluff	Staring	27-0078-00	157	16	Shallow Lake	NCHF	Increasing Trend	--	MTS	--	EX	EX	EX	FS	NS
Riley-Purgatory-Bluff	Silver	27-0136-00	18	--	Shallow Lake	NCHF	Insufficient Data	--	IF	--	EX	EX	EX	IF	NS
Scott	O'Dowd	70-0095-00	298	22	Shallow Lake	NCHF	Increasing Trend	EX	IF	--	MTS	EX	MTS	NS	IF
Scott	Thole	70-0120-01	103	12	Shallow Lake	NCHF	No Evidence of Trend	MTS	MTS	--	EX	EX	EX	FS	NS

Abbreviations for Ecoregion: DA = Driftless Area, NCHF = North Central Hardwood Forest, NGP = Northern Glaciated Plains, NLF = Northern Lakes and Forests, NMW = Northern Minnesota Wetlands, RRV = Red River Valley, WCBP = Western Corn Belt Plains
Abbreviations for Secchi Trend: D = decreasing/declining trend, I = increasing/improving trend, NT = no detectable trend, -- = not enough data
Abbreviations for Indicator Evaluations: -- = No Data, **MTS** = Meets Standard; **EX** = Exceeds Standard; **IF** = Insufficient Information
Abbreviations for Use Support Determinations: **--** = No Data, **NA** = Not Assessed, **IF** = Insufficient Information, **FS** = Full Support (Meets Criteria); **NS** = Not Support (Impaired, exceeds standard)
Key for Cell Shading: = existing impairment, listed prior to 2014 reporting cycle; = new impairment; = full support of designated use; = insufficient information.

Summary

Sixty-four lakes in the City of Mendota Heights Subwatershed were reviewed for aquatic recreation use. The ecoregion standard for aquatic recreation use protects lake users from nuisance algal bloom conditions fueled by elevated phosphorus concentrations that degrade recreational use potential. Of those, 18 basins were previously listed impaired for aquatic recreation use based on nutrient data in a past assessment cycle and had either no data or newer data supporting the initial listing. Three of these existing listings (Staring, Unnamed and McKnight) had long-term Secchi trends that were indicating an increase in water clarity, suggesting water quality improvement may be occurring. Only two basins were added as impaired during this assessment cycle, Silver and Rice Marsh. Both basins perform as shallow lakes with some borderline wetland characteristics, secondary indirect recreational use (boating, kayaking and aesthetics) is clear on both basins, considering review of aerial imagery and local input aquatic recreational use assessment moved forward. O'Dowd Lake was previously listed impaired for aquatic recreational use based on an incorrect comparison to deep lake assessment criteria, since that listing locals have collected and submitted depth data indicating it is best defined as a shallow lake, Red Rock and Mitchell Lakes were previously listed impaired based on nutrient data for aquatic recreation use in 2002, local watershed districts have been closely monitoring and executing best management practices (BMPs) recently in lake and contributing watershed, resulting in rebounding water quality to meet standard, delisting requests were received and processed based on new data. Twenty-eight lake basins were deemed to be fully supporting aquatic recreation use. Some high recreation quality lakes include Lac Lavon and Round; these lakes provide opportunities for suburban residents to enjoy good water quality close to home despite high stressor potential to the basin and should be prime candidates for protection strategies. Jensen and Bavaria are lakes that currently meet aquatic recreation use standard; with that said, a long-term trend in the Secchi dataset for each basin is indicating water clarity is decreasing and could be an early sign of degradation in recreational water quality. These are also high priority waters for protection efforts. Threats to water quality in this subwatershed are directly associated dense urban development; various BMPs both by individual shore owners and by residents across the contributing watershed can be effective in curbing further degradation.

Nine lakes had fish community data available to make an assessment of aquatic life use. Four lakes were found to be fully supporting of aquatic life use: Thole, Crystal, Staring and Mitchell. High proportions of insectivores, low proportions of tolerant and omnivore species were positive influences on the fish IBI scoring metrics for these lakes. Common Carp (tolerant taxa) control measures have been enacted on Staring. Crystal was noted to be vulnerable, considering it is just meeting fish IBI threshold and additional human disturbance will likely result in an impaired status in the future. Potential stressors noted are common in urban settings; impervious surfaces, shoreline development density and localized plant management activities. Fish community survey for Lake Ann noted potential inefficiency in sampling effort; a more representative sample will be needed to make a complete aquatic life use assessment.

Purgatory Creek (-828)

Water chemistry data for Purgatory Creek does not clearly indicate an issue for aquatic life, additional total suspended solid (TSS) data was uncovered at a public meeting, bringing the violation rate to 9%; the Secchi tube (STUBE) dataset did not have a single violation. Two flow through lake basins, Silver Creek and Staring Lake, are potential sinks for nutrients and sediment from associated tributaries. Biological data gathered for aquatic life use assessment suggest fish are meeting aquatic life use standards while macroinvertebrates are not. Habitat scores were generally good; however, sedimentation impacts were noted. While TSS levels were not elevated enough to, trigger an aquatic life listing, the occasional high levels observed and potential streambed instability may be stressing macroinvertebrate communities. Chemical stress from high phosphorous levels observed during IWM monitoring may also be contributing to biological impairment. Comparison of historic biological data to recent survey results implies that the quality of the fish community has degraded in recent years, and their overall vitality is potentially vulnerable. While not impaired, measures should be taken to protect the community before it falls below standards. Measures taken to improve macroinvertebrate populations will also likely benefit the fish community. Improving longitudinal stream connectivity within the watershed could help improve and stabilize the health of the fish populations in the future. High bacteria concentrations triggering aquatic recreation use impairment on Purgatory Creek.

Assumption Creek (-582)

A new aquatic life impairment is proposed for fish based on IWM assessment data; in contrast, macroinvertebrate results meet requirements but are potentially vulnerable within upper confidence limits. Assumption Creek is a DNR designated trout stream. While no trout were captured during MPCA fish visits, DNR records show that a natural self-sustaining brook trout population was evident in the stream as late as 2002. The fish community observed during surveys conducted in 1999 included several species more indicative of a Warmwater fish community; more recent visits have shown less diversity, which is more typical of Coldwater streams. All visits have produced American brook lamprey or lamprey ammocetes, a sensitive species intolerant to environmental disturbance. MSHA stream habitat assessments were fair to good, notable disturbance included instream sedimentation, which corroborate elevated TSS levels seen in instream chemistry. Stream temperature monitoring in 2014 and 2015 do not reveal that stream temperature is likely limiting the fish population indicating habitat and/or chemistry may be predominant stressors (July 2014 average min. 12.15°C, average max. 16.18°C; July 2015 average min. 12.75°C, average max. 16.05°C).

Riley Creek (-511)

TSS and STUBE data violations persist on Riley Creek and confirm the initial listing identified in 2002, as such the turbidity listing will remain at this time. The 2014 MPCA biological monitoring assessment indicates a new aquatic life use impairment for both fish and macroinvertebrates. Both assemblages scored below lower confidence limits, indicating degraded biological communities. The fish community was almost exclusively comprised of very tolerant species including black bullhead, fathead minnow, and common carp. MSHA habitat scores were good, suggesting poor biological condition is likely a result of chemical stressors. Data gathered during biological visits and during event based sampling on the reach suggest that TSS may be a likely biological stressor. High bacteria concentrations triggering aquatic recreation use impairment on Riley Creek.

Eagle Creek (-519)

Coldwater designated Eagle Creek appears to be benefitting from a groundwater sourced small watershed with an intact riparian corridor, few violations across all aquatic life use water chemistry parameters were noted during assessment and protection measures should continue going forward. Both fish and macroinvertebrate assemblages were fully supporting the aquatic life use. Eagle Creek was only one of two reaches within the greater Lower Minnesota Watershed that met general use aquatic life use requirements. MPCA historic fish survey data from 1999 suggest that conditions have improved in recent years; however, 2014 FIBI scores were only just above standards, suggesting a vulnerable biological community. All visits produced meager brown trout populations; however, both young of year and adult trout were sampled demonstrating a self-reproducing population, a unique resource within the metro area. Average stream summer maximum temperatures were indicative of a Coldwater thermal regime, which is suitable for Coldwater obligate species (15.33°C in 2014). While stream habitat scores were generally good, instream sediment has dominated by sand and coarse substrates were limited. Impacts of surrounding residential development and storm water runoff may be elevating TSS levels during storm events and should be considered when implementing protection strategies. High bacteria concentrations triggering aquatic recreation use impairment on Eagle Creek.

Bluff Creek (-710)

Bluff Creek recently was still signaling a TSS issue, with 30% violation rates in the TSS datasets respectively; as such the existing turbidity listing will remain. DO data was limited in Bluff Creek; the standard was violated on 3 occasions during 2008 and 2014. While data did not clearly indicate impairment, it is possible that oxygen is a stressor to aquatic life. An aquatic life use impairment was identified on Bluff Creek in 2004 for FIBI; this impairment was confirmed by recent monitoring data. A use class change from Warmwater 2B to Coldwater 2A is being pursued as the macroinvertebrates at both stations within the reach have strong Coldwater communities. Stream temperatures also demonstrate thermal potential is adequate for supporting Coldwater communities from data gathered by MPCA in 2016 (Figure 31) and datasets gathered in previous years by local partners. Coldwater obligates were absent from the fish community across all visits, fish diversity also increased by 9 species when comparing the 2000 visit to the 2015 visit, the community remains overwhelmingly dominated by tolerant species and is more indicative of a Warmwater stream, demonstrating evidence of severe degradation of the fish community. Fair MSHA scores were observed at both stations; bank erosion and instream sedimentation corroborate the existing and confirmed listing for turbidity/TSS for aquatic life use, potentially causing stress to stream fish communities. The watershed district is currently working on a fish passage BMP to alleviate potential connectivity issues caused by a barrier upstream of MN Hwy 101.

While not at a level to cause impairment, elevated chloride concentrations are clearly occurring in the fall/winter months across many years within the dataset. Controlling winter storm treatments could potentially prevent a future chloride listing.

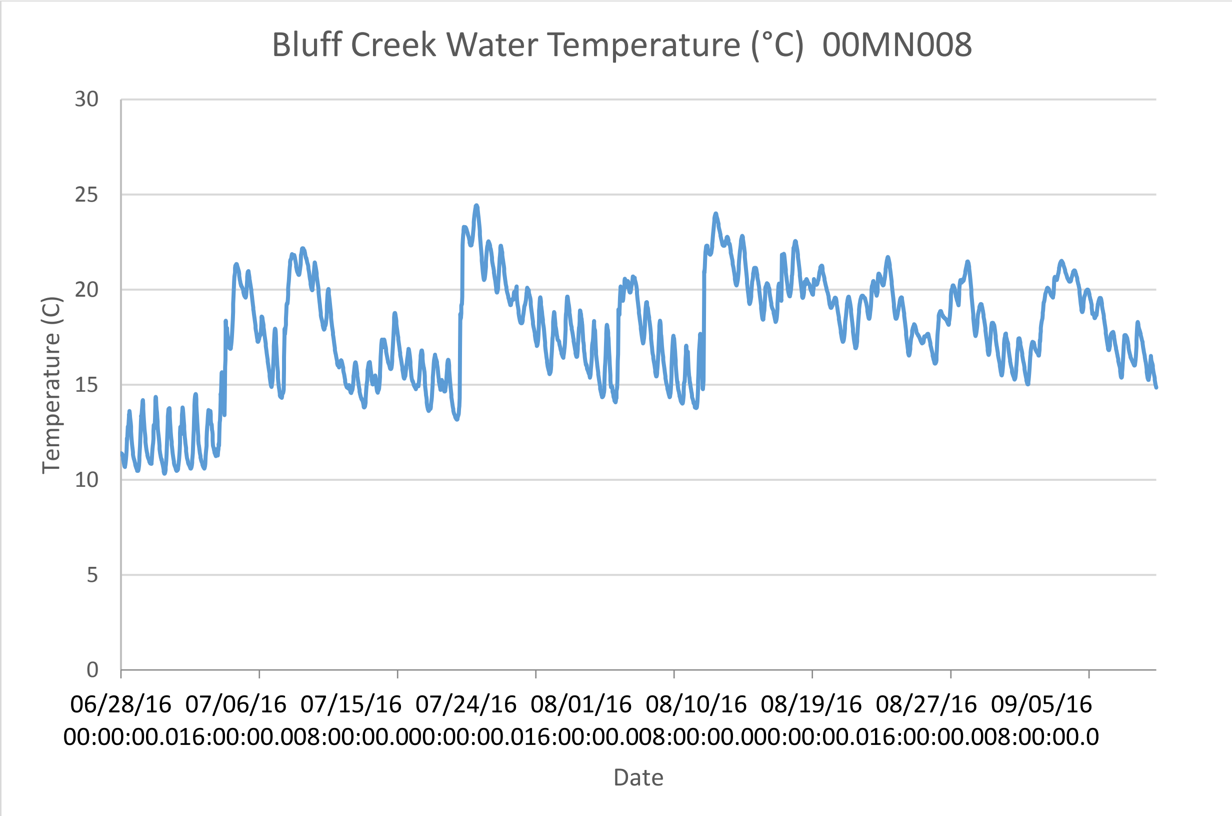


Figure 31. Continuous Water Temperature Monitoring Results on Bluff Creek at Biological Station 00MN008 in 2016.

East Creek (-581)

Biological monitoring assessment results have identified a new aquatic life use assessment impairment on East Creek for both fish and macroinvertebrates. A comparison of historic data to recent data shows little change in fish community structure from 2001 to 2014; the fish communities in both surveys were dominated by tolerant species and individuals. High turbidity levels identified in a 2008 listing were confirmed by more recent monitoring at a 16% exceedance rate in TSS datasets; as such, the existing impairment will remain. High TSS corroborates elevated levels of instream sediment and stream bank erosion observed during MSHA stream habitat surveys, indicating a potential stress source for biotic communities. Major flood mitigation efforts (artificial channels, drop structures, dams) on East Creek within the city of Chaska have severely altered the stream's drainage and longitudinal connectivity and are also likely negatively impacting the stream fish community. A carryforward impairment of high fecal coliform levels will remain on East Creek for aquatic recreation.

Chaska Creek (-803)

New aquatic life impairments were suggested for both fish and macroinvertebrates within Chaska Creek (-803) during the 2016 assessment cycle; however, additional monitoring was recommended prior to making a final assessment decision, local partners question whether major flooding events in 2014 may have skewed monitoring results. 2014 MPCA data suggests a significant decline in fish population in recent years, historical data from 2000 demonstrates FIBI scores well above meeting standards while recent results show scores below lower confidence limits. Significantly fewer fish were captured during the 2014 sample and a higher proportion of the individuals that were captured were tolerant. Similar to East Creek, Chaska Creek's drainage has been significantly altered as a result of Minnesota River flood mitigation efforts within the city of Chaska, drop structures and fish barriers prevent longitudinal fish migration on Chaska Creek, likely limiting the potential of its fish communities. MSHA habitat results show excess sediment and limited natural channel development scores suggesting fair habitat conditions may also be stressing stream biology. A carryforward impairment of high fecal coliform levels will remain on Chaska Creek for aquatic recreation.

Discussion within this subwatershed summary does not include the assessments on the mainstem Minnesota River; those results can be found within the Minnesota Large River Monitoring and Assessment Report.

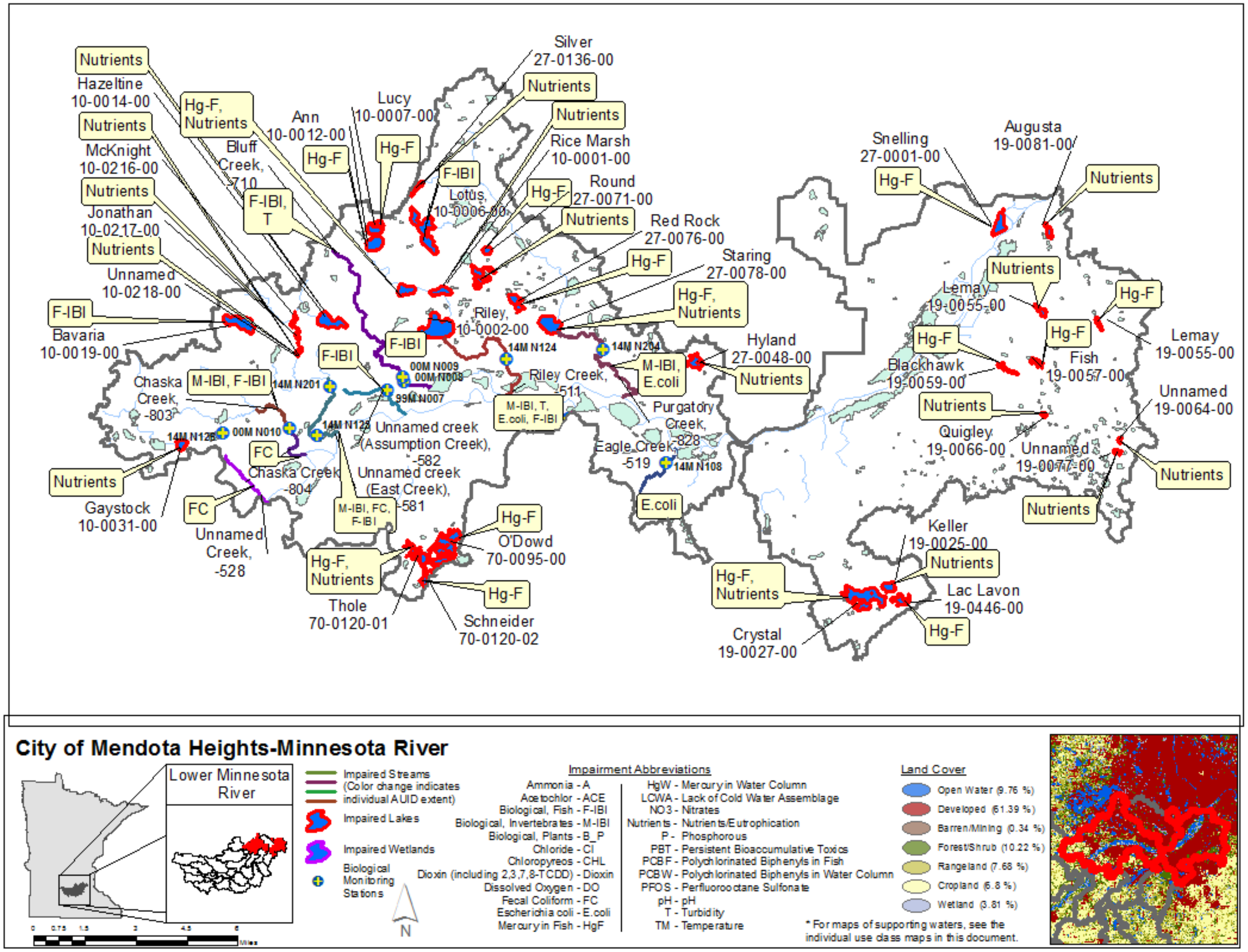


Figure 32. Currently listed impaired waters by parameter and land use characteristics in the City of Mendota Heights - Minnesota River Aggregated 12-HUC.

Tributary to Minnesota River -- Prior Lake Outlet Aggregated 12-HUC HUC 0702001211-04

The Trib. to the Minnesota River (Prior Lake Outlet) Subwatershed encompasses nearly 47 mi.[2] of north central Scott County. This lake dominated watershed is comprised of 10% open water, predominately comprised of lakes. The subwatershed transitions from rural agrarian landuse in its headwaters to suburban sprawl in Prior Lake and again into urban industrial uses in Shakopee below the Minnesota River bluffs before entering wildlife refuge parkland at its outlet. Twenty-two percent of the watershed is cropland, 19% is utilized as rangeland and 32% is developed. The headwaters begins in the southwestern region of the subwatershed near the small village of Lydia draining in a northern direction from Sutton and Fish Lakes. The watershed continues draining northeast to Spring Lake, which connects with the Prior Lake chain. Prior Lake's outlet drains to Jeffers and Pike Lakes flowing north passing Deans Lake and crossing US Hwy 169 before passing Quarry Lake in Shakopee. North of MN Hwy 101 the channel enters the Minnesota Valley National Wildlife refuge draining to Blue Lake before joining the Minnesota River.

Table 25. Aquatic life and recreation assessments on stream reaches: Tributary to Minnesota River Aggregated 12-HUC. Reaches are organized upstream to downstream in the table.

AUID **Reach Name**, *Reach Description*	Biological Station ID	Reach Length (miles)	Use Class	Aquatic Life Indicators: Fish IBI	Invert IBI	Dissolved Oxygen	TSS	Secchi Tube	Chloride	pH	Ammonia -NH_3	Pesticides ***	Eutrophication	Aquatic Life	Aquatic Rec. (Bacteria)
07020012-604 ***Unnamed creek (County Ditch 13),*** *Unnamed ditch to Spring Lk (70-0054-00)*	14MN099	2.77	2Bm, 3C	EX	MTS	IF	IF	IF	--	IF	IF	--	IF	IMP	--
07020012-728 ***Unnamed creek (Prior Lake Outlet Channel),*** *Dean Lk to Blue Lk*	14MN123	1.88	2Bg, 3C	EX	EX	IF	MTS	MTS	MTS	MTS	MTS	--	MTS	IMP	SUP

Abbreviations for Indicator Evaluations: **MTS** = Meets Standard; **EX** = Fails Standard; **IF** = Insufficient Information
Abbreviations for Use Support Determinations: **--** = No Data, **NA** = Not Assessed, **IF** = Insufficient Information, **SUP** = Full Support (Meets Criteria); **IMP** = Impaired (Fails Standards)
Key for Cell Shading: = existing impairment, listed prior to 2014 reporting cycle; = new impairment; = full support of designated use; = insufficient information.
Abbreviations for Use Class: **WWg** = Warmwater general, **WWm** = Warmwater modified, **WWe** = Warmwater exceptional, **CWg** = Coldwater general, **CWe** = Coldwater exceptional, **LRVW** = limited resource value water
*Assessments were completed using proposed use classifications changes that have not yet been written into rule.

Table 26. Lake assessments: Trib. to Minnesota River – Prior Lake Outlet Aggregated 12-HUC.

WD/WMO	Lake Name	DNR ID	Area (acres)	Max Depth (ft)	Assessment Method	Ecoregion	Secchi Trend	Aquatic Life Indicators: Fish IBI	Aquatic Life Indicators: Chloride	Aquatic Life Indicators: Pesticides ***	Aquatic Recreation Indicators: Total Phosphorus	Aquatic Recreation Indicators: Chlorophyll-a	Aquatic Recreation Indicators: Secchi	Aquatic Life Use	Aquatic Recreation Use
Prior Lake-Spring Lake (Scott)	Lower Prior	70-0026-00	941	56	Deep Lake	NCHF	No Evidence of Trend	EX	MTS	--	MTS	MTS	MTS	NS	FS
Prior Lake-Spring Lake(Scott)	Spring	70-0054-00	587	34	Deep Lake	NCHF	No Evidence of Trend	EX	IF	--	EX	EX	EX	NS	NS
Prior Lake-Spring Lake(Scott)	Crystal	70-0061-00	30	26	Deep Lake	NCHF	Insufficient Data	--	--	--	IF	EX	MTS	--	IF
Prior Lake-Spring Lake(Scott)	Fish	70-0069-00	170	28	Deep Lake	NCHF	No Evidence of Trend	IF	IF	--	EX	EX	IF	IF	NS
Prior Lake-Spring Lake(Scott)	Upper Prior	70-0072-00	376	43	Deep Lake	NCHF	Increasing Trend	IF	MTS	--	EX	EX	EX	IF	NS
Prior Lake-Spring Lake(Scott)	Pike	70-0076-00	50	9	Shallow Lake	NCHF	No Evidence of Trend	--	--	--	EX	EX	EX	--	NS
Prior Lake-Spring Lake(Scott)	Unnamed	70-0078-00	25	--	Shallow Lake	NCHF	--	--	--	--	IF	IF	--	--	IF
Scott	Keup's	70-0079-00	49	--	Shallow Lake	NCHF	--	--	MTS	--	IF	--	--	IF	IF
Prior Lake-Spring Lake(Scott)	Unnamed	70-0085-00	20	--	Shallow Lake	NCHF	--	--	MTS	--	EX	--	--	IF	IF

Abbreviations for Ecoregion: DA = Driftless Area, NCHF = North Central Hardwood Forest, NGP = Northern Glaciated Plains, NLF = Northern Lakes and Forests, NMW = Northern Minnesota Wetlands, RRV = Red River Valley, WCBP = Western Corn Belt Plains

Abbreviations for Secchi Trend: D = decreasing/declining trend, I = increasing/improving trend, NT = no detectable trend, -- = not enough data

Abbreviations for Indicator Evaluations: -- = No Data, **MTS** = Meets Standard; **EX** = Exceeds Standard; **IF** = Insufficient Information

Abbreviations for Use Support Determinations: **--** = No Data, **NA** = Not Assessed, **IF** = Insufficient Information, **FS** = Full Support (Meets Criteria); **NS** = Not Support (Impaired, exceeds standard)

Key for Cell Shading: ☐ = existing impairment, listed prior to 2014 reporting cycle; ☐ = new impairment; ☐ = full support of designated use; ☐= insufficient information.

Summary

New stream biological impairments were identified for both biological assemblages at the watershed's outlet station, as well as a new fish impairment on an upstream reach assessed using modified use standards. The upstream station is channelized and heavily modified, low fish IBI scores are reflective of poor habitat conditions observed onsite and a fish community comprised entirely of tolerant species. The macroinvertebrate community has MIBI scores supportive of the modified use threshold, but there are strong macroinvertebrate indicators of TSS and fine bedded sediment stressors in the upstream watershed. Impacts of agricultural landuse are likely limiting the stream biology at this station.

Nine lakes were reviewed for aquatic recreation use assessment in the Prior Lake Subwatershed. The ecoregion standard for aquatic recreation use (AQR) protects lake users from nuisance algal bloom conditions fueled by elevated phosphorus concentrations that degrade recreational use potential. This subwatershed is dominated lake basins connected through small tributaries. Four lakes were previously assessed in 2002 and listed impaired for aquatic recreation use based on nutrient data; Upper Prior, Spring, Pike and Fish. Fish Lake is a small deep basin located in the headwaters, newer data collected reveals seasonal averages are still exceeding impairment thresholds, but a noticeable trend in nutrient and algae concentrations slowly decreasing could signal an improvement in water quality in the near future. Upper Prior had extensive datasets collected since the initial listing for all AQR assessment parameters, newer data confirmed the initial listing. Recent data (2012-2015) had varying conditions – some years with low algae and others high – flow appears to be driving the change, with dry years producing more algae. It should be noted that an increasing long-term trend in water clarity is detected in the Secchi disk dataset, potentially showing improving water quality from local work in the watershed and improvement towards attaining standards. Spring Lake previously assessed and listed in 2002 had newer data confirming nuisance algal conditions persist. Lower Prior was the sole fully supporting lake for AQR use in this subwatershed, all three assessment parameters indicated good water quality for recreational use. Considering the regional popularity and locally heavy shoreline development of Spring, Upper Prior, and Lower Prior, future restoration and protection work should be explored to prevent Lower Prior from future impaired status and potentially improving water quality on the two upstream basins. Upstream impaired lakes, especially Spring and Upper Prior, are operating as sinks for flow through water before inletting into Lower Prior, the inlet to Lower Prior may only be mixing with the southeast bay, and the remaining basin may not be seeing the influence of inputs from the tributary. Dean Lake was previously listed impaired for AQR use based on nutrient data in 2006. The lake was re-evaluated in 2016 to determine if it was functioning as a shallow lake or more representative of wetland conditions. The final determination was that Dean Lake be classified as a wetland and removed from the impaired waters list.

Aquatic life use data was available on six lakes; with only two having, fish IBI information from recent DNR surveys. Lower Prior had two fish IBI surveys that scored well below impairment threshold, indicating aquatic fish communities are stressed from current water quality conditions. The low scores were attributed to low diversity of native species, no intolerant species, high proportion of tolerant biomass (Common Carp) and high numbers of insectivores (White Sucker, Carp). Low proportions of top carnivore (walleye, northern pike) species was observed in both surveys as well. Three surveys were available from Spring Lake, all of which had fish IBI scores indicating poor water quality for supporting aquatic life. Poor fish IBI scores were being driven by low diversity of native species, insectivores and intolerants, as well as a lack of top carnivore (walleye, black crappie) biomass and higher than anticipated proportions of omnivores (yellow bullhead). Neither basin had aquatic vegetation survey data available at this time. Chloride is certainly above background conditions; deep lakes have high concentrations of chloride. However, values are not yet approaching the standard. Work to minimize excess salt application to sidewalks, driveways, and road would benefit the lakes in the watershed.

Upstream basins play a large role in water quality on the downstream reach; lakes and wetlands can assimilate nutrients and sediment, and reduce the concentrations that flow out. The reach upstream of Dean Lake (-726) had good water quality; the oxygen concentrations may be a result of productivity in surrounding wetlands. The reach downstream of Dean Lake before the confluence with the Minnesota River had water chemistry reflective of good water quality. Numerous basins and wetlands upstream of this tributary are clearly playing a role in good water quality. One minor violation for DO may provide reason to conduct additional pre 9 am DO investigations to help determine if low DO levels are limiting biology. Bacteria data collected during the IWM effort revealed this reach is meeting AQR use criteria.

Instream habitat results were also good within the downstream reach but indicate stream bank erosion and sedimentation of coarse substrates could be problematic. Observed fish species were generally tolerant and capture rates were low, perhaps tied to two fish barriers approximately 4 miles upstream, limiting stream connectivity. The macroinvertebrate community showed an impaired condition despite good habitat and water quality; it is possible that the cold temperatures present at this site are having an impact on macroinvertebrate diversity, and that this stream could be showing an impaired Coldwater condition as it flows through this reach. Overall, the impairments observed on the lower reach appear reflective of effects of urban development and storm water runoff.

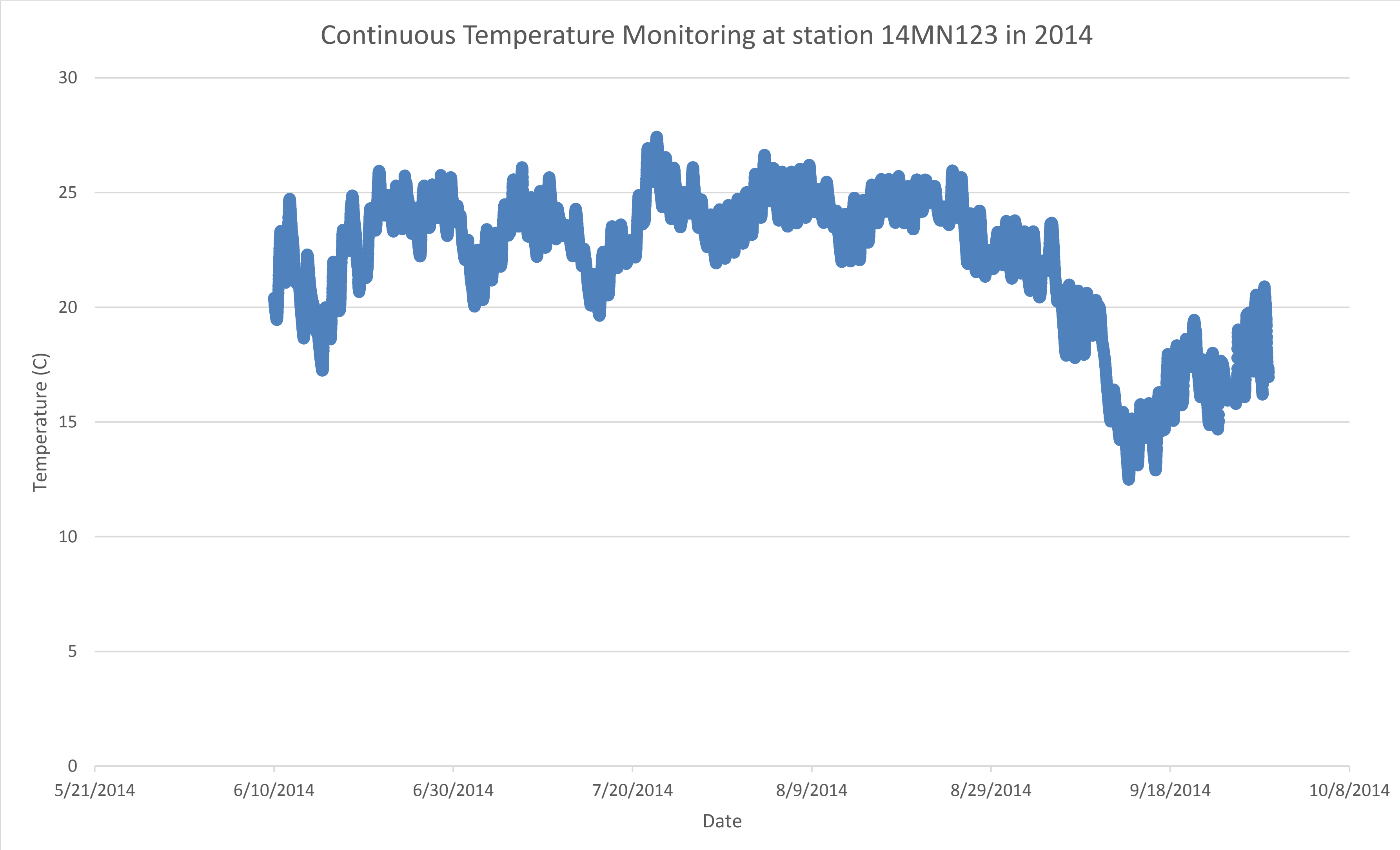


Figure 33. Continuous temperature monitoring data from Prior Lake Outlet at biological Station 14MN123 in 2014.

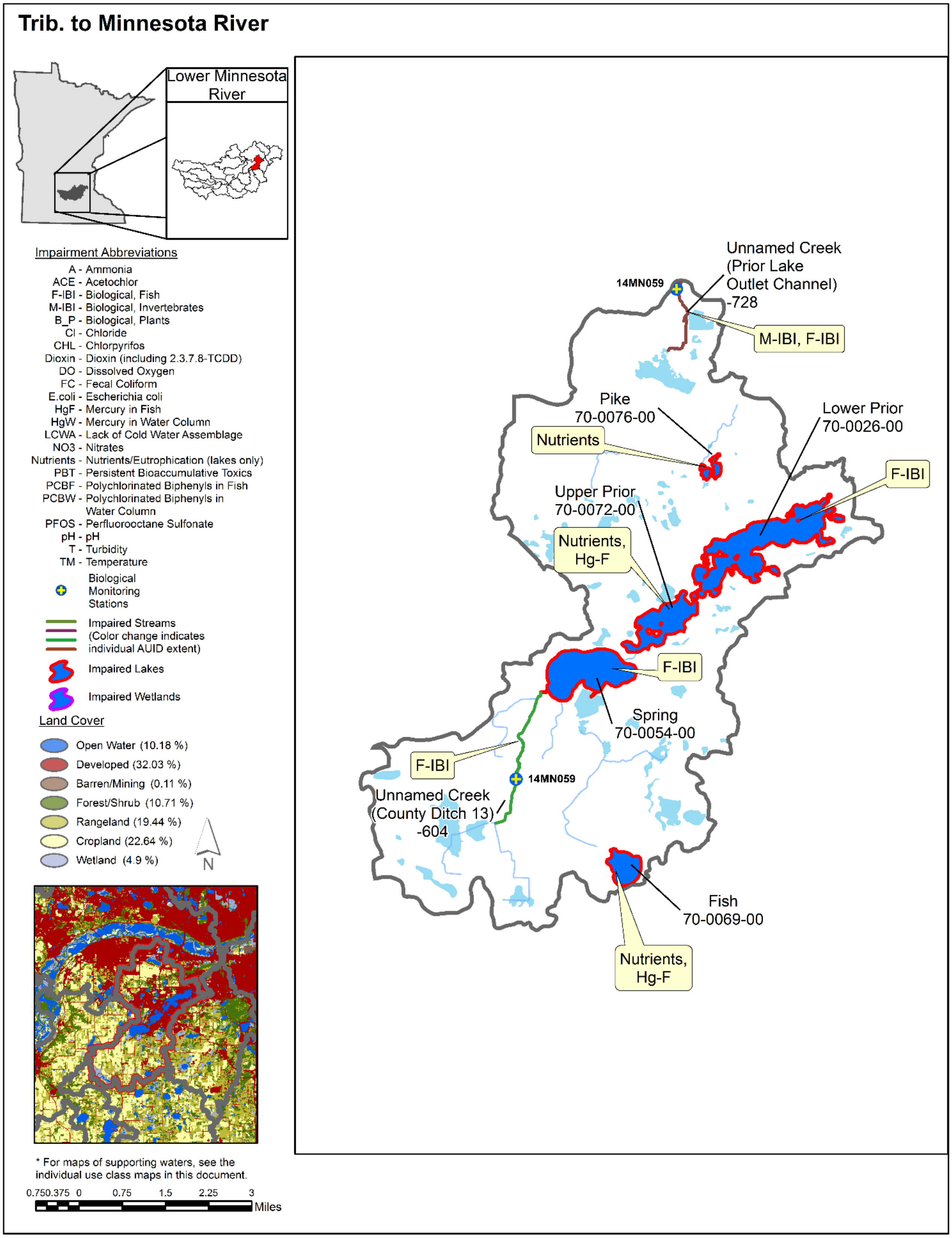


Figure 34. Currently listed impaired waters by parameter and land use characteristics in the Tributary to Minnesota River - Prior Lake Outlet Aggregated 12-HUC.

Nine Mile Creek Aggregated 12-HUC HUC 0702001211-02

The Nine Mile Creek Subwatershed encompasses nearly 50 $mi.^2$ of southwestern Hennepin County. Lying in the heart of the TCMA, the subwatershed's landscape is predominately urban, 84% is developed. Within the subwatershed's urban core, nearly 16% of the subwatershed's remaining land retains a natural green space component, consisting of 5.7% open water, 5.9% forest and 3.3% wetland, providing buffers and a sporadic green corridor for Nine Mile Creek and its branches. The subwatershed is rich in shallow lakes and wetlands that feed its lotic systems. Nine Mile Creek begins as two branches in the northwestern portion of the watershed, a North and South Fork. The south fork emerges from a series of wetland and storm water complexes in residential southeastern Minnetonka, flowing southeast through Bryant Lake and Smetana Lake before joining with the North Fork upstream of Normandale Lake in Bloomington. The north fork's headwaters begin in an industrial area near the heart of downtown Hopkins. It travels in a southeasterly direction through residential Edina, flowing through several wetlands before combining to form Nine Mile Creek just south of I494. There are two dams on Nine Mile Creek after the two branches merge, the Normandale Lake Dam and further downstream at the outlet of Marsh Lake Park. Dams in the subwatershed were constructed in the late 1970s for flood control management within the city of Bloomington. Nine Mile gains gradient as it approaches the Minnesota River bluffs, descending into the Minnesota Valley National Wildlife Refuge and flowing through another series of wetlands and Nine Mile Lake before joining the Minnesota River approximately one mile west of I35W in Bloomington.

Table 27. Aquatic life and recreation assessments on stream reaches: Nine Mile Creek Aggregated 12-HUC. Reaches are organized upstream to downstream in the table.

AUID *Reach Name*, *Reach Description*	Biological Station ID	Reach Length (miles)	Use Class	Aquatic Life Indicators: Fish IBI	Invert IBI	Dissolved Oxygen	TSS	Secchi Tube	Chloride	pH	Ammonia -NH_3	Pesticides ***	Eutrophication	**Aquatic Life**	**Aquatic Rec. (Bacteria)**
07020012-723 ***Ninemile Creek,*** *South Fork, Smetana Lk to Ninemile Cr*	03MN059	3.77	2Bg, 3C	EX	EX	IF	IF	IF	--	IF	IF	--	IF	IMP	--
07020012-807 ***Ninemile Creek,*** *Headwaters to Metro Blvd*	03MN094	6.17	2Bg, 3C	EX	--	IF	IF	MTS	--	IF	IF	--	IF	IMP	--
07020012-808 ***Ninemile Creek,*** *Metro Blvd to end of unnamed wetland*	03MN058	4.94	2Bm, 3C	EX	EX	IF	IF	MTS	IF	IF	IF	--	IF	IMP	--
07020012-809 ***Ninemile Creek,*** *Unnamed wetland to Minnesota R*	03MN098, 03MN099, 96MN006, 03MN100	5.32	2Bg, 3C	EX	EX	IF	MTS	MTS	EX	MTS	MTS	--	IF	IMP	IMP

Abbreviations for Indicator Evaluations: **MTS** = Meets Standard; **EX** = Fails Standard; **IF** = Insufficient Information
Abbreviations for Use Support Determinations: **--** = No Data, **NA** = Not Assessed, **IF** = Insufficient Information, **SUP** = Full Support (Meets Criteria); **IMP** = Impaired (Fails Standards)
Key for Cell Shading: = existing impairment, listed prior to 2014 reporting cycle; = new impairment; = full support of designated use; = insufficient information.
Abbreviations for Use Class: **WWg** = Warmwater general, **WWm** = Warmwater modified, **WWe** = Warmwater exceptional, **CWg** = Coldwater general, **CWe** = Coldwater exceptional, **LRVW** = limited resource value water
*Assessments were completed using proposed use classifications changes that have not yet been written into rule.

Table 28. Lake assessments: Nine Mile Creek Aggregated 12-HUC.

WD/WMO	Lake Name	DNR ID	Area (acres)	Max Depth (ft)	Assessment Method	Ecoregion	Secchi Trend	Aquatic Life Indicators: Fish IBI	Chloride	Pesticides ***	Aquatic Recreation Indicators: Total Phosphorus	Chlorophyll-a	Secchi	Aquatic Life Use	Aquatic Recreation Use
Nine Mile	Normandale	27-1045-01	95	12	Shallow Lake	NCHF	Insufficient Data	--	--	--	EX	MTS	MTS	--	IF
Nine Mile	Cornelia (North)	27-0028-01	31	--	Shallow Lake	NCHF	--	--	--	--	EX	EX	EX	--	NS
Nine Mile	Cornelia (South)	27-0028-02	34	--	Shallow Lake	NCHF	--	--	--	--	EX	EX	EX	--	NS
Nine Mile	Edina	27-0029-00	24	--	Shallow Lake	NCHF	Insufficient Data	--	IF	--	IF	IF	IF	IF	NS
Nine Mile	Indianhead	27-0044-00	12	6	Shallow Lake	NCHF	Insufficient Data	--	--	--	--	--	IF	--	IF
Nine Mile	Bush	27-0047-00	175	23	Deep Lake	NCHF	No Evidence of Trend	IF	--	--	MTS	MTS	MTS	IF	FS
Nine Mile	Mirror	27-0055-00	21	--	Shallow Lake	NCHF	No Evidence of Trend	--	--	--	--	--	EX	--	IF
Nine Mile	North Anderson	27-0062-01	99	--	Shallow Lake	NCHF	Increasing Trend	--	--	--	MTS	IF	MTS	--	FS
Nine Mile	Southwest Anderson	27-0062-03	56	9	Shallow Lake	NCHF	No Evidence of Trend	--	--	--	IF	IF	IF	--	IF
Nine Mile	Bryant	27-0067-00	173	45	Deep Lake	NCHF	Increasing Trend	EX	MTS	--	MTS	EX	MTS	NS	FS
Nine Mile	Smetana	27-0073-00	23	12	Shallow Lake	NCHF	Insufficient Data	--	--	--	MTS	MTS	MTS	--	IF
Nine Mile	Minnetoga	27-0088-00	13	27	Deep Lake	NCHF	Insufficient Data	--	--	--	MTS	MTS	MTS	--	FS
Nine Mile	SHADY OAK (MIDDLE BAY)	27-0089-02	19	--	Deep Lake	NCHF	Insufficient Data	--	--	--	MTS	MTS	MTS	--	FS
Nine Mile	Wing	27-0091-00	12	--	Shallow Lake	NCHF	No Evidence of Trend	--	--	--	EX	EX	EX	--	NS
Nine Mile	Rose	27-0092-00	23	--	Shallow Lake	NCHF	Insufficient Data	--	--	--	EX	EX	EX	--	NS

Abbreviations for Ecoregion: DA = Driftless Area, NCHF = North Central Hardwood Forest, NGP = Northern Glaciated Plains, NLF = Northern Lakes and Forests, NMW = Northern Minnesota Wetlands, RRV = Red River Valley, WCBP = Western Corn Belt Plains

Abbreviations for Secchi Trend: D = decreasing/declining trend, I = increasing/improving trend, NT = no detectable trend, -- = not enough data

Abbreviations for Indicator Evaluations: -- = No Data, **MTS** = Meets Standard; **EX** = Exceeds Standard; **IF** = Insufficient Information

Abbreviations for Use Support Determinations: **--** = No Data, **NA** = Not Assessed, **IF** = Insufficient Information, **FS** = Full Support (Meets Criteria); **NS** = Not Support (Impaired, exceeds standard)

Key for Cell Shading: = existing impairment, listed prior to 2014 reporting cycle; = new impairment; = full support of designated use; = insufficient information.

Summary

Lakes

Eighteen lakes in the Nine Mile Creek Subwatershed were reviewed for aquatic recreation use (AQR). The ecoregion standard for aquatic recreation use protects lake users from nuisance algal bloom conditions fueled by elevated phosphorus concentrations that degrade recreational use potential. This subwatershed is a composed of lakes that fall under both shallow and deep lake criteria. Four lake basins were previously listed impaired for aquatic recreation use based on nutrient data; Cornelia (North), Wing, Rose and Edina. Where newer data was available on these existing aquatic recreation use impairments it only further confirmed the initial listings. Cornelia (South) was the sole new aquatic recreation use listing, the small contributing headwater watershed is almost entirely disturbed and the basin itself is shallow; both lend to declines in recreational water quality. Southwest Anderson is on the cusp of AQR impairment, local in-lake management has been occurring in the recent past, indicating a noticeable increase in AQR water quality, at this time the basin will not be listed, in-lake management should continue going forward. Water quality of Normandale Lake may not be accurately depicted using AQR parameters available, phosphorus is exceeding and response variables are not revealing the expected response, dense vegetation and attached algae growth are impacting nutrients available for suspended algae growth. Bryant Lake was previously listed impaired for AQR use in 2008, with nutrient and algae data indicating poor water quality. More recently, various best management practices (BMPs) including increased surface water storage and in lake management are having a noticeable impact on recreational water quality, to the point that all three AQR assessment parameters are now meeting thresholds and a trend revealing increase clarity. Bryant Lake will be removed from the impaired waters list as a restored water; local watershed efforts lead to the improvement. Protection work to maintain currently high water quality basins would benefit suburban residents within the densely populated metropolitan area. Chloride data was available on two basins, neither of which suggest it is stressing the aquatic life within the lake basin. As expected, in a densely urbanized watershed, the chloride levels are well above background conditions, with concentrations in Bryant Lake exceeding 100 mg/L. Work to ensure appropriate amounts of deicing salts are used on sidewalks, driveways, and roads will benefit the lakes in this watershed.

Bryant and Bush lakes had fish community information available from DNR lake index of biotic integrity (IBI) program. Bryant was found to be not supporting aquatic life use (AQL). Low diversity of native, intolerant, insectivore and vegetation dwelling species observed during sampling efforts are driving the IBI score below the threshold. Aquatic plant community data indicates a healthy plant populations exist in Bryant Lake. Bush Lake had two lake IBI surveys recently in 2013 and 2015, a poor IBI score result from each survey, driven by high biomass of omnivore and tolerant species (Common Carp), and low proportion of insectivore species. Sampling protocol came into question during the assessment due to trap net use outside of established index period, considering the validity of the data is in question in the basin an assessment will not be made at this time.

Streams

As with many urban river corridors, many of the cities through which Nine Mile Creek and its tributaries flow have set aside the river and its riparian zone as green space. This has had the effect of allowing streams to maintain a meandering channel throughout much of their natural path. While a meandering channel is desirable for maintaining a healthy aquatic biological community, the impacts of urbanization can often have impacts on natural flow patterns and in-stream habitat that overwhelm the benefits of a natural stream corridor. Three of the four stream reaches in the Nine Mile Creek Watershed that were assessed using biological indicators have natural channels and thus were assessed using general aquatic life use standards, one was assessed for biology using modified tiered aquatic life use standards due to alterations to its natural drainage in conjunction with limited biological potential of instream habitat. An extensive set of biological data collected by the MPCA and the local watershed district over a range of 12 to 18 years was available in making assessment decisions in each of the assessable stream reaches. The South Fork of Nine Mile Creek has data from four stations, which show a consistent pattern of impairment for both fish, and macroinvertebrates, save for two fish samples collected at site 03MN059, which have twice bounced above thresholds only to fall below in following years. Habitat appears to have gotten worse over time as this location, with poor channel stability, bank erosion and a limited riparian zone being potential contributors to lower biological scores. A previous biological impairment existed for a stream reach, which has since been divided based on a change to its aquatic life use expectations. The station (03MN094) on which the previous impairment was defined is now combined with site 00MN011 in reach -807. The previous impairment had been carried to the current reach (-807), as more recent data has confirmed the original impairment to the fish community. The reach immediately downstream (-808) has been designated as modified, and a new biological impairment is proposed for both FIBI and MIBI, despite having a lower aquatic life use. Data collected beyond the assessment window (2003) showed fish and macroinvertebrate communities above impairment thresholds, but more recent data (2014) shows much lower biological scores suggesting a degrading condition over time. An impoundment just below this reach is likely limiting fish migration and may be contributing to lower FIBI scores. The stream reach located below the impoundment (-809) has the most extensive set of fish data in the watershed, with 15 visits to 5 different stations collected over the course of 18 years. These samples show a consistent pattern of scoring well below impairment thresholds save for two samples, one collected at each site 03MN100, and 96MN096, which scored above the threshold. Macroinvertebrate data only exists for one station in this reach (96MN006), where the MIBI score was below the impairment threshold. Instream habitat measurements taken over time suggest that habit is degrading throughout the watershed. Habitat scores improve approaching the mouth near the Minnesota River, due to an intact and extensive riparian zone. Instream conditions indicate the channel stability, bank erosion and sediment contributions are likely impacting biological communities throughout the watershed. Existing impairments for chloride on the downstream reach, and trends towards high nutrient values throughout the watershed, suggest water quality could also be impacting biological communities. Despite impaired conditions existing watershed-wide, instream habitat and channel conditions are such that improvement to the biological communities is possible. Bank stabilization and mitigation of peak flow contributions are likely improvements that could work toward creating more stable stream habitats for both fish and macroinvertebrate communities. Additional work to lower nutrient levels in contributing lakesheds could also have a beneficial impact in downstream aquatic communities.

The upper reaches of Nine Mile Creek (-807 & -808) had limited water chemistry data available for assessment; the Secchi tube data revealed good clarity across large datasets indicating sediment loads may not be stressing AQL in the upstream reaches. Flow through lakes and wetland complexes typically provide an increased residence time, which can play a role in water quality in downstream waterbodies. The downstream reach of Nine Mile Creek (-809) had an existing chloride impairment; newer data revealed high chloride concentrations still occur in the winter months each year. Chloride exceedances appeared to be correlated to winter road maintenance, but reappearance is seen in one May sample as well. Current are underway to address road salt application and associated indirect consequences. Other aquatic life parameters with relatively large datasets did not reveal clear stressors. Bacteria concentrations observed within the downstream reach of Nine Mile Creek will trigger aquatic recreation use impairment. The upper reaches of the South Fork Nine Mile Creek had limited water chemistry data available for a current assessment of either aquatic recreation or aquatic life use based on water chemistry alone.

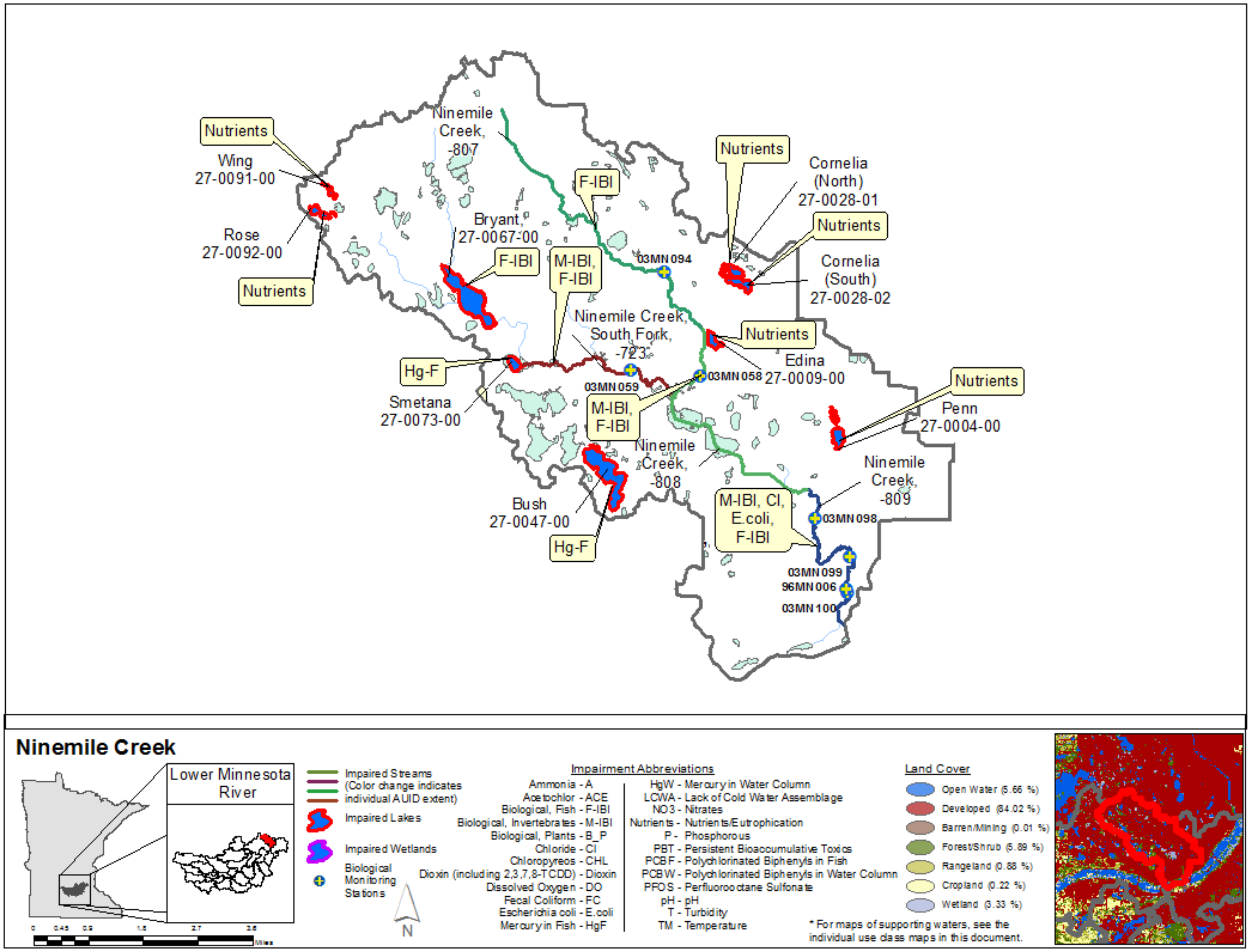


Figure 35. Currently listed impaired waters by parameter and land use characteristics in the Nine Mile Creek Aggregated 12-HUC.

Credit River Aggregated 12-HUC HUC 0702001211-03

The Credit River Subwatershed drains 47 mi.[2] of Scott County. The Credit River's headwaters start in a rural landscape, just south of Credit River Township as the river flows downstream, the surrounding land use transitions to small acreages and increasing levels of residential development as the river enters the city of Savage and joins the Minnesota River. The Credit River emerges from wetland complexes in the southern reaches of the watershed and flows north, gaining gradient as the river moves through the bluff of the Minnesota River valley. Its low gradient stream margins have likely attributed to wider natural buffers observed in much of the river's agricultural headwaters and continuing through Murphey-Hanrahan Regional Park and Hidden Valley Park before emerging into downtown Savage where stream alteration is more prevalent and natural riparian buffers are more scarce. Land use in the watershed is primarily divided between developed (26.8%), range (26.9%), forested (22.1%) and row crop (14.3%). Four percent of the watershed's landscape is covered by open water, divided between the watershed's namesake and several small lakes including Orchard, Murphy, Hanrahan and Cleary. In the last 30 years, the watershed's land use has shifted from a small rural community into a more densely populated growing suburban area, development pressures will continue as the TCMA continues to expand.

Table 29. Aquatic life and recreation assessments on stream reaches: Credit River Aggregated 12-HUC. Reaches are organized upstream to downstream in the table.

AUID *Reach Name*, *Reach Description*	Biological Station ID	Reach Length (miles)	Use Class	Aquatic Life Indicators: Fish IBI	Invert IBI	Dissolved Oxygen	TSS	Secchi Tube	Chloride	pH	Ammonia -NH_3	Pesticides ***	Eutrophication	**Aquatic Life**	**Aquatic Rec. (Bacteria)**
07020012-811 ***Credit River,*** *-93.3526 44.7059 to Minnesota R*	14MN059, 90MN117	12.11	2Bg, 3C	EX	EX	NA	MTS	MTS	EX	MTS	MTS	--	IF	NS	NS

Abbreviations for Indicator Evaluations: **MTS** = Meets Standard; **EX** = Fails Standard; **IF** = Insufficient Information
Abbreviations for Use Support Determinations: **--** = No Data, **NA** = Not Assessed, **IF** = Insufficient Information, **SUP** = Full Support (Meets Criteria); **IMP** = Impaired (Fails Standards)
Key for Cell Shading: ☐ = existing impairment, listed prior to 2014 reporting cycle; ☐ = new impairment; ☐ = full support of designated use; ☐= insufficient information.
Abbreviations for Use Class: **WWg** = Warmwater general, **WWm** = Warmwater modified, **WWe** = Warmwater exceptional, **CWg** = Coldwater general, **CWe** = Coldwater exceptional, **LRVW** = limited resource value water
*Assessments were completed using proposed use classifications changes that have not yet been written into rule.

Table 30. Lake assessments: Credit River Aggregated 12-HUC.

WD/WMO	Lake Name	DNR ID	Area (acres)	Max Depth (ft)	Assessment Method	Ecoregion	Secchi Trend	Aquatic Life Indicators:			Aquatic Recreation Indicators:			Aquatic Life Use	Aquatic Recreation Use
								Fish IBI	Chloride	Pesticides ***	Total Phosphorus	Chlorophyll-a	Secchi		
Scott	Krenz	70-0009-00	13	--	Shallow Lake	NCHF	No Evidence of Trend	--	--	--	--	--	MTS	--	IF
Black Dog	Kingsley	19-0030-00	35	--	Shallow Lake	NCHF	No Evidence of Trend	--	--	--	MTS	MTS	MTS	--	FS
Black Dog	Orchard	19-0031-00	230	31	Deep Lake	NCHF	Increasing Trend	MTS	MTS	--	MTS	MTS	MTS	FS	FS
Scott	Hanrahan	70-0019-00	75	8	Shallow Lake	NCHF	Insufficient Data	--	--	--	--	--	IF	--	IF
Scott	Markley	70-0021-00	16	--	Shallow Lake	NCHF	No Evidence of Trend	--	--	--	EX	MTS	MTS	--	IF
Scott	Cleary	70-0022-00	149	9	Shallow Lake	NCHF	No Evidence of Trend	--	--	--	EX	EX	IF	--	NS
Scott	Murphy	70-0010-00	47	15	Shallow Lake	NCHF	Increasing Trend	--	--	--	MTS	MTS	MTS	--	FS
Scott	Unnamed (S Portion)	70-0011-02	38	24	Shallow Lake	NCHF	No Evidence of Trend	--	--	--	MTS	MTS	MTS	--	FS
Scott	McColl Pond	70-0017-00	21	11	Shallow Lake	NCHF	Insufficient Data	--	--	--	--	--	IF	--	IF
Prior Lake-Spring Lake(Scott)	Cate's or Hidden	70-0018-00	31	--	Shallow Lake	NCHF	Increasing Trend	--	--	--	MTS	MTS	MTS	--	FS

Abbreviations for Ecoregion: DA = Driftless Area, NCHF = North Central Hardwood Forest, NGP = Northern Glaciated Plains, NLF = Northern Lakes and Forests, NMW = Northern Minnesota Wetlands, RRV = Red River Valley, WCBP = Western Corn Belt Plains
Abbreviations for Secchi Trend: D = decreasing/declining trend, I = increasing/improving trend, NT = no detectable trend, -- = not enough data
Abbreviations for Indicator Evaluations: -- = No Data, **MTS** = Meets Standard; **EX** = Exceeds Standard; **IF** = Insufficient Information
Abbreviations for Use Support Determinations: **--** = No Data, **NA** = Not Assessed, **IF** = Insufficient Information, **FS** = Full Support (Meets Criteria); **NS** = Not Support (Impaired, exceeds standard)
Key for Cell Shading: = existing impairment, listed prior to 2014 reporting cycle; = new impairment; = full support of designated use; = insufficient information.

Summary

Streams

Biological data utilized for the aquatic life use assessment of the Credit River indicate that the stream is not meeting standards. Supporting fish and macroinvertebrate data was gathered outside of the assessment window at the upstream station (90MN117) from 1990 through 2002. In 2002, both fish and macroinvertebrates were meeting standards but were within upper confidence limits. Recent data indicate the health of the rivers biological communities have degraded since 2002. Data from 2014, at the same station, show both assemblages falling below the impairment threshold and lower confidence limits, suggesting recent activity or change within the subwatershed may be impacting stream biology. Further downstream (14MN059) survey results were better compared to the upstream station. The communities at the downstream station were still below impairment thresholds but within lower confidence limits for both assemblages, indicating vulnerable stream biology. Stream fish communities were dominated by tolerant species across most visits. Similarly, macroinvertebrate communities were dominated by tolerant individuals, with intolerant taxa nearly absent across all visits at both stations. The relatively high quality of habitat scores found at both stations suggest water quality and/or hydrological stress are dominant stressors impacting stream biology.

The downstream reach of Credit River had the majority of water chemistry data available within this subwatershed. Chloride concentrations are high, exceeding standards and pose a serious threat to aquatic life within the reach. Chloride exceedances appear to be correlated to winter road maintenance, but reappearance was seen in one June sample as well. Current projects are underway to address road salt application and associated indirect consequences. Nutrient levels were elevated throughout the subwatershed, but an increased response in algae or excessive plant growth was not observed. Bacteria concentrations were persistently high, triggering a listing for aquatic recreation use on this reach.

Lakes

Ten lakes were reviewed for aquatic recreation use in the Credit River Subwatershed. The ecoregion standard for aquatic recreation use protects lake users from nuisance algal bloom conditions fueled by elevated phosphorus concentrations that degrade recreational use potential. The majority of basins in this subwatershed fall under the shallow lake criteria. Shallow basins in the subwatershed supporting good recreation water quality included; Cate's, Murphy and Kingsley lakes, these basins appear to be benefitting from small, relatively undisturbed contributing watersheds. Cleary Lake was the sole impaired lake basin, previously assessed and listed in 2008. Newer data available during recent assessments indicated elevated phosphorus levels are continuing to drive dense algal production. Internal loading from frequent mixing events in a shallow basin plays a large role in nutrient resuspension in the water column. The shallow basin would benefit from projects on the landscape contributing watershed to reduce phosphorus runoff and potential in-lake nutrient management. The data for Markley Lake was unclear; the water quality is very close to the standard, indicating that it is high priority for protection efforts that would help ensure the basin does not degrade into an impaired status in the near future. Land use throughout the watershed is relatively diverse considering the nearby metropolitan area, with a significant amount of undisturbed parkland. This natural area increases surface water infiltration and reduces runoff, which is reflected in the good water quality of the majority of small lakes within the park boundaries.

Orchard Lake has a maximum depth and littoral area consistent with a deep lake. Orchard Lake exhibited good water quality that is supporting aquatic recreation use, despite dense shoreline development. Deeper lakes typically stratify seasonally locking away nutrients in the hypolimnion, leaving significantly lower nutrient concentrations in surface waters that drive algal production. Orchard Lake was also found to be supporting aquatic life use based on available fish IBI information. The high proportion of top carnivores (northern pike), low number of omnivorous species (yellow bullhead) and high density of insectivore species all positively influence the IBI score. Vegetation survey information revealed a healthy plant population, supporting the fish IBI data. Potential stressors noted are common in urban settings, impervious surfaces, shoreline development density, and localized plant management activities. Considering the sensitivity to these stressors, this basin should be regarded as vulnerable to future degradation.

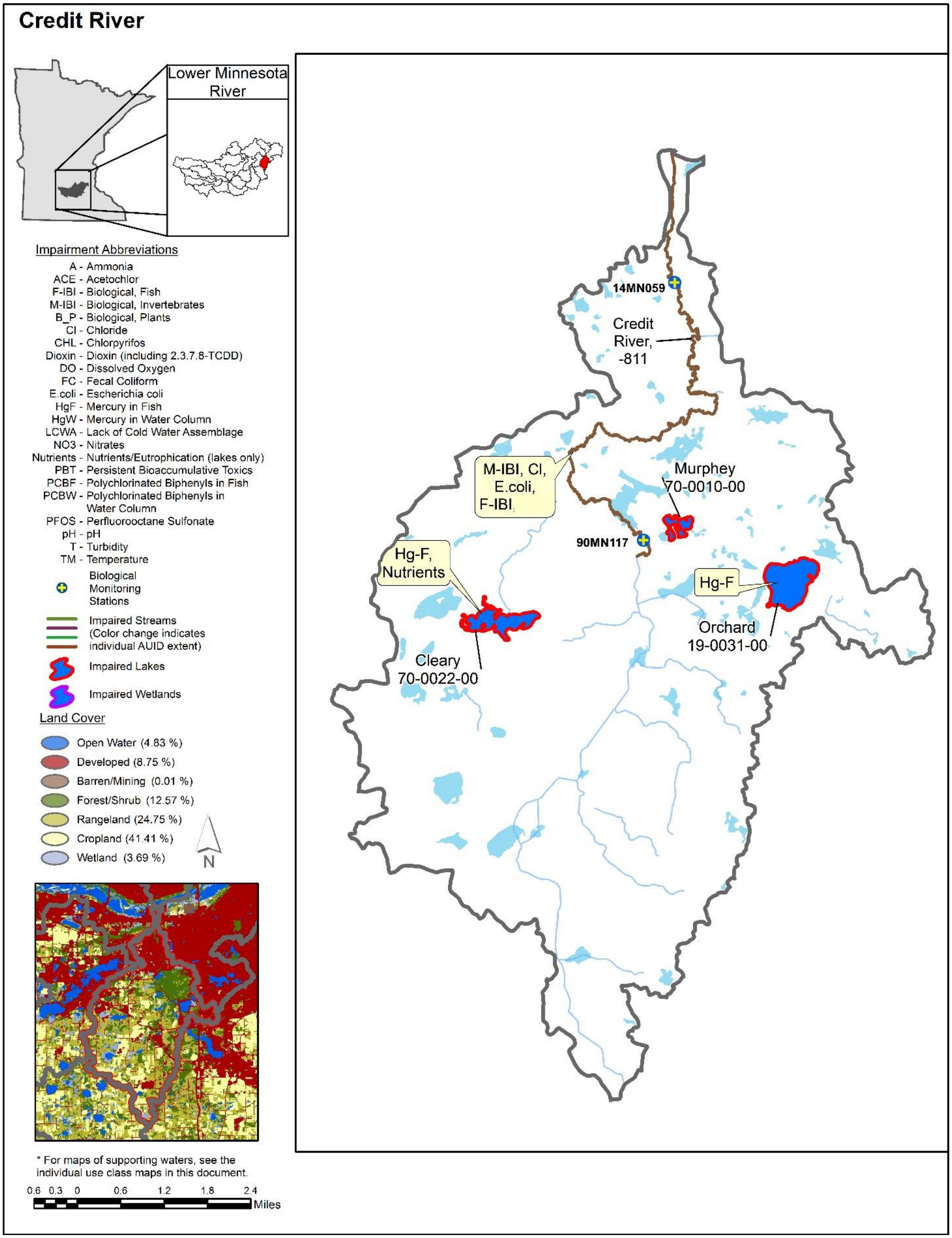


Figure 36. Currently listed impaired waters by parameter and land use characteristics in the Credit River Aggregated 12-HUC.

Watershed-wide results and discussion

Assessment results and data summaries are included below for the entire HUC-8 watershed unit of the Lower Minnesota River Watershed, grouped by sample type. Summaries are provided for lakes, streams and rivers in the watershed for the following: aquatic life and recreation uses, aquatic consumption results, load monitoring data results, transparency trends and remote sensed lake transparency. Additionally, groundwater and wetland monitoring results 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 Lower Minnesota River Watershed.

Stream water quality

In the Lower Minnesota River Watershed 117 of 186 stream AUIDs were assessed. (Table 31) Of the assessed streams, only 15 were considered to be fully supporting of aquatic life and three streams were fully supporting of aquatic recreation. Seventeen AUIDs were classified as limited resource waters and assessed accordingly.

Throughout the watersheds, 104 AUIDs are non-supporting for aquatic life and/or recreation. Of those AUIDs, 80 are non-supporting for aquatic life and 47 are non-supporting for aquatic recreation. Aquatic life use impairments were identified on six reaches solely based on water chemistry data while the remaining 74 were identified where biology was sampled. Of these 74 impairments 48 were derived from both fish and macroinvertebrates, 18 listings were fish only impairments and eight listings were invert only impairments. Of the 74 Aquatic Life Use impairments identified, 37 were held to modified use standards while 37 were held to general use standards. Supporting reaches for aquatic life use where fish and/or macroinvertebrates were sampled were identified in only 15 reaches in the watershed. Of these 15, 13 streams were held to modified use standards while only two were held to general use standards. There was a single new impairment identified for pesticides (Acetechlor) on Silver Creek within the Bevens Creek Subwatershed, while two reaches were found to be meeting pesticide standards on Riley Creek and Nine Mile Creek.

Table 31. Assessment summary for stream water quality in the Lower Minnesota River Watershed.

				Supporting		Non-supporting				
Watershed	**Area (acres)**	**# Total AUIDs**	**# Assessed AUIDs**	**# Aquatic Life**	**# Aquatic Recreation**	**# Aquatic Life**	**# Aquatic Recreation**	**# Limited Resource Value**	**Insufficient Data**	**# Delistings**
Lower Minnesota River	1243147	**186**	**117**	**15**	**3**	**80**	**48**	**17**	**61**	**0**
City of Mendota Heights	143488	19	9	2	0	6	6	0	6	0
Nine Mile Creek	31552	5	4	0	0	4	1	0	1	0
Credit River	30208	6	1	0	0	1	1	0	5	0
Prior Lake Outlet	29824	4	2	0	1	2	0	0	2	0
Carver Creek	53056	14	12	3	2	2	7	1	3	0
Bevens Creek	154201	16	10	0	0	7	7	4	7	0
Forest Prairie Creek	45248	6	6	1	0	5	1	0	0	0
Le Sueur Creek	50560	7	3	0	0	3	1	1	3	0
South Branch Rush River	68672	7	5	1	0	4	2	0	2	0
North Branch Rush River	63360	11	9	1	0	5	3	2	4	0
High Island Creek	154201	24	14	3	0	10	6	3	9	0
City of Belle Plaine	54848	8	6	0	0	3	5	0	1	0
Sand Creek	175168	33	17	2	0	15	5	2	12	0
Middle Branch Rush River	54400	9	7	2	0	4	0	2	3	0
Rush River	20736	3	3	0	0	3	1	0	0	0
Judicial Ditch 1A	49280	6	4	0	0	3	0	2	3	0
City of Le Sueur	61760	7	5	0	0	3	3	0	2	0

Lake water quality

Of the lakes within the Lower Minnesota River Watershed 133 greater than 10 acres had some type of assessment data available (Table 32). The availability of biological index data during this assessment cycle provided an opportunity to make complete aquatic life use assessments on lakes. Forty-four lakes were found to be support aquatic recreation, six were found to support for aquatic life use. Thirty-seven lakes were previously listed impaired prior to this assessment cycle for aquatic recreation use based on eutrophication data, more recent data collected on these previously listed lakes confirm initial impairments. Eighteen new lake impairments for aquatic recreation will be added based on eutrophication data. Six new lakes were found to be fully supporting aquatic life using fish community data; Orchard, Crystal, Thole, McMahon, Mitchell and Staring. Eight Lakes were found to not supporting aquatic life use based on fish community data; Waconia, Riley, Lotus, Baravia, Bryant, Lower Prior, Spring and O'Dowd. Insufficient data was available for aquatic life or aquatic recreation use assessments on 57 lakes. Three lakes were put through the delisting process in this assessment effort; Bryant, Mitchell, and McMahon. Two lakes with aquatic recreation use impairments were corrected and removed from the impaired waters list during this assessment review; O'Dowd and Dean.

Table 32. Assessment summary for lake water chemistry in the Lower Minnesota River Watershed.

			Supporting		Non-supporting			
Watershed	**Area (acres)**	**Lakes >10 Acres**	**# Aquatic Life**	**# Aquatic Recreation**	**# Aquatic Life**	**# Aquatic Recreation**	**Insufficient Data**	**# Delistings**
Lower Minnesota River	1243147	**133**	**6**	**44**	**8**	**55**	**57**	**3**
City of Mendota Heights	143488	54	4	29	4	20	23	0
Nine Mile Creek	31552	18	0	7	1	6	7	1
Credit River	30208	10	1	5	0	1	5	0
Prior Lake	29824	9	0	1	2	4	8	0
Carver Creek	53056	10	0	0	1	8	4	0
Bevens Creek	154201	2	0	0	0	1	2	0
Forest Prairie Creek	45248	10	0	0	0	1	1	0
Le Sueur Creek	50560	1	0	0	0	1	0	0
South Branch Rush River	68672	1	0	0	0	1	1	0
North Branch Rush River	63360	1	0	0	0	1	1	0
High Island Creek	154201	3	0	1	0	2	0	0
Sand Creek	175168	14	1	1	0	9	5	2

Fish contaminant results

Mercury was analyzed in fish tissue samples collected from High Island Creek and Rush River, as well as 46 lakes in the watershed. Polychlorinated biphenyls (PCBs) were measured in fish from the 2 streams and 29 lakes. Perfluorochemicals were analyzed in fish from 13 lakes. Overall, 18 fish species were tested for contaminants. A total of 2,284 fish were collected for contaminant analysis between 1983 and 2015.

Contaminant concentrations are summarized by waterway, fish species and year (Table 33). “Total Fish” indicates the total number of fish analyzed and “N” indicates the number of samples. The number of fish exceeds the number of samples when fish are combined into a composite sample. This was typically done for panfish, such as bluegill sunfish and yellow perch. “Anatomy” refers to the type of sample; since 1989, most of the samples have been skin-on fillets (FILSK) or for fish without scales (catfish and bullheads), skin-off fillets (FILET). Occasionally, whole fish (WHORG) are analyzed.

Rush River and 34 lakes were listed as impaired for mercury in fish tissue in MPCA’s 2016 Draft Impaired Waters List. The majority of the impaired waters (Rush River and 27 lakes) were added to the Statewide Mercury TMDL. The other seven impaired lakes had mercury concentrations high enough to not qualify for the Statewide TMDL.

None of the waters in this watershed were listed as impaired for PCBs in fish tissue. PCB concentrations in fish tissue were near or below the reporting limit (0.01 - 0.05 mg/kg). Fish consumption advice, developed by the MDH, has meal advice of “unrestricted” for PCBs in fish less than or equal to 0.05 mg/kg. A notable exception was common carp collected from Snelling Lake in 1986; 3 carp were combined into a single composite sample that had a PCB concentration of 0.844 mg/kg. Because the measurement is more than 10 years old, it is not included for consideration in the current fish consumption advisory for the lake. At the next opportunity to collect fish from Snelling Lake, PCBs should be analyzed in common carp.

Of the 13 perfluorochemicals analyzed, only perfluorooctane sulfonate (PFOS) substantially accumulates in fish tissue; therefore, fish consumption advisories (by MDH) and impairments (by MPCA) are based on PFOS concentrations. Average concentrations over 40 µg/kg (parts per billion) are listed for one meal per week advice; over 200 µg/kg they are listed for one meal per month and MPCA lists water as impaired for fish consumption. Fish (19-0057-00), Hyland, Lemay, Snelling, Round and Red Rock have meal advice for one meal per week because of PFOS for at least one fish species. None of the lakes or rivers in this watershed are impaired (exceed 200 µg/kg) for PFOS.

Overall, mercury concentrations in fish remain a concern for the Rush River and many of the lakes tested in the watershed. Carp from Snelling Lake should be retested for PCBs. The Fish Contaminant Monitoring Program will continue to retest the fish from impaired waters to assess if mercury levels are changing.

Table 33. Summary of fish length, mercury and PCBs by waterway-species-year.

DOWID	Waterway	Species	Year	Anat-omy[1]	Total Fish	No. Samples	Length (in)			Mercury (mg/kg)			PCBs (mg/kg)				PFOS (mg/kg)			
							Mean	Min	Max	Mean	Min	Max	N	Mean	Max	< RL	N	Mean	Max	< RL
07020012 -653, -833, -834, 837, -838	HIGH ISLAND CREEK	White sucker	2014	FILSK	5	1	14.6	14.6	14.6	0.150	0.150	0.150	1	0.035	0.035	Y				
07020012 -521, -548	RUSH R. *	Channel catfish	2014	FILSK	2	2	18.4	17.5	19.2	0.176	0.126	0.225	2	0.035	0.035	Y				
		Golden redhorse	2014	FILSK	5	5	12.9	12.0	14.6	0.106	0.087	0.134	2	0.035	0.035	Y				
10000200	RILEY**	Bluegill sunfish	2005	FILSK	8	1	6.6	6.6	6.6	0.090	0.090	0.090								
			2011	FILSK	9	2	5.9	5.5	6.3	0.060	0.055	0.065								
			2015	FILSK	10	1	8.3	8.3	8.3	0.143	0.143	0.143								
		Black bullhead	2005	FILET	8	1	9.8	9.8	9.8	0.117	0.117	0.117								
			2011	FILET	5	1	9.7	9.7	9.7	0.056	0.056	0.056								
		Black crappie	1999	FILSK	10	1	6.9	6.9	6.9	0.120	0.120	0.120								
			2005	FILSK	9	1	7.9	7.9	7.9	0.204	0.204	0.204								
			2015	FILSK	2	1	9.4	9.4	9.4	0.088	0.088	0.088								
		Common Carp	1999	FILSK	3	1	22.6	22.6	22.6	0.200	0.200	0.200	1	0.014	0.014					
			2005	FILSK	4	1	23.2	23.2	23.2	0.132	0.132	0.132	1	0.01	0.01	Y				
		Northern pike	1999	FILSK	8	8	26.1	21.4	36.7	0.286	0.200	0.380	1	0.01	0.01	Y				
			2005	FILSK	6	6	21.9	16.2	27.2	0.150	0.077	0.197								
			2011	FILSK	7	7	23.4	21.0	28.5	0.120	0.104	0.153								
			2015	FILSK	8	8	22.7	18.7	25.9	0.195	0.084	0.262								
		Walleye	1999	FILSK	4	4	21.6	15.5	27.0	0.753	0.350	1.060	1	0.016	0.016					
			2005	FILSK	5	5	18.7	17.8	19.8	0.452	0.206	0.679								
			2015	FILSK	4	4	21.5	19.9	24.1	0.408	0.345	0.464								
10000600	LOTUS*	Bluegill sunfish	1999	FILSK	10	1	6.6	6.6	6.6	0.080	0.080	0.080								
		Common Carp	1999	FILSK	1	1	27.5	27.5	27.5	0.160	0.160	0.160	1	0.025	0.025					
		Northern pike	1999	FILSK	7	7	27.5	24.3	32.1	0.227	0.110	0.480								
			2010	FILSK	2	2	22.2	20.3	24.1	0.028	0.024	0.031								
		Walleye	1999	FILSK	8	8	20.4	16.4	23.6	0.373	0.150	0.580								
			2006	FILSK	5	5	13.7	13.0	14.2	0.067	0.052	0.087								
			2010	FILSK	8	8	17.6	14.2	23.3	0.082	0.042	0.164								
			2015	FILSK	12	12	14.7	12.0	24.0	0.063	0.038	0.197								
10000700	LUCY*	Bluegill sunfish	2000	FILSK	10	1	5.8	5.8	5.8	0.050	0.050	0.050								

							Length (in)			Mercury (mg/kg)			PCBs (mg/kg)				PFOS (mg/kg)			
DOWID	Waterway	Species	Year	Anat-omy[1]	Total Fish	No. Samples	Mean	Min	Max	Mean	Min	Max	N	Mean	Max	< RL	N	Mean	Max	< RL
		Black bullhead	2000	FILET	8	1	8.9	8.9	8.9	0.120	0.120	0.120								
		Northern pike	2000	FILSK	6	6	19.7	16.1	28.6	0.275	0.180	0.440	1	0.01	0.01	Y				
10001200	ANN*	Bluegill sunfish	2000	FILSK	7	1	6.5	6.5	6.5	0.080	0.080	0.080								
		Black bullhead	2000	FILET	6	1	9.9	9.9	9.9	0.090	0.090	0.090								
		Northern pike	2000	FILSK	7	7	26.5	20.2	34.1	0.360	0.170	0.880	1	0.01	0.01	Y				
10001300	SUSAN*	Bluegill sunfish	1993	FILSK	10	1	6.9	6.9	6.9	0.062	0.062	0.062								
			2014	FILSK	10	1	6.1	6.1	6.1	0.044	0.044	0.044								
		Black bullhead	2014	FILSK	5	1	11.2	11.2	11.2	0.071	0.071	0.071								
		Black crappie	2014	FILSK	10	1	8.3	8.3	8.3	0.079	0.079	0.079								
		Common Carp	1993	FILSK	8	3	18.1	15.3	21.0	0.020	0.011	0.032	1	0.01	0.01	Y				
		Northern pike	1993	FILSK	8	4	22.6	18.0	26.5	0.122	0.069	0.180	1	0.01	0.01	Y				
			2014	FILSK	8	8	24.5	19.1	29.5	0.166	0.111	0.249								
		Walleye	1993	FILSK	3	2	14.7	13.8	15.5	0.157	0.084	0.230								
		Yellow bullhead	2014	FILSK	5	1	10.4	10.4	10.4	0.054	0.054	0.054								
10001900	BAVARIA**	Bluegill sunfish	2002	FILSK	9	1	6.8	6.8	6.8	0.141	0.141	0.141								
			2007	FILSK	10	1	6.1	6.1	6.1	0.125	0.125	0.125								
			2013	FILSK	10	2	8.0	7.8	8.1	0.131	0.118	0.144								
		Common Carp	2002	FILSK	4	1	24.1	24.1	24.1	0.129	0.129	0.129								
		Northern pike	2002	FILSK	5	5	24.4	17.2	36.4	0.306	0.100	0.806								
			2007	FILSK	4	4	29.4	27.8	30.7	0.693	0.340	0.877								
		Yellow bullhead	2007	FILET	8	1	11.5	11.5	11.5	0.360	0.360	0.360								
			2013	FILET	5	1	11.7	11.7	11.7	0.305	0.305	0.305								
10002900	MILLER**	Bluegill sunfish	2006	FILSK	7	1	6.3	6.3	6.3	0.155	0.155	0.155								
		Common Carp	2006	FILSK	8	1	16.1	16.1	16.1	0.146	0.146	0.146								
		Northern pike	2006	FILSK	5	5	28.4	22.4	34.2	0.585	0.220	0.861								
10005200	REITZ*	Bluegill sunfish	2004	FILSK	8	1	7.0	7.0	7.0	0.151	0.151	0.151								
		Black bullhead	2004	FILET	8	1	7.7	7.7	7.7	0.105	0.105	0.105								
		Black crappie	2004	FILSK	8	1	8.8	8.8	8.8	0.255	0.255	0.255								
		Northern pike	2004	FILSK	5	5	22.2	17.0	28.5	0.212	0.087	0.381								
10005900	WACONIA*	Bluegill sunfish	1983	WHORG	5	1	6.3	6.3	6.3	0.060	0.060	0.060								
			1993	FILSK	10	1	7.8	7.8	7.8	0.110	0.110	0.110	1	0.016	0.016					
			2008	FILSK	15	7	6.8	5.9	7.6	0.069	0.066	0.072					5	4.95	5.00	Y

DOWID	Waterway	Species	Year	Anat-omy[1]	Total Fish	No. Samples	Length (in)			Mercury (mg/kg)			PCBs (mg/kg)				PFOS (mg/kg)			
							Mean	Min	Max	Mean	Min	Max	N	Mean	Max	< RL	N	Mean	Max	< RL
		Black crappie	1983	FILSK	5	1	6.7	6.7	6.7	0.080	0.080	0.080								
			2008	FILSK	15	7	7.7	6.7	9.1	0.049	0.045	0.052					5	4.85	4.93	Y
		Common Carp	1983	FILSK	4	1	20.4	20.4	20.4	0.090	0.090	0.090	1	0.072	0.072					
			1993	FILSK	21	4	24.7	18.4	30.7	0.092	0.075	0.110	4	0.045	0.074					
		Freshwater Drum	2008	FILSK	3	1	19.6	19.6	19.6	0.200	0.200	0.200								
			2010	FILSK	18	18	16.0	12.2	21.5	0.120	0.026	0.415					9	4.92	5.05	Y
		Muskellunge	2006	FILSK	1	1	42.3	42.3	42.3	1.146	1.146	1.146								
		Northern pike	1983	FILSK	21	6	21.9	17.4	28.0	0.390	0.120	0.580	2	0.05	0.05	Y				
			1993	FILSK	8	3	27.1	22.9	30.2	0.443	0.320	0.670	3	0.02	0.041					
			2006	FILSK	2	2	28.3	27.6	29.0	0.943	0.753	1.132								
			2014	FILSK	3	3	31.8	30.0	33.2	0.326	0.280	0.403								
		Walleye	1983	FILSK	4	3	20.1	17.1	23.0	0.537	0.270	0.680	1	0.05	0.05	Y				
			1993	FILSK	29	4	18.2	14.5	22.9	0.318	0.200	0.480	4	0.018	0.026					
			2006	FILSK	8	8	21.4	15.2	27.5	0.632	0.166	1.248								
			2014	FILSK	3	3	16.8	15.0	20.3	0.318	0.264	0.379								
		Yellow bullhead	2010	FILET	2	1	12.1	12.1	12.1	0.158	0.158	0.158								
		Yellow perch	2006	WHORG	7	3	6.5	6.1	7.0	0.067	0.065	0.072								
10008400	BURANDT	Black bullhead	2006	FILET	5	1	7.3	7.3	7.3	0.103	0.103	0.103								
		Black crappie	2006	FILSK	9	1	6.1	6.1	6.1	0.268	0.268	0.268								
		Freshwater Drum	2006	FILSK	3	1	15.5	15.5	15.5	0.117	0.117	0.117								
		Northern pike	2006	FILSK	2	2	22.5	22.3	22.7	0.622	0.445	0.799								
		Yellow bullhead	2006	FILET	2	1	12.3	12.3	12.3	0.834	0.834	0.834								
10008800	HYDES*	Bluegill sunfish	2007	FILSK	10	6	5.2	2.8	6.9								6	4.86	5.08	Y
			2013	FILSK	5	1	8.3	8.3	8.3	0.072	0.072	0.072								
		Black bullhead	2007	FILET	8	1	9.3	9.3	9.3	0.051	0.051	0.051								
		Black crappie	2001	FILSK	10	1	9.2	9.2	9.2	0.114	0.114	0.114								
			2007	FILSK	6	6	9.2	7.9	9.8								6	4.88	4.93	Y
		Common Carp	2001	FILSK	5	1	17.1	17.1	17.1	0.034	0.034	0.034	1	0.01	0.01	Y				
		Northern pike	2001	FILSK	6	6	26.6	20.2	31.7	0.204	0.136	0.296								
			2007	FILSK	5	5	23.9	18.1	29.1								5	4.66	4.93	Y
			2013	FILSK	8	8	22.6	17.5	26.5	0.173	0.109	0.220								
19002400	WOOD PARK	Bluegill sunfish	2012	FILSK	5	1	6.6	6.6	6.6	0.072	0.072	0.072								

DOWID	Waterway	Species	Year	Anat-omy[1]	Total Fish	No. Samples	Length (in)			Mercury (mg/kg)			PCBs (mg/kg)				PFOS (mg/kg)			
							Mean	Min	Max	Mean	Min	Max	N	Mean	Max	< RL	N	Mean	Max	< RL
19002700	CRYSTAL**	Bluegill sunfish	1985	FILSK	7	1	5.1	5.1	5.1	0.080	0.080	0.080	1	0.05	0.05	Y				
			2005	FILSK	7	1	5.0	5.0	5.0	0.065	0.065	0.065								
		Northern pike	1985	FILSK	4	1	19.6	19.6	19.6	0.210	0.210	0.210	1	0.05	0.05	Y				
			2005	FILSK	5	5	27.8	21.5	32.0	0.355	0.249	0.592								
		White sucker	2005	FILSK	3	1	17.5	17.5	17.5	0.019	0.019	0.019								
19002900	LEE	Bluegill sunfish	2008	FILSK	12	7	5.4	5.1	5.9								7	22.23	30.2	
		Black crappie	2008	FILSK	9	6	8.4	7.1	9.1								6	37.00	44	
19003100	ORCHARD*	Bluegill sunfish	2001	FILSK	10	1	6.0	6.0	6.0	0.052	0.052	0.052								
			2012	FILSK	5	1	5.7	5.7	5.7	0.061	0.061	0.061								
		Black bullhead	1991	FILET	5	1	9.8	9.8	9.8	0.069	0.069	0.069	1	0.01	0.01	Y				
			2001	FILET	4	1	10.0	10.0	10.0	0.224	0.224	0.224								
		Black crappie	1991	FILSK	10	1	6.6	6.6	6.6	0.180	0.180	0.180								
			2012	FILSK	4	1	7.3	7.3	7.3	0.199	0.199	0.199								
		Common Carp	1991	FILSK	2	1	21.8	21.8	21.8	0.090	0.090	0.090	1	0.01	0.01	Y				
		Largemouth bass	1991	FILSK	1	1	18.4	18.4	18.4	1.100	1.100	1.100	1	0.01	0.01	Y				
		Muskellunge	1991	FILSK	1	1	19.9	19.9	19.9	0.310	0.310	0.310								
		Northern pike	1991	FILSK	21	4	25.6	18.6	34.1	0.518	0.330	0.790	3	0.01	0.01	Y				
			2001	FILSK	7	7	23.0	19.2	27.4	0.326	0.239	0.554	1	0.01	0.01	Y				
			2012	FILSK	8	8	24.9	22.5	27.8	0.397	0.226	0.486								
		Walleye	2012	FILSK	1	1	21.2	21.2	21.2	0.556	0.556	0.556								
		Yellow bullhead	1991	FILET	3	1	9.1	9.1	9.1	0.370	0.370	0.370								
19005500	LEMAY	Bluegill sunfish	2009	FILSK	9	2	5.4	5.4	5.4	0.035	0.035	0.035					1	105.00	105	
19005700	FISH**	Bluegill sunfish	1998	FILSK	9	1	6.1	6.1	6.1	0.150	0.150	0.150								
			2002	FILSK	6	1	6.4	6.4	6.4	0.182	0.182	0.182								
			2008	FILSK	12	7	5.6	5.1	6.1								7	75.74	106	
		Black bullhead	2002	FILET	10	1	9.1	9.1	9.1	0.133	0.133	0.133								
		Black crappie	2008	FILSK	11	6	6.9	6.5	7.3								6	101.17	129	
		Largemouth bass	2002	FILSK	1	1	15.5	15.5	15.5	0.513	0.513	0.513								
		Northern pike	1998	FILSK	10	10	23.6	17.6	32.2	0.561	0.250	0.990								
				WHORG	10	10	23.6	17.6	32.2	0.320	0.010	0.626								
			2002	FILSK	10	10	17.5	13.1	30.9	0.246	0.122	0.714								
			2008	FILSK	5	5	20.7	18.9	23.2								5	134.80	192	

DOWID	Waterway	Species	Year	Anat-omy[1]	Total Fish	No. Samples	Length (in)			Mercury (mg/kg)			PCBs (mg/kg)				PFOS (mg/kg)			
							Mean	Min	Max	Mean	Min	Max	N	Mean	Max	< RL	N	Mean	Max	< RL
			2013	FILSK	8	8	25.0	20.6	29.5	0.682	0.463	0.868								
		Pumpkinseed sunfish	2008	FILSK	11	6	5.2	4.3	5.6								6	17.18	22.7	
		Yellow perch	1998	WHORG	1	1	6.7	6.7	6.7	0.090	0.090	0.090								
19005900	BLACKHAWK*	Bluegill sunfish	2003	FILSK	9	1	6.1	6.1	6.1	0.171	0.171	0.171								
		Black crappie	2003	FILSK	10	1	6.7	6.7	6.7	0.332	0.332	0.332								
		Northern pike	2003	FILSK	3	3	20.6	18.7	24.2	0.563	0.502	0.645								
19006600	QUIGLEY	Bluegill sunfish	2012	FILSK	4	1	6.4	6.4	6.4	0.119	0.119	0.119								
		Black bullhead	2012	FILET	1	1	10.4	10.4	10.4	0.056	0.056	0.056								
		Black crappie	2012	FILSK	5	1	7.7	7.7	7.7	0.147	0.147	0.147								
		Largemouth bass	2012	FILSK	1	1	11.2	11.2	11.2	0.192	0.192	0.192								
19007600	MCDONOUGH	Bluegill sunfish	2015	FILSK	2	1	7.8	7.8	7.8	0.173	0.173	0.173								
		Black bullhead	2015	FILET	5	1	8.4	8.4	8.4	0.175	0.175	0.175								
19007800	GUN CLUB	Bluegill sunfish	2008	FILSK	10	1	5.1	5.1	5.1	0.075	0.075	0.075								
		Black crappie	2008	FILSK	5	1	6.4	6.4	6.4	0.161	0.161	0.161								
		Largemouth bass	2008	FILSK	3	3	11.0	5.3	15.6	0.176	0.070	0.321								
19013600	UNNAMED POND*	Black crappie	1991	FILSK	5	1	8.0	8.0	8.0	0.230	0.230	0.230	1	0.01	0.01	Y				
19044600	LAC LAVON*	Bluegill sunfish	1995	FILSK	10	1	6.2	6.2	6.2	0.170	0.170	0.170								
		Northern pike	1995	FILSK	8	2	17.4	15.6	19.1	0.235	0.230	0.240	1	0.01	0.01	Y				
19045100	SUNSET POND	Bluegill sunfish	2009	FILSK	10	2	5.9	5.7	6.1	0.074	0.074	0.074					1	17.30	17.3	
		Northern pike	2009	FILSK	8	8	20.9	14.2	26.4	0.314	0.257	0.381					4	32.20	50	
27000100	SNELLING*	Bluegill sunfish	1986	FILSK	5	1	6.5	6.5	6.5	0.090	0.090	0.090								
			2003	FILSK	6	1	6.2	6.2	6.2	0.135	0.135	0.135								
			2009	FILSK	5	1	5.7	5.7	5.7								1	4.69	4.69	Y
			2010	FILSK	5	1	5.7	5.7	5.7								1	91.80	91.8	
		Common Carp	1986	FILSK	3	1	19.6	19.6	19.6	0.220	0.220	0.220	1	0.844	0.844					
			2003	FILSK	2	1	25.5	25.5	25.5	0.114	0.114	0.114								
		Northern pike	1986	FILSK	2	1	24.8	24.8	24.8	0.350	0.350	0.350	1	0.05	0.05	Y				
			2003	FILSK	5	5	22.4	19.5	25.3	0.359	0.289	0.464	1	0.01	0.01	Y				
			2009	FILSK	5	5	23.8	22.0	27.2								5	213.60	264	
			2010	FILSK	5	5	24.3	21.7	26.8								5	138.08	200	
27000400	PENN	Black crappie	2010	FILSK	5	5	8.0	7.7	8.5								5	9.21	12.4	
		Common Carp	2008	FILSK	3	1	17.3	17.3	17.3	0.082	0.082	0.082	1	0.025	0.025	Y				

DOWID	Waterway	Species	Year	Anat-omy[1]	Total Fish	No. Samples	Length (in)			Mercury (mg/kg)			PCBs (mg/kg)				PFOS (mg/kg)			
							Mean	Min	Max	Mean	Min	Max	N	Mean	Max	< RL	N	Mean	Max	< RL
27002800	CORNELIA	Black crappie	2005	FILSK	10	1	9.2	9.2	9.2	0.039	0.039	0.039								
		Common Carp	2005	FILSK	4	1	16.8	16.8	16.8	0.032	0.032	0.032	1	0.02	0.02	Y				
27004700	BUSH*	Bluegill sunfish	1990	FILSK	11	3	6.1	5.8	6.4	0.167	0.110	0.200	3	0.01	0.01	Y				
			2013	FILSK	4	1	7.6	7.6	7.6	0.086	0.086	0.086								
		Black bullhead	1990	FILET	6	1	8.3	8.3	8.3	0.260	0.260	0.260	1	0.01	0.01	Y				
		Black crappie	1990	FILSK	2	2	7.6	7.3	7.8	0.205	0.170	0.240	2	0.01	0.01	Y				
			2013	FILSK	6	1	9.5	9.5	9.5	0.167	0.167	0.167								
		Crappie, unknown spec.	1989	FILSK	5	1	8.0	8.0	8.0	0.240	0.240	0.240	1	0.01	0.01	Y				
		Largemouth bass	1990	FILSK	1	1	6.8	6.8	6.8	0.600	0.600	0.600	1	0.01	0.01	Y				
		Northern pike	1989	FILSK	2	2	23.7	22.2	25.1	0.610	0.530	0.690	2	0.01	0.01	Y				
			1990	FILSK	5	5	17.6	15.1	19.1	0.344	0.280	0.410	5	0.01	0.01	Y				
			2007	FILSK	24	24	22.2	19.1	31.2	0.576	0.350	1.102								
		Yellow bullhead	1990	FILET	2	2	11.3	10.3	12.3	0.595	0.560	0.630	2	0.01	0.01	Y				
			2013	FILET	5	1	13.4	13.4	13.4	0.287	0.287	0.287								
		Yellow perch	2007	WHORG	10	4	5.9	5.4	6.3	0.076	0.057	0.103								
27004800	HYLAND	Bluegill sunfish	1995	FILSK	10	1	7.0	7.0	7.0	0.200	0.200	0.200								
			2002	FILSK	7	1	5.9	5.9	5.9	0.093	0.093	0.093								
			2008	FILSK	5	5	6.1	5.1	7.1								5	12.44	19.9	
			2013	FILSK	9	2	7.5	7.4	7.5	0.146	0.143	0.148								
		Black bullhead	1995	FILET	8	1	12.7	12.7	12.7	0.100	0.100	0.100	1	0.01	0.01	Y				
		Black crappie	2008	FILSK	5	5	7.2	6.7	7.9								5	23.92	30.6	
		Largemouth bass	2008	FILSK	5	5	13.3	11.0	15.7								5	43.32	51.4	
27006700	BRYANT*	Black crappie	1999	FILSK	10	1	7.3	7.3	7.3	0.240	0.240	0.240								
			2012	FILSK	10	2	6.4	5.9	6.8	0.099	0.080	0.117								
		Common Carp	1999	FILSK	3	1	22.1	22.1	22.1	0.120	0.120	0.120	1	0.058	0.058					
		Northern pike	1999	FILSK	3	3	27.9	21.8	32.5	0.443	0.200	0.610	1	0.01	0.01	Y				
			2012	FILSK	8	8	22.7	19.8	26.5	0.252	0.184	0.318								
		Yellow bullhead	2012	FILET	5	1	10.9	10.9	10.9	0.222	0.222	0.222								
27007000	MITCHELL	Bluegill sunfish	1999	FILSK	10	1	6.2	6.2	6.2	0.080	0.080	0.080								
		Black bullhead	1999	FILET	7	1	10.4	10.4	10.4	0.180	0.180	0.180	1	0.01	0.01	Y				
27007100	ROUND*	Bluegill sunfish	2000	FILSK	10	1	6.0	6.0	6.0	0.160	0.160	0.160								
			2008	FILSK	5	5	5.9	5.3	6.3								5	48.54	63.2	

DOWID	Waterway	Species	Year	Anat-omy[1]	Total Fish	No. Samples	Length (in)			Mercury (mg/kg)			PCBs (mg/kg)				PFOS (mg/kg)			
							Mean	Min	Max	Mean	Min	Max	N	Mean	Max	< RL	N	Mean	Max	< RL
		Black bullhead	2000	FILET	6	1	10.8	10.8	10.8	0.050	0.050	0.050								
		Largemouth bass	2008	FILSK	1	1	11.2	11.2	11.2								1	127.00	127	
		Walleye	2000	FILSK	2	2	23.4	19.5	27.2	1.405	1.360	1.450	1	0.01	0.01	Y				
27007300	SMETANA*	Bluegill sunfish	2005	FILSK	6	1	7.8	7.8	7.8	0.105	0.105	0.105								
		Black bullhead	2005	FILET	6	1	10.7	10.7	10.7	0.086	0.086	0.086								
		Common Carp	2005	FILSK	4	1	23.9	23.9	23.9	0.151	0.151	0.151								
		Northern pike	2005	FILSK	7	7	21.7	15.9	33.0	0.311	0.145	0.555								
27007600	RED ROCK*	Bluegill sunfish	1999	FILSK	10	1	6.2	6.2	6.2	0.070	0.070	0.070								
			2007	FILSK	10	6	5.4	3.9	7.2								6	39.93	58.3	
			2011	FILSK	8	2	6.3	5.6	6.9	0.041	0.027	0.054								
		Black bullhead	1999	FILET	7	1	9.0	9.0	9.0	0.150	0.150	0.150								
		Black crappie	2007	FILSK	5	5	8.2	6.7	10.6								5	102.72	153	
		Largemouth bass	2007	FILSK	5	5	13.6	13.0	15.0								5	68.52	85.7	
		Northern pike	1999	FILSK	8	8	23.1	18.7	31.9	0.186	0.140	0.330	1	0.01	0.01	Y				
			2011	FILSK	8	8	23.3	19.3	26.2	0.238	0.158	0.432								
		Yellow perch	2011	FILSK	10	2	6.8	6.5	7.0	0.034	0.033	0.035								
27007800	STARING**	Bluegill sunfish	1995	FILSK	10	1	7.4	7.4	7.4	0.290	0.290	0.290								
			2002	FILSK	10	1	7.0	7.0	7.0	0.081	0.081	0.081								
			2008	FILSK	5	5	5.4	4.5	5.9								5	17.39	31.2	
			2015	FILSK	10	1	6.7	6.7	6.7	0.052	0.052	0.052								
		Black crappie	2008	FILSK	5	5	6.9	6.1	7.5								5	15.86	19.1	
			2015	FILSK	10	1	8.5	8.5	8.5	0.063	0.063	0.063								
		Common Carp	1995	FILSK	6	1	20.7	20.7	20.7	0.200	0.200	0.200	1	0.01	0.01	Y				
		Largemouth bass	2008	FILSK	5	5	16.0	15.4	16.5								5	28.34	36.7	
		Northern pike	1995	FILSK	35	6	24.3	17.4	31.9	0.525	0.330	0.700	1	0.01	0.01	Y				
			2015	FILSK	6	6	20.4	17.3	23.2	0.129	0.095	0.181								
40007900	CLEAR	Bluegill sunfish	2013	FILSK	10	2	7.4	7.2	7.5	0.086	0.075	0.096								
		Black bullhead	2013	FILET	4	1	12.0	12.0	12.0	0.079	0.079	0.079								
		Black crappie	2013	FILSK	10	2	8.6	8.2	9.0	0.106	0.087	0.125								
		Northern pike	2013	FILSK	8	8	21.8	19.3	27.3	0.115	0.079	0.171								
70001000	MURPHY*	Bluegill sunfish	1999	FILSK	10	1	5.3	5.3	5.3	0.070	0.070	0.070								
			2005	FILSK	7	1	5.9	5.9	5.9	0.049	0.049	0.049								

DOWID	Waterway	Species	Year	Anat-omy[1]	Total Fish	No. Samples	Length (in)			Mercury (mg/kg)			PCBs (mg/kg)				PFOS (mg/kg)			
							Mean	Min	Max	Mean	Min	Max	N	Mean	Max	< RL	N	Mean	Max	< RL
		Black bullhead	1999	FILET	8	1	7.7	7.7	7.7				1	0.01	0.01	Y				
			2005	FILET	10	1	6.4	6.4	6.4	0.107	0.107	0.107								
		Largemouth bass	2005	FILSK	5	5	12.2	8.8	14.6	0.210	0.179	0.239								
		Sauger	2005	FILSK	1	1	19.1	19.1	19.1	0.355	0.355	0.355								
70002200	CLEARY*	Bluegill sunfish	1995	FILSK	10	1	7.2	7.2	7.2	0.190	0.190	0.190								
		Black bullhead	1995	FILSK	3	1	13.4	13.4	13.4	0.018	0.018	0.018								
		Largemouth bass	1995	FILSK	4	1	10.9	10.9	10.9	0.280	0.280	0.280								
		Walleye	1995	FILSK	9	2	18.1	15.9	20.2	0.340	0.340	0.340	1	0.01	0.01	Y				
70002600	LOWER PRIOR*	Bluegill sunfish	1996	FILSK	10	1	6.9	6.9	6.9	0.091	0.091	0.091								
			2008	FILSK	10	1	7.9	7.9	7.9	0.076	0.076	0.076								
			2015	FILSK	10	1	7.1	7.1	7.1	0.090	0.090	0.090								
		Black crappie	2008	FILSK	10	1	8.2	8.2	8.2	0.057	0.057	0.057								
			1996	FILSK	5	2	25.1	22.5	27.6	0.078	0.065	0.090	2	0.11	0.15					
		Largemouth bass	2006	FILSK	6	6	12.2	9.9	13.7	0.212	0.114	0.425								
			2015	FILSK	2	2	14.8	14.5	15.0	0.204	0.193	0.215								
		Northern pike	1996	FILSK	19	5	23.2	17.2	31.7	0.192	0.120	0.330	1	0.01	0.01	Y				
			2006	FILSK	4	4	32.2	30.6	35.0	0.369	0.250	0.519								
			2008	FILSK	2	2	23.8	23.3	24.2	0.219	0.188	0.250								
			2015	FILSK	8	8	21.7	16.5	30.5	0.219	0.100	0.462								
		Walleye	1996	FILSK	19	5	19.3	11.0	27.2	0.363	0.074	0.730	1	0.01	0.01	Y				
			2012	FILSK	8	8	16.8	14.0	24.6	0.200	0.102	0.550								
			2015	FILSK	8	8	15.2	9.9	19.8	0.247	0.158	0.591								
		Yellow bullhead	2006	FILET	19	2	11.3	10.6	11.9	0.148	0.119	0.177								
70005000	MCMAHON*	Bluegill sunfish	2004	FILSK	9	1	6.3	6.3	6.3	0.127	0.127	0.127								
		Black bullhead	2004	FILET	7	1	10.5	10.5	10.5	0.101	0.101	0.101								
		Black crappie	2004	FILSK	8	1	7.3	7.3	7.3	0.128	0.128	0.128								
		Northern pike	2004	FILSK	5	5	24.7	19.5	32.1	0.263	0.210	0.384								
70005400	SPRING*	Bluegill sunfish	2002	FILSK	8	1	7.1	7.1	7.1	0.041	0.041	0.041								
		Black bullhead	2002	FILET	9	1	12.1	12.1	12.1	0.017	0.017	0.017								
		Black crappie	1993	FILSK	10	1	7.6	7.6	7.6	0.160	0.160	0.160								
			2002	FILSK	7	1	8.4	8.4	8.4	0.080	0.080	0.080								
		Common Carp	1993	FILSK	9	3	24.4	19.6	30.0	0.049	0.037	0.074	3	0.019	0.03					

DOWID	Waterway	Species	Year	Anat-omy[1]	Total Fish	No. Samples	Length (in)			Mercury (mg/kg)			PCBs (mg/kg)				PFOS (mg/kg)			
							Mean	Min	Max	Mean	Min	Max	N	Mean	Max	< RL	N	Mean	Max	< RL
		Northern pike	1993	FILSK	5	2	25.0	23.9	26.0	0.215	0.210	0.220	1	0.01	0.01	Y				
			2006	FILSK	5	5	30.4	28.8	34.7	0.275	0.218	0.408								
			2008	FILSK	5	5	27.2	24.6	30.1	0.189	0.135	0.314								
		Walleye	1993	FILSK	23	5	20.1	11.2	27.5	0.314	0.120	0.460	1	0.024	0.024					
			2002	FILSK	5	5	18.9	15.0	23.7	0.119	0.072	0.204								
			2006	FILSK	1	1	24.8	24.8	24.8	0.356	0.356	0.356								
			2012	FILSK	7	7	17.2	15.3	19.8	0.162	0.125	0.292								
		White sucker	1993	FILSK	10	2	19.6	18.2	20.9	0.040	0.037	0.043								
		Yellow bullhead	2006	FILET	23	2	11.1	9.6	12.6	0.071	0.050	0.092								
		Yellow perch	2008	WHORG	7	1	6.9	6.9	6.9	0.025	0.025	0.025								
70006900	FISH**	Bluegill sunfish	2003	FILSK	6	1	6.9	6.9	6.9	0.045	0.045	0.045								
			2014	FILSK	6	1	6.3	6.3	6.3	0.048	0.048	0.048								
		Black crappie	2014	FILSK	10	1	8.2	8.2	8.2	0.055	0.055	0.055								
		Common Carp	2003	FILSK	3	1	17.9	17.9	17.9	0.031	0.031	0.031	1	0.01	0.01	Y				
		Northern pike	2014	FILSK	1	1	24.8	24.8	24.8	0.121	0.121	0.121								
		Walleye	2003	FILSK	5	5	22.3	17.8	27.5	0.396	0.123	0.931								
		Yellow perch	2014	FILSK	5	1	7.6	7.6	7.6	0.041	0.041	0.041								
70007200	UPPER PRIOR*	Bluegill sunfish	1996	FILSK	10	1	7.0	7.0	7.0	0.088	0.088	0.088								
			2007	FILSK	10	6	5.0	4.3	6.3								6	5.00	5.25	
			2008	FILSK	10	1	7.0	7.0	7.0	0.045	0.045	0.045								
		Black crappie	2008	FILSK	10	1	8.0	8.0	8.0	0.035	0.035	0.035								
		Common Carp	1996	FILSK	7	3	26.2	23.3	29.2	0.133	0.110	0.150	1	0.015	0.015					
		Largemouth bass	2007	FILSK	5	5	13.2	12.2	14.6								5	5.14	6.14	
		Northern pike	1996	FILSK	13	5	19.3	15.1	25.1	0.126	0.079	0.240								
			2006	FILSK	1	1	36.0	36.0	36.0	0.293	0.293	0.293								
		Walleye	1996	FILSK	10	3	20.6	16.0	25.8	0.313	0.140	0.490	1	0.01	0.01	Y				
			2012	FILSK	8	8	19.2	16.0	22.7	0.122	0.062	0.319								
		Yellow bullhead	2006	FILET	7	1	12.5	12.5	12.5	0.052	0.052	0.052								
			2008	FILET	4	1	11.9	11.9	11.9	0.055	0.055	0.055								
		Yellow perch	2008	WHORG	9	2	8.1	7.4	8.7	0.016	0.014	0.017								
70009100	CEDAR*	Bluegill sunfish	1995	FILSK	10	1	6.4	6.4	6.4	0.038	0.038	0.038								
			2007	FILSK	10	5	5.1	3.5	6.7								6	5.17	6.76	

DOWID	Waterway	Species	Year	Anat-omy[1]	Total Fish	No. Samples	Length (in)			Mercury (mg/kg)			PCBs (mg/kg)				PFOS (mg/kg)			
							Mean	Min	Max	Mean	Min	Max	N	Mean	Max	< RL	N	Mean	Max	< RL
			2008	FILSK	10	1	6.6	6.6	6.6	0.028	0.028	0.028								
			2015	FILSK	10	1	7.0	7.0	7.0	0.010	0.010	0.010								
		Black crappie	2008	FILSK	8	1	6.7	6.7	6.7	0.071	0.071	0.071								
			2015	FILSK	8	1	8.0	8.0	8.0	0.029	0.029	0.029								
		Largemouth bass	2007	FILSK	5	4	16.0	15.7	16.5								5	5.14	6.24	
		Walleye	1995	FILSK	22	4	19.7	14.3	27.7	0.175	0.120	0.290	1	0.01	0.01	Y				
			2007	FILSK	1	1	16.9	16.9	16.9								1	4.95	4.95	Y
			2015	FILSK	8	8	19.1	16.8	22.5	0.053	0.040	0.066								
		White sucker	1995	FILSK	8	1	18.1	18.1	18.1	0.041	0.041	0.041								
		Yellow bullhead	2006	FILET	8	2	11.3	9.5	13.1	0.111	0.045	0.177								
		Yellow perch	2010	FILSK	9	2	9.0	8.8	9.2	0.010	0.010	0.010								
70009500	O'DOWD*	Black bullhead	2007	FILET	8	1	9.3	9.3	9.3	0.063	0.063	0.063								
		Black crappie	1991	FILSK	16	1	6.4	6.4	6.4	0.099	0.099	0.099	1	0.01	0.01	Y				
		Northern pike	1991	FILSK	14	3	23.2	19.1	27.8	0.173	0.130	0.220	2	0.01	0.01	Y				
		Walleye	1991	FILSK	3	2	20.6	19.1	22.0	0.310	0.190	0.430	1	0.021	0.021					
		White sucker	1991	FILSK	6	1	18.1	18.1	18.1	0.042	0.042	0.042	1	0.01	0.01	Y				
70012000	THOLE/ SCHNEIDER*	Bluegill sunfish	2005	FILSK	8	1	6.2	6.2	6.2	0.054	0.054	0.054								
(Thole -01, Schneider -02)			2013	FILSK	5	1	7.1	7.1	7.1	0.076	0.076	0.076								
		Black bullhead	1993	FILET	10	1	7.0	7.0	7.0	0.053	0.053	0.053								
			2005	FILET	5	1	7.4	7.4	7.4	0.099	0.099	0.099								
			2013	FILET	5	1	10.4	10.4	10.4	0.059	0.059	0.059								
		Black crappie	1993	FILSK	10	1	7.4	7.4	7.4	0.074	0.074	0.074								
			2005	FILSK	8	1	6.7	6.7	6.7	0.063	0.063	0.063								
			2013	FILSK	5	1	7.7	7.7	7.7	0.064	0.064	0.064								
		Northern pike	1993	FILSK	15	4	22.5	19.5	25.8	0.138	0.120	0.180	1	0.016	0.016					
			2005	FILSK	7	7	22.6	17.6	27.1	0.249	0.226	0.288								
			2013	FILSK	8	8	20.7	17.1	26.1	0.228	0.160	0.468								

*** Impaired for mercury in fish tissue as of 2016 Draft Impaired Waters List; categorized as EPA Class 4a for waters covered by the Statewide Mercury TMDL.**

**** Impaired for mercury in fish tissue as of 2014 Draft Impaired Waters List; categorized as EPA Class 5 for waters needing a TMDL.**

1 Anatomy codes: FILSK – edible fillet, skin-on; FILET—edible fillet, skin-off; PLUG—dorsal muscle piece, without skin; WHORG—whole organism

Pollutant load monitoring

The WPLMN monitors two subwatershed sites and uses data collected by the Metropolitan Council Environmental Services at two basin (Minnesota River mainstem) sites within the Lower Minnesota River Watershed as shown in Table 34. Data within this report will largely focus on the WPLMN subwatershed sites with more extensive detail provided on the basin sites within the MPCA's "Minnesota River Large River Report," due to be published in 2017.

Of the subwatershed sites, High Island Creek near Henderson, CSAH 6 is located near the outlet of the watershed and drains an area of 152,320 acres. High Island Creek near Arlington is located upstream and drains an area of 104,960 acres. This site is situated at the watershed "knick point" below which High Island Creek increases instream gradient as it incises and drops approximately 200 feet in elevation from the surrounding uplands to confluence with the Minnesota River.

Table 34. WPLMN stream monitoring sites for the Lower Minnesota River Watershed.

Site Type	Stream Name	USGS ID	DNR/MPCA ID	EQuIS ID
Basin	Minnesota River nr Jordan, MN	05330000	E33145001	S000-039
Basin	Minnesota River at Fort Snelling State Park, MN	05330920	E33143004	NA
Subwatershed	High Island Creek nr Henderson, CSAH6	05327000	E33091001	S000-676
Subwatershed	High Island Creek nr Arlington, CR9	05326700	H33075001	S001-891

Average annual FWMCs of TSS, TP and NO_3+NO_2-N for major watershed stations statewide are presented below, with the Lower Minnesota River Watershed highlighted. Water runoff, a significant factor in pollutant loading, is also shown. Water runoff is the portion of annual precipitation that makes it to a river or stream; and is expressed in inches.

As a rule, elevated levels of TSS and NO_3+NO_2-N are regarded as "non-point" source derived pollutants originating from many small diffuse sources such as urban or agricultural runoff. Excess TP can be attributed to both non-point as well as point sources such as industrial or wastewater treatment plants. Major "non-point" sources of phosphorus include dissolved phosphorus from fertilizers and phosphorus adsorbed to and transported with sediment during runoff.

Excessive TSS, TP, and NO_3+NO_2-N in surface waters impacts fish and other aquatic life, as well as fishing, swimming and other recreational uses. High levels of NO_3+NO_2-N is a concern for drinking water.

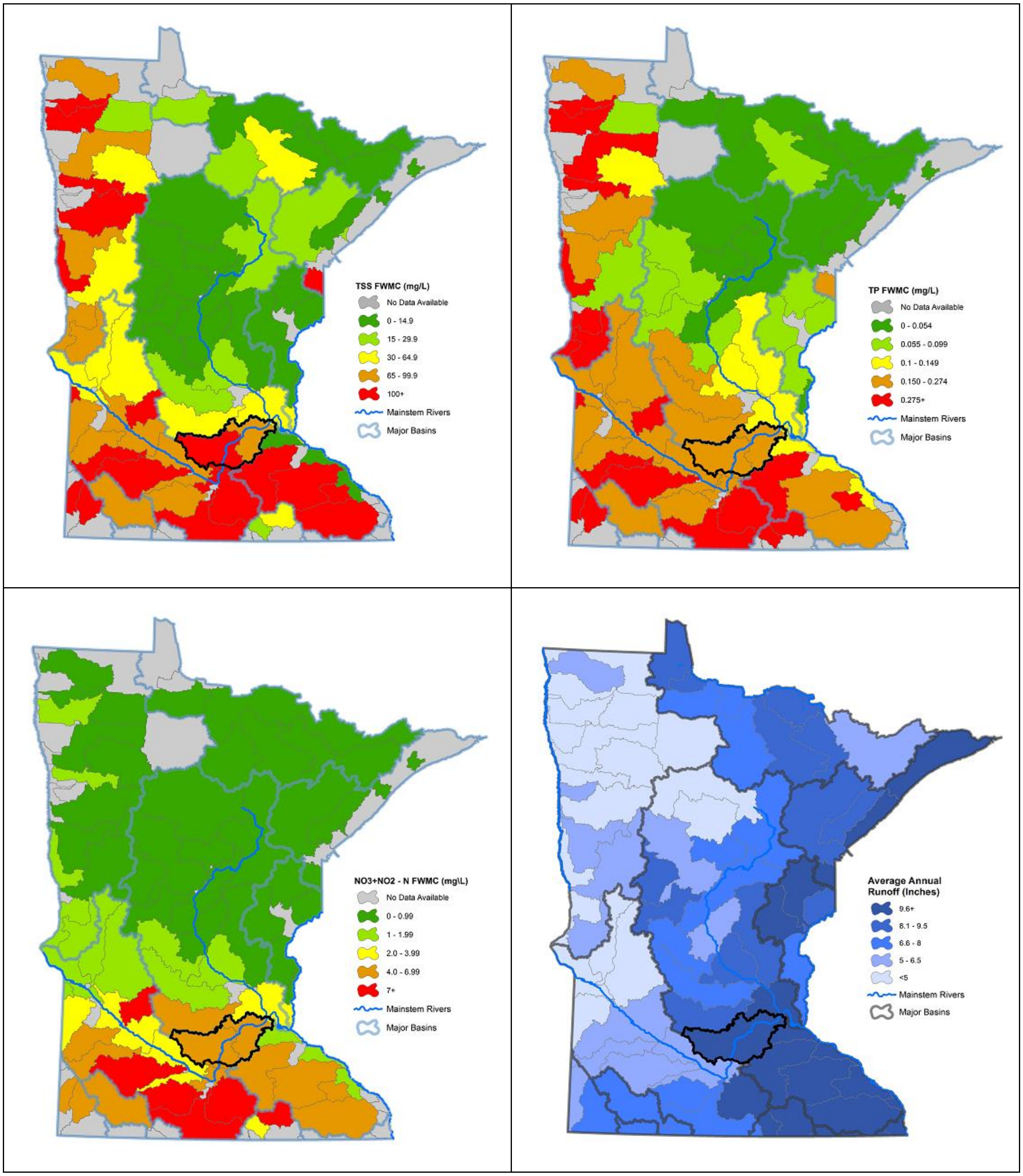


Figure 37. 2007-2014 average annual TSS, TP and NO3-NO2-N flow weighted mean concentrations and runoff by major watershed in Minnesota.

When compared with other major watersheds throughout the state, Figure 37 shows the average annual, TSS and TP FWMCs for High Island Creek near Arlington and High Island Creek near Henderson to be several times higher than watersheds in north central and northeast Minnesota, but in line with the agriculturally rich watersheds found in the northwest and southern regions of the state. However, even among agricultural watersheds, the TSS and TP FWMCs measured at the Henderson site are among the highest measured within the WPLMN. These FWMCs are also substantially higher than those measured at the upland site near Arlington due to increased streambank and bluff erosion and gulley erosion within the ravines that line the incised, lower region, of this watershed. NO_3+NO_2-N FWMCs between sites are similar.

More information, including results for subwatershed stations, can be found at the WPLMN website.

Seventy-five percent of the 36 TSS samples collected at the Arlington site between 2013 and 2014 exceeded the Central River Nutrient Region standard of 30 mg/L while 84% of the 28 TSS samples collected at Henderson exceeded the standard. One hundred percent of the 2013 through 2014 June through September TP samples from both sites exceeded the "summer" Central River Nutrient Region TP standard of 0.100 mg/L.

Substantial year-to-year variability in water quality and pollutant loading occurs for most rivers and streams, including High Island Creek. Barring large differences in pollutant concentrations, annual differences in pollutant loads are largely a function of differences in total flow volume. Results for individual years are shown in the charts below.

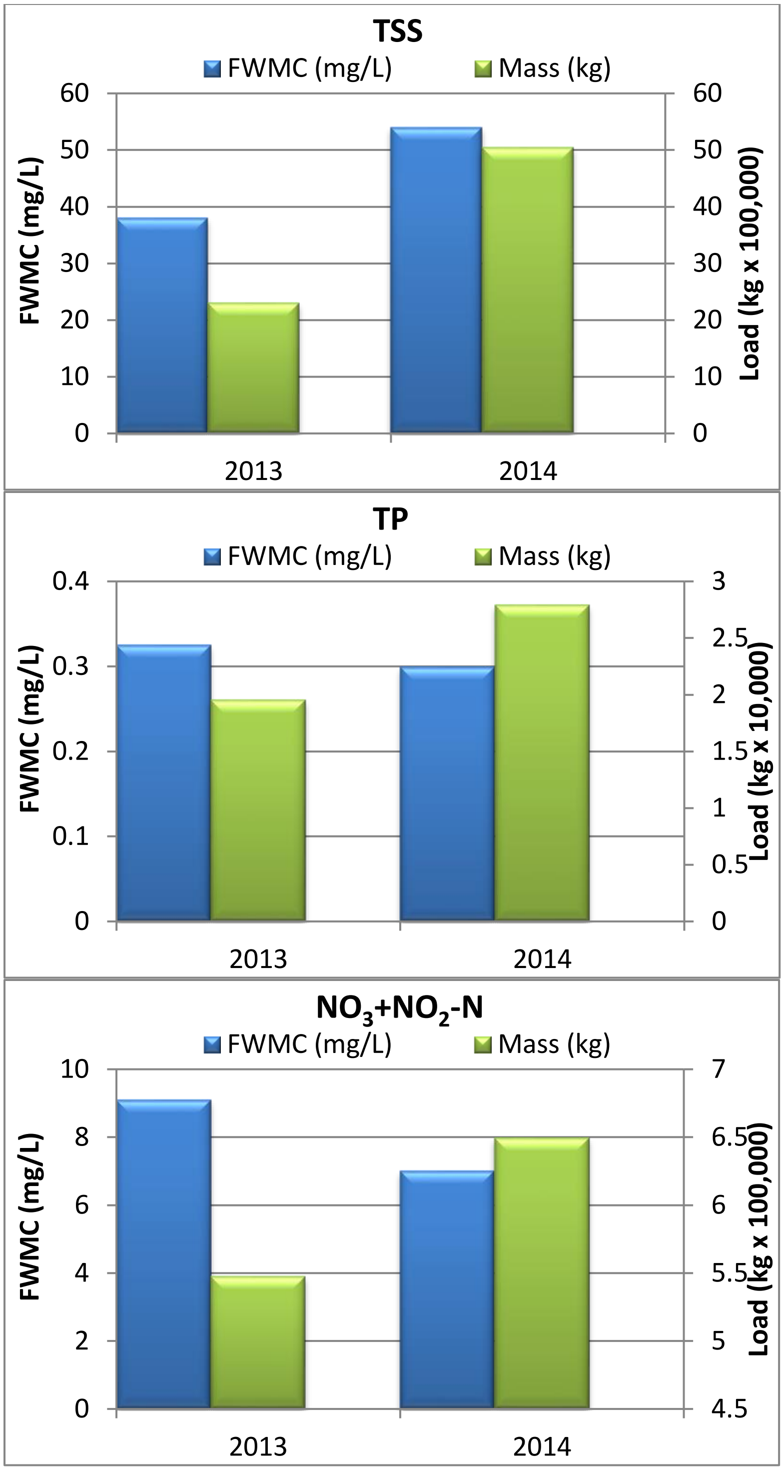


Figure 38. TSS, TP and NO3+NO2-N flow weighted mean concentrations and loads for High Island Creek near Arlington, Minnesota.

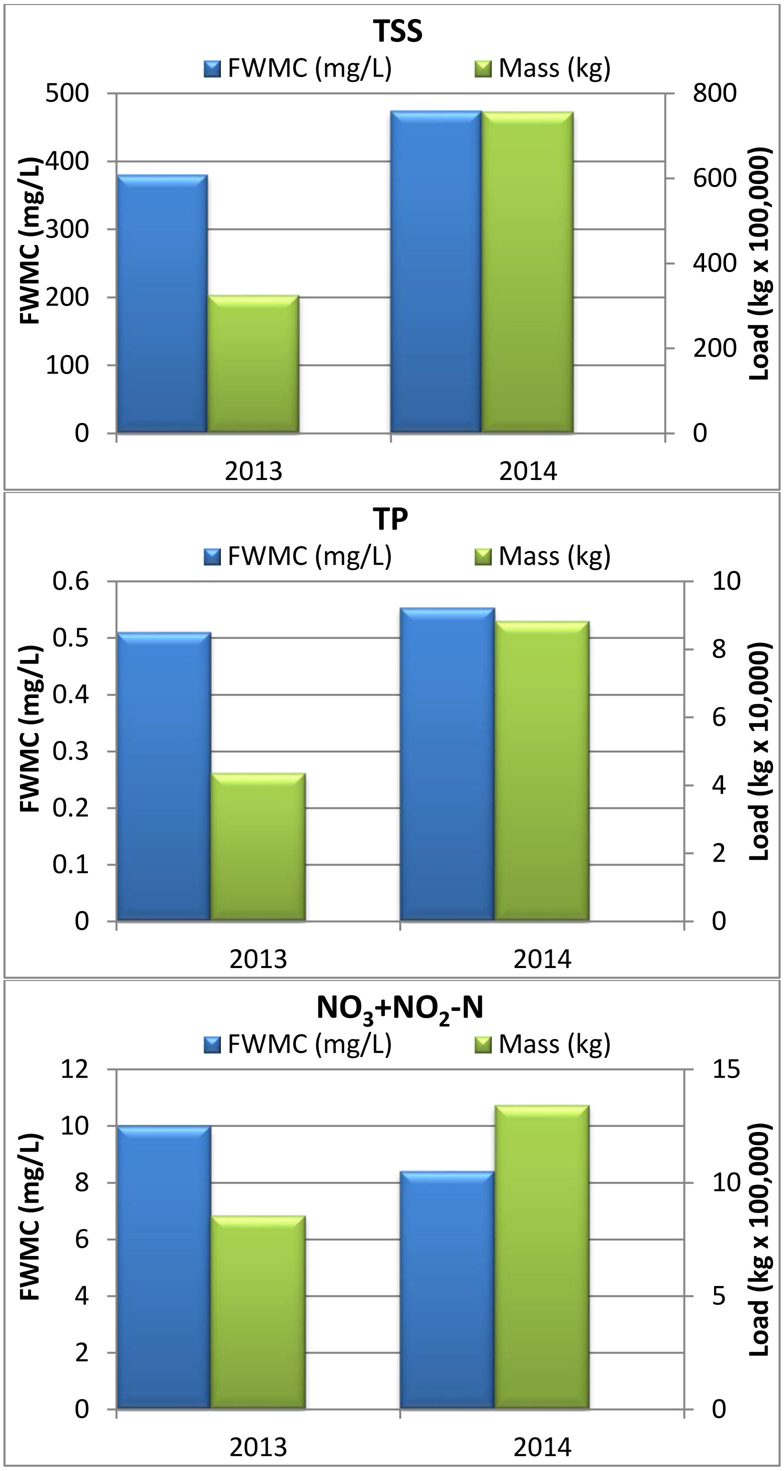


Figure 39. TSS, TP and NO3+NO2-N flow weighted mean concentrations and loads for High Island Creek near Henderson, Minnesota.

Groundwater monitoring

Groundwater quality

The MPCA statewide baseline study areas encompassing the Lower Minnesota River Watershed concluded the surficial aquifers in the east and northeast part of the watershed around theTCMA have comparatively high levels of chloride and sodium, suggesting they are easily impacted from human activities. Groundwater in the central and western part of the watershed have good deep bedrock water quality, but Cretaceous and buried drift aquifers have high concentrations of dissolved solids, boron, manganese, iron and sulfate. (MPCA 1999a, 1999b)

The MPCA currently monitors four domestic wells and two monitoring wells within the Lower Minnesota River Watershed. These wells are located in the more urbanized east/northeast portion of the watershed (Figure 40). Results of the sampling to date reflect the groundwater chemistry found in the baseline study and some elevated chloride levels also reflect the response of surficial aquifers to surficial activities.

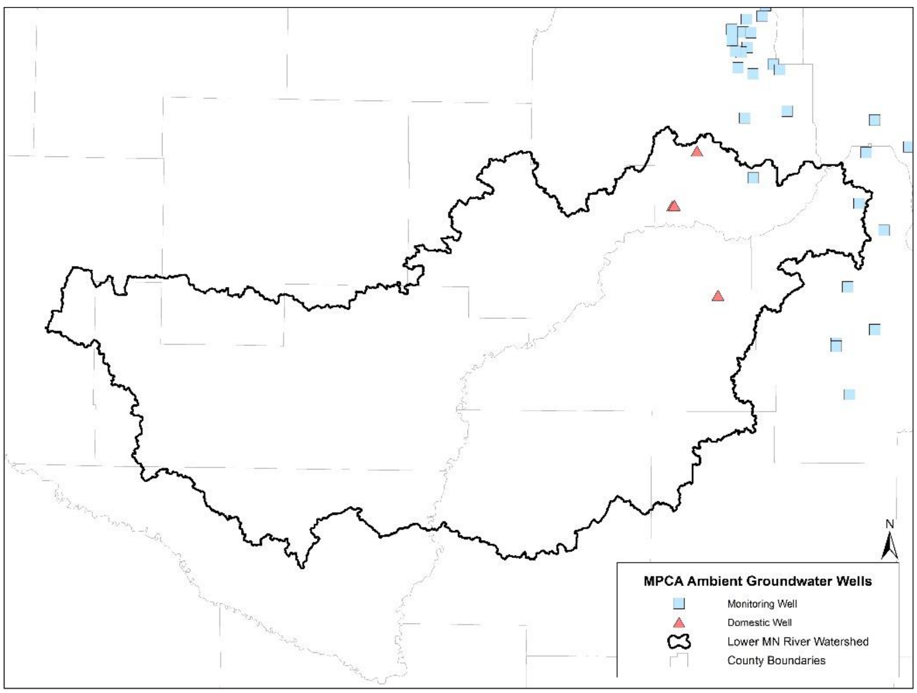


Figure 40. MPCA ambient groundwater wells in and around the Lower Minnesota River Watershed.

Mandatory MDH testing of new drinking water wells for arsenic, a naturally occurring but potentially harmful contaminant for humans, found that certain areas of the state are more likely to have arsenic concentrations above the maximum contaminant level (MCL) of 10 μg/L. The percentages of new wells with concentrations exceeding the MCL by county in the Lower Minnesota River Watershed are as follows: Renville (24.8%) Carver (21.2%), Le Sueur (11.5%), Hennepin (15.4%), McLeod (9.3%), Rice (5.1%), Scott (3.6%), Sibley (3.1%) and Dakota (0.9%) (MDH, 2017).

Groundwater quantity

The DNR monitors groundwater levels to track trends and aid in managing the resource. Recorded water levels from two DNR observation wells in the Lower Minnesota River Watershed are displayed below in Figure 41. Monthly data show seasonal fluctuations in groundwater levels. Annual averages of water levels in each well exhibit no significant trend.

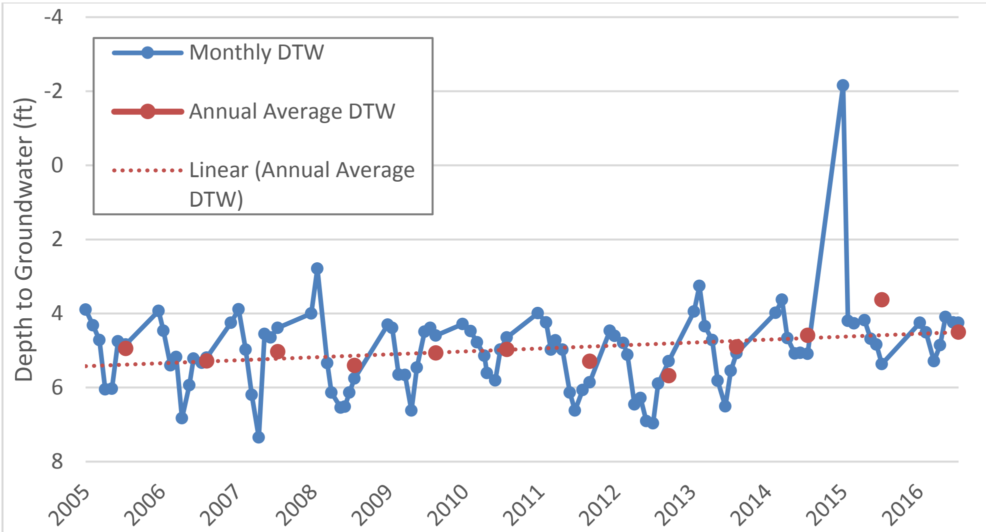
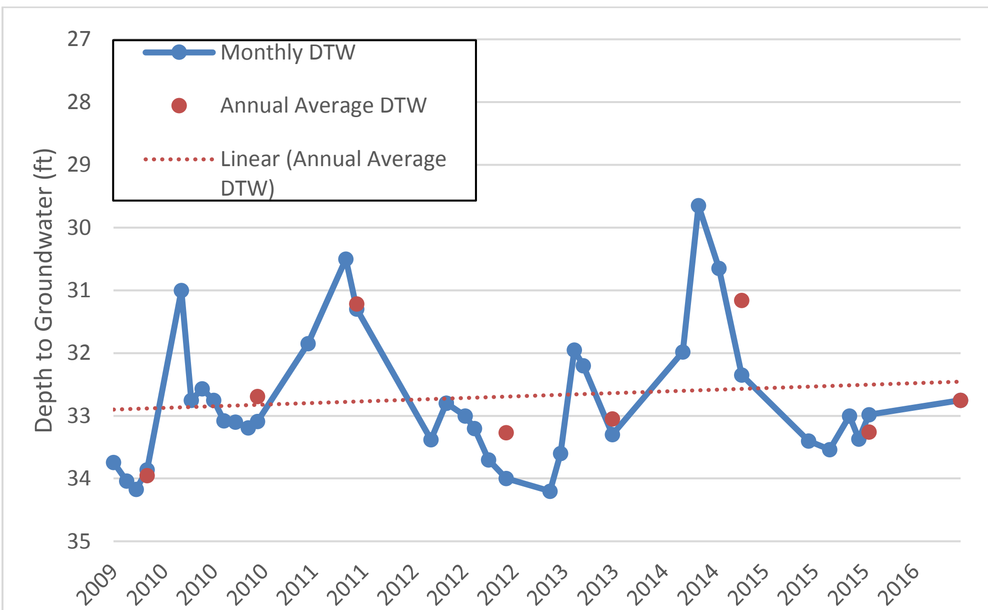


Figure 41. Groundwater Level Measurements- DNR Observation Wells Savage Fen #8 (above) and MW-9A (below).



Groundwater/surface water withdrawals

The DNR requires permits for users withdrawing more than 10,000 gallons of water per day or one million gallons/year. Annual reports are entered into and stored in the DNR Permitting and Reporting System (MPARS). Figure 42 and Figure 43 display, respectively, total active permitted groundwater and surface water withdrawals within the watershed for the past 20 years (DNR, 2016b). Over this time period, groundwater withdrawals have not shown a statistically significant trend while surface water withdrawals have increased at a moderately significant rate (p=0.1).

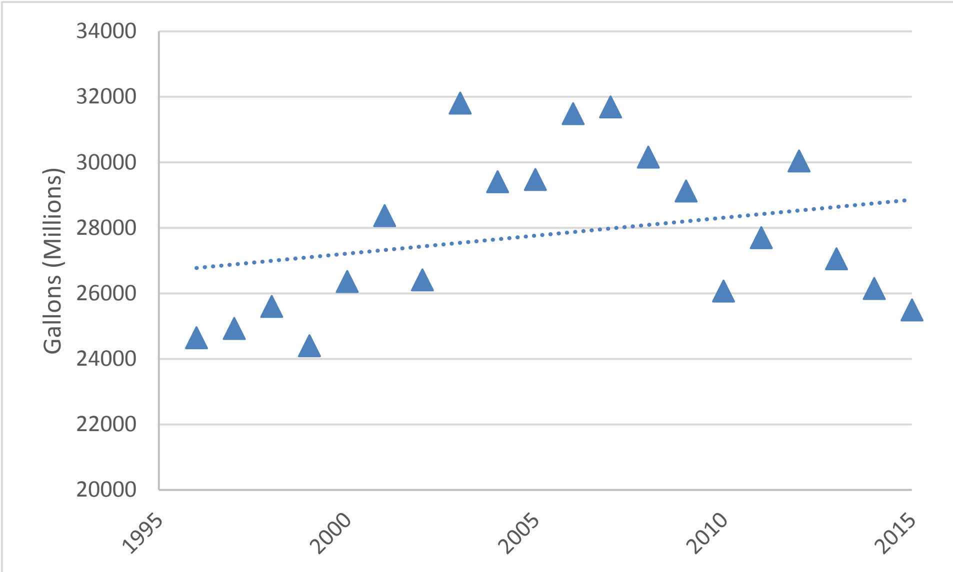


Figure 42. Total annual permitted groundwater withdrawals, Lower Minnesota River Watershed (1996-2015).

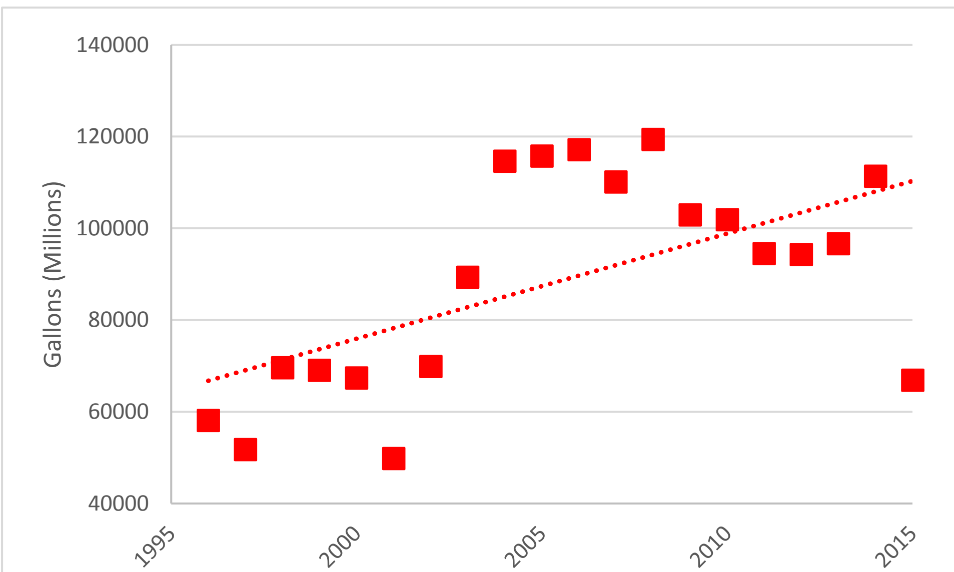


Figure 43. Total annual permitted surface water withdrawals, Lower Minnesota River Watershed (1996-2015).

Stream flow

Groundwater/surface water interactions are common and the impacts of groundwater use on surface water quantity have been documented in places like Little Rock Creek and White Bear Lake. Discharge is one measure of the volume of water in a stream.

Figure 44 and Figure 45 (below) show mean annual (water year) and mean summer (July/August) discharge for High Island Creek near Henderson. Available data for annual flow exhibit an increasing, but not statistically significant, trend. Summer flows appear to vary and, particularly in August, are quite low, but there is no statistically significant trend over the past 20 years (USGS, 2017).

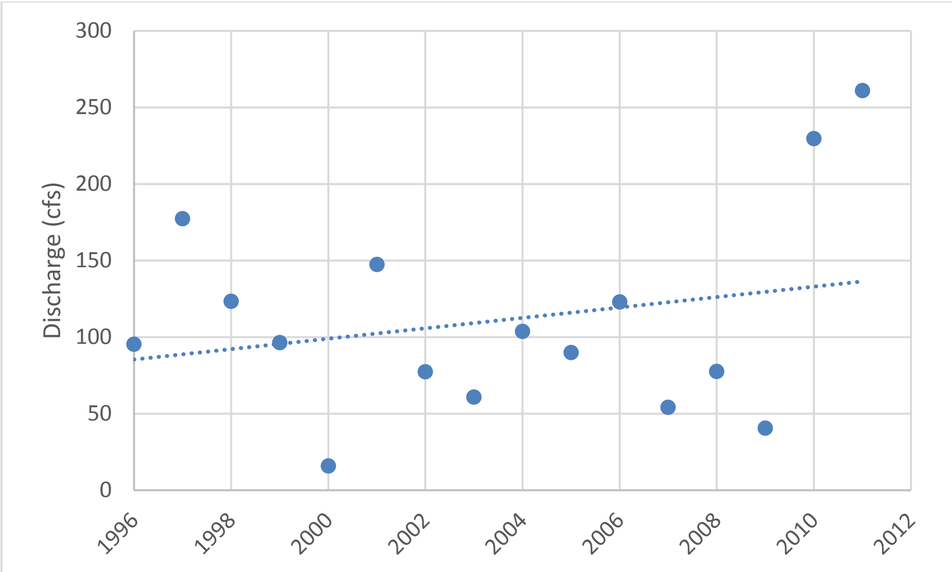


Figure 44. Mean annual discharge measurements for High Island Creek (Water Years 1996-2011).

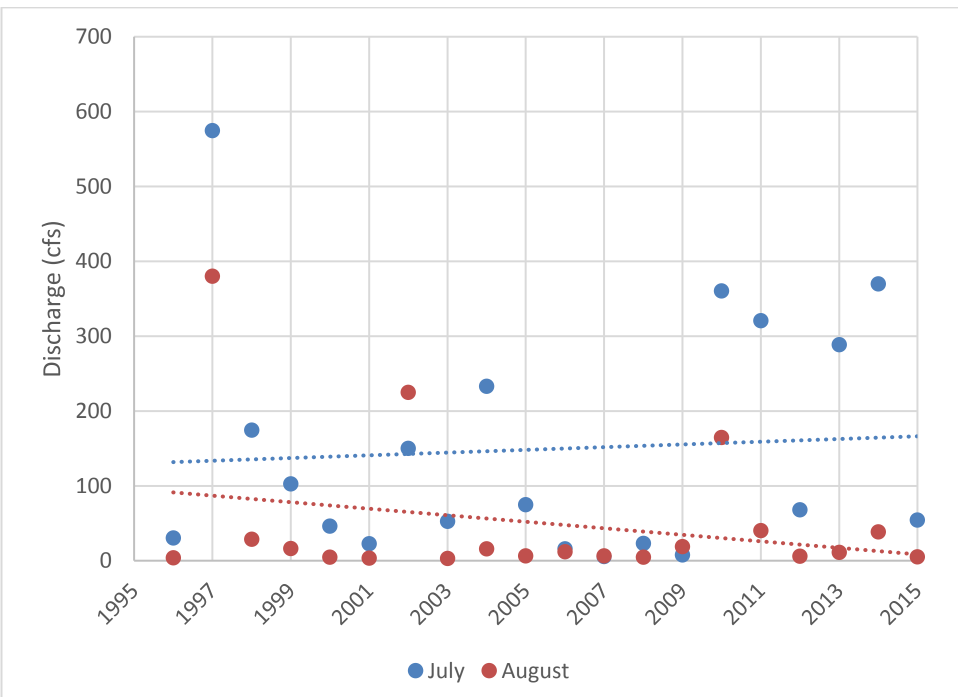


Figure 45. Mean July/August discharge measurements for High Island Creek (1996-2015).

Wetland condition

The western two-fifths of the Lower Minnesota River Watershed occurs in the Temperate Prairies Ecoregion, whereas the eastern three-fifths region of the watershed occur in the Mixed Wood Plains Ecoregion (Figure 13). Wetland condition, based on floristic quality, in the Temperate Prairies Ecoregion is among the worst in the state and the Mixed Wood Plains Ecoregion is not much better (Table 35). Over 80% of the wetlands in these two ecoregions are estimated to be in poor or fair condition (MPCA 2015). Wetland invertebrate indices in the Temperate Prairies developed for natural wetland basins having semi-permanent to permanent water regimes, found 27% of depressional wetlands are in poor condition while 41% of these marsh-type wetlands are in good condition. Wetland condition in the Mixed Wood Plains ecoregion were somewhat better based on macroinvertebrate results (Genet, 2015).

Dominance of many wetlands by invasive plants, particularly narrow-leaf cattail (Typha angustifolia), hybrid cattail (Typha X glauca) and reed canary grass (Phalaris arundinacea), are believed to contribute to the large difference between macroinvertebrate and floristic quality such that invasive plants have more direct impact on the composition and structure of the plant community. These invasive plants often outcompete native species due to their tolerance of nutrient enrichment, hydrologic alterations and toxic pollutants such as chlorides (Galatowisch, 2012).

Table 35. Wetland biological condition statewide and by major ecoregions according to vegetation and macroinvertebrate indicators. Vegetation results are expressed as extent (i.e., percentage of wetland acres) and include essentially all wetland types (MPCA, 2015). Macroinvertebrate results represent natural depressional wetlands (e.g., prairie potholes) expressed as the percentage of natural wetland basins (Genet 2015). Depressional wetland monitoring focused in Mixed Wood Plains and Temperate Prairie ecoregions (as opposed to statewide) where it is a more prevalent type.

Vegetation Condition in All Wetlands

Condition Category	Mixed Wood Shield	Mixed Wood Plains	Temperate Prairies
Exceptional	64%	6%	7%
Good	20%	12%	11%
Fair	16%	42%	40%
Poor		40%	42%

Macroinvertebrate Condition in Depressional Wetlands

Condition Category	Mixed Wood Plains	Temperate Prairies
Good	46%	41%
Fair	34%	30%
Poor	20%	27%

Depressional wetland condition results are for natural wetland Basins only.

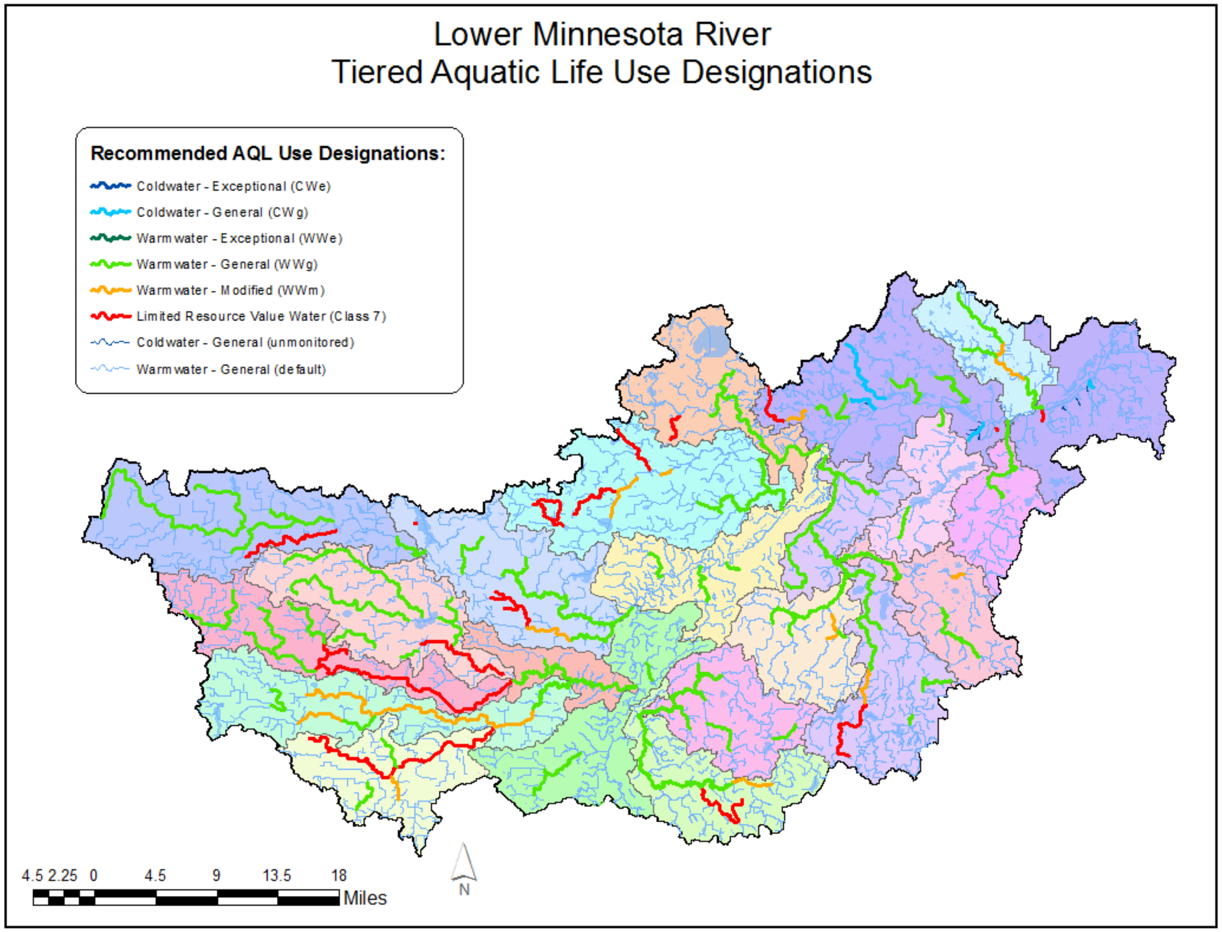


Figure 46. Stream tiered aquatic life use designations in the Lower Minnesota River Watershed.

Figure 47. Fully supporting waters by designated use in the Lower Minnesota River Watershed.

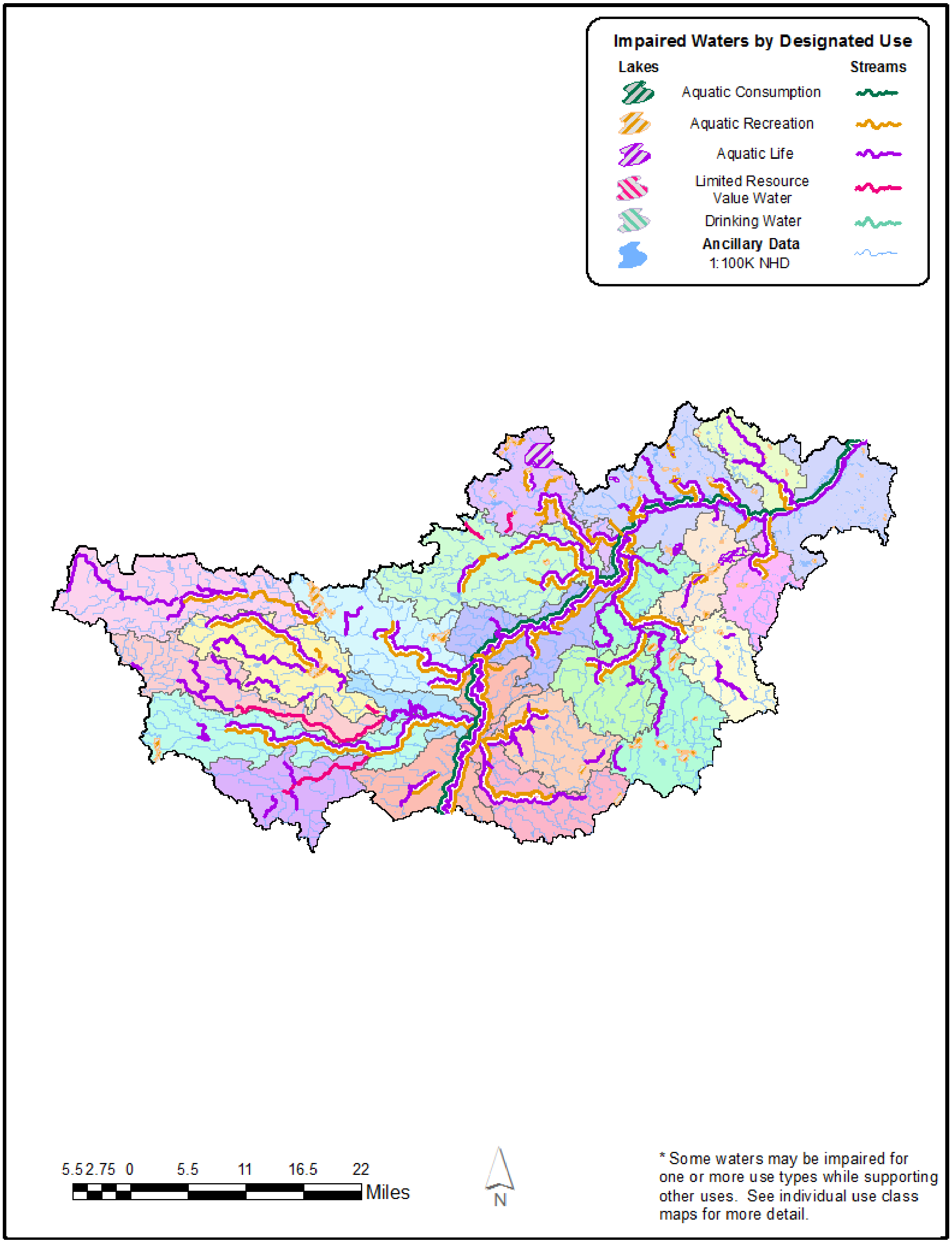


Figure 48. Impaired waters by designated use in the Lower Minnesota River Watershed.

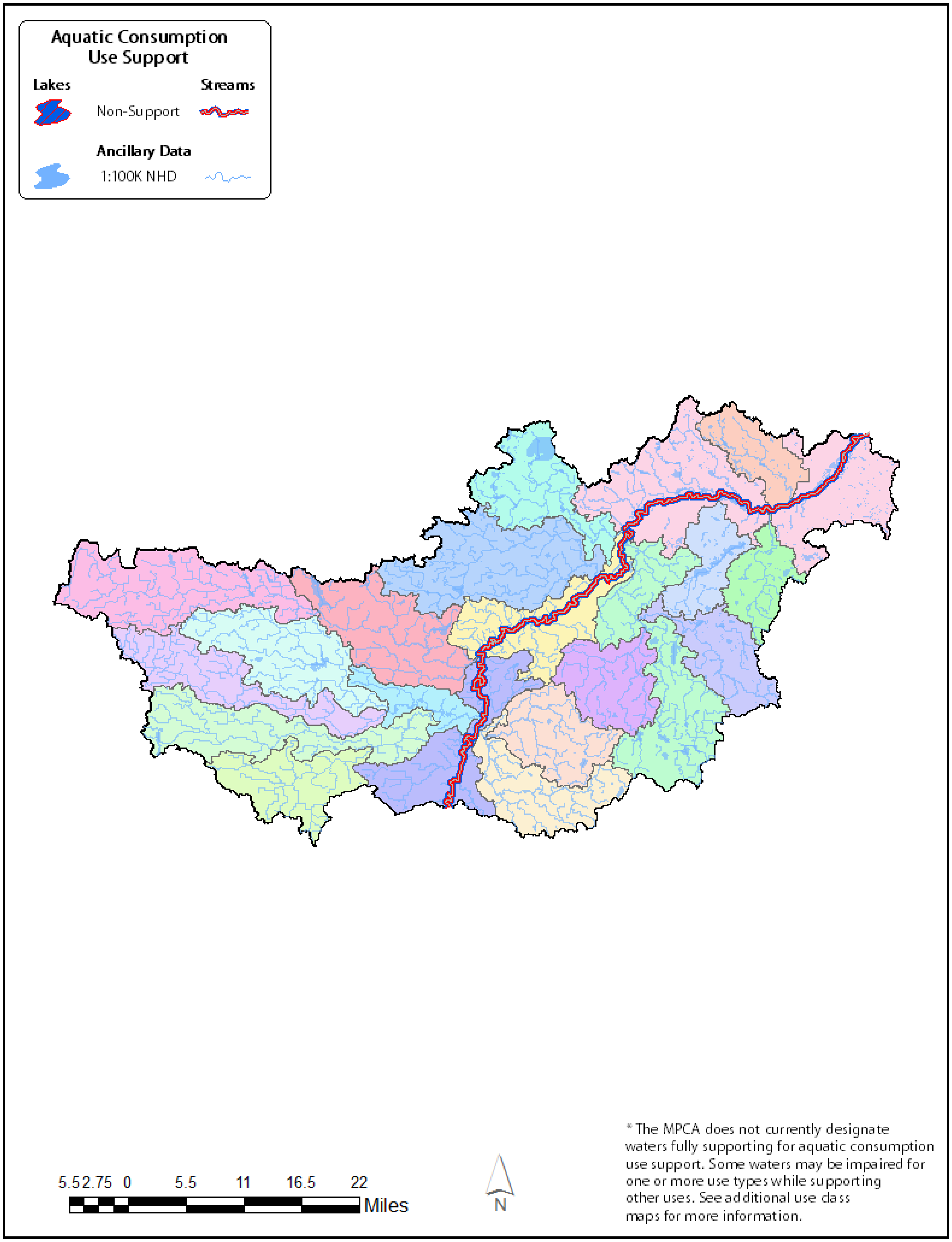


Figure 49. Aquatic consumption use support in the Lower Minnesota River Watershed.

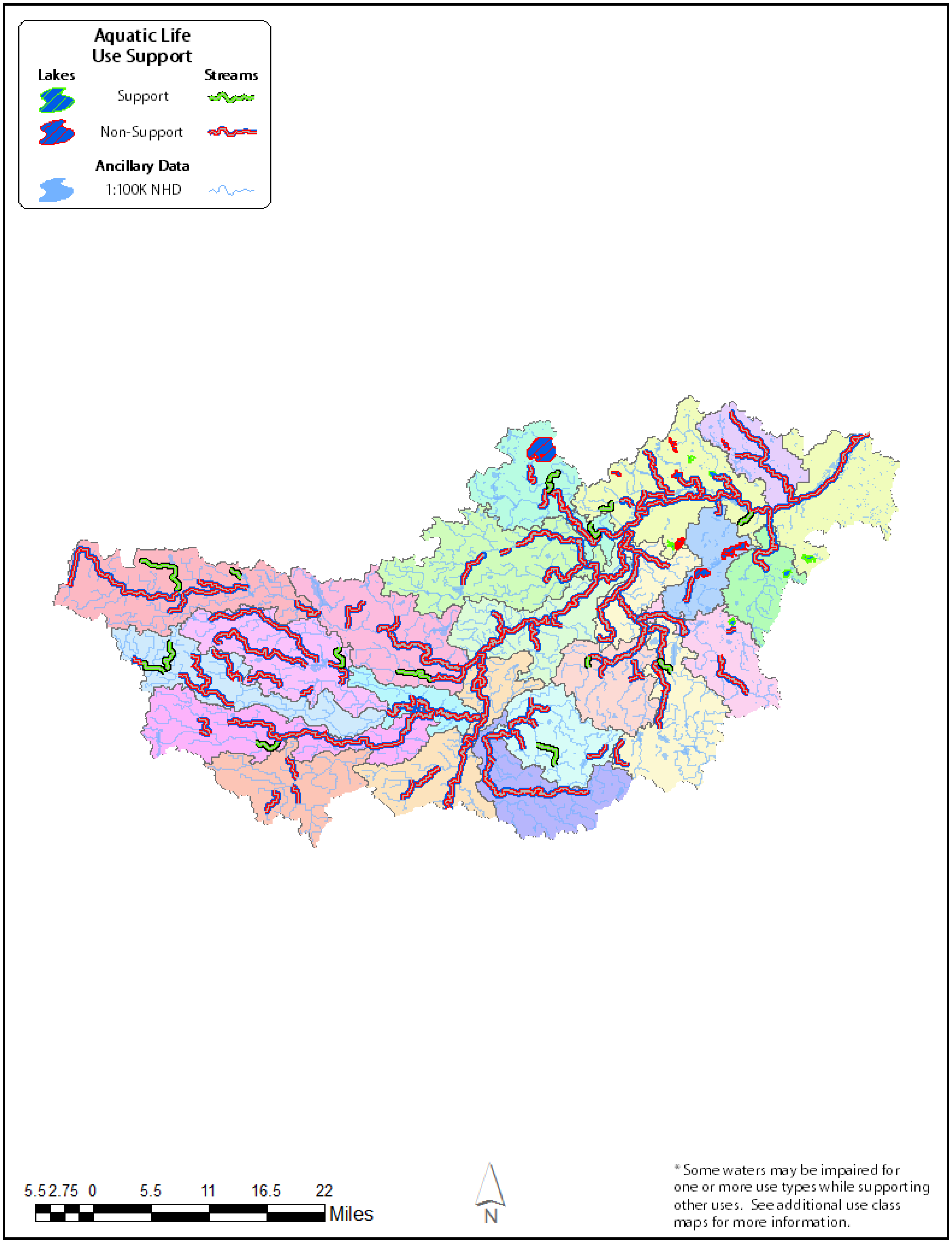


Figure 50. Aquatic life use support in the Lower Minnesota River Watershed.

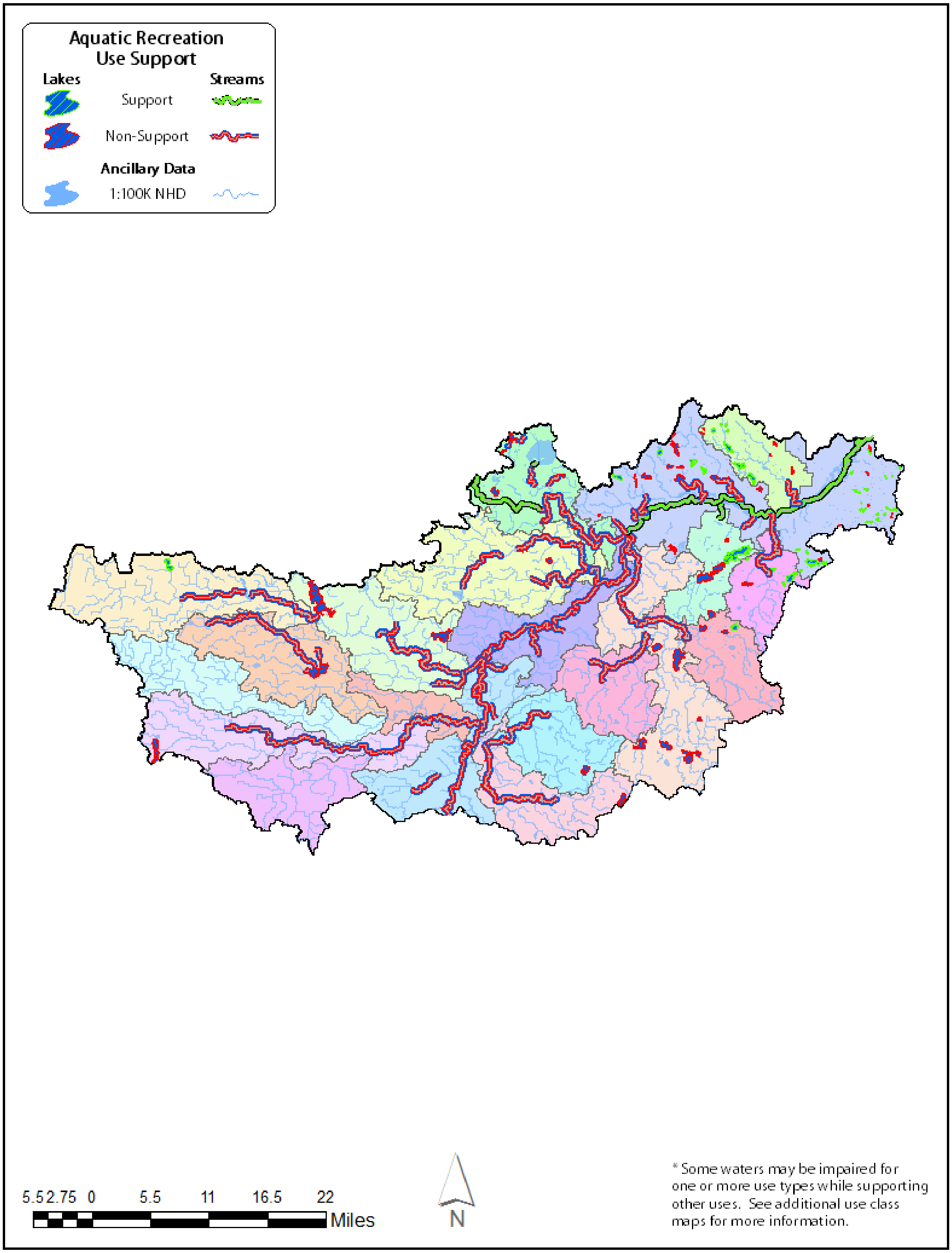


Figure 51. Aquatic recreation use support in the Lower Minnesota River Watershed.

Long-term trends for the Lower Minnesota River Watershed

MPCA completes annual trend analysis on lakes and streams across the state based on long-term transparency measurements. The data collection for this work relies heavily on volunteers across the state and also incorporates any agency and partner data submitted to EQuIS.

The trends are calculated using a Seasonal Kendall statistical test for waters with a minimum of eight years of transparency data (Secchi disk measurements in lakes and Secchi Tube measurements instream).

Citizen volunteer monitoring occurs at 36 streams and 88 lakes in the Lower Minnesota River Watershed. Citizen engaged monitoring is high in this watershed, likely a function of the population density. Citizen stream monitoring data do not indicate long-term trends at any locations at this time. Twenty-five lakes have increasing trend in water clarity, while 10 have decreasing trend.

Table 36. Water Clarity Trends at Citizen Stream Monitoring Sites.

Lower Minnesota River HUC 07020012	Citizen Stream Monitoring Program	Citizen Lake Monitoring Program
number of sites w/ increasing trend	0	25
number of sites w/ decreasing trend	0	10
number of sites w/ no trend	36	53

In June 2014, the MPCA published its final trend analysis of river monitoring data located statewide based on the historical Milestones Network. The network is a collection of 80 monitoring locations on rivers and streams across the state with good, long-term water quality data. The period of record is generally more than 30 years, through 2010, with monitoring at some sites going back to the 1950s. While the network of sites is not necessarily representative of Minnesota's rivers and streams as a whole, they do provide a valuable and widespread historical record for many of the state's waters.

There are two such sites within the Lower Minnesota River Watershed, both on the mainstem Minnesota River. One at River Mile 64 near Henderson and one at River Mile 3.5 near the airport.

Table 37. Pollutant Trends in the Lower Minnesota River Watershed.

Pollutant Trends in the Lower Minnesota River Watershed

Data is from Minnesota Pollution Control Agency "Milestone" monitoring sites.

	Total Suspended Solids	Total Phosphorus	Nitrite/ Nitrate	Ammonia	Biochemical Oxygen Demand	Chloride
Minnesota River at MN-19 Bridge at Henderson (S000-040)(MI-64) (period of record 1955 - 2009)						
overall trend	**decrease**	**decrease**	**no trend**	**decrease**	**decrease**	**increase**
estimated average annual change	-0.7%	-1.3%		-5.6%	-2.1%	3.2%
estimated total change	-30%	-48%		-83%	-68%	362%
1995 - 2009 trend	**decrease**	**decrease**	**no trend**	**no trend**	**increase**	little data
estimated average annual change	-4.3%	-2.6%			4.7%	
estimated total change	-51%	-34%			108%	
median concentrations first 10 years	140	0.4	4	0.10	6	17
median concentrations most recent 10 years	81	0.2	3	<0.05	4	32
Minnesota River at MCES Site off SE End of Runway 12L/30R (S000-310)(MI-3.5) (period of record 1980 - 2009)						
overall trend	**no trend**	**decrease**	**no trend**	**decrease**	**no trend**	little data
estimated average annual change		-1.8%		-7.7%		
estimated total change		-41%		-90%		
1995 - 2009 trend	**decrease**	**decrease**	**no trend**	**no trend**	**no trend**	little data
estimated average annual change	-4.8%	-3.0%				
estimated total change	-54%	-38%				
median concentrations first 10 years	77	0.4	3	0.28	4	--
median concentrations most recent 10 years	71	0.2	7	<0.05	3	55

(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.)

Starting in 2017, the MPCA will be switching to the Pollutant Load Monitoring Network for long-term trend analysis on rivers and streams. Data from this program has much more robust sampling and will cover over 100 sites across the state. Within the watershed, two stations are on High Island Creek and the two existing Minnesota River sites mentioned previously. Trend analysis on these stations will occur as datasets mature.

Remote sensing for lakes in the Lower Minnesota River Watershed

The University of Minnesota, in partnership with MPCA, conducts remote sensing of lake clarity. The information provides a snapshot of water transparency during late summer over a span of 30 years. Secchi disk transparency data is paired with satellite imagery to come up with estimates of water clarity across the state. While there are limitations to the data, such as cloud cover, vegetation, or stained water altering the estimated Secchi transparency, it does provide information to help prioritize monitoring and protection efforts on lakes, which do not have, water quality data.

Twenty lakes had remote sensing data available within the Lower Minnesota River Watershed. Sixteen of those basins had data indicating the late summer transparency was less than one meter, while four had transparencies between one and two meters. The use of transparency data for assessment is based on Secchi disk clarity measurement only, which is tied to the aquatic recreation use standard.

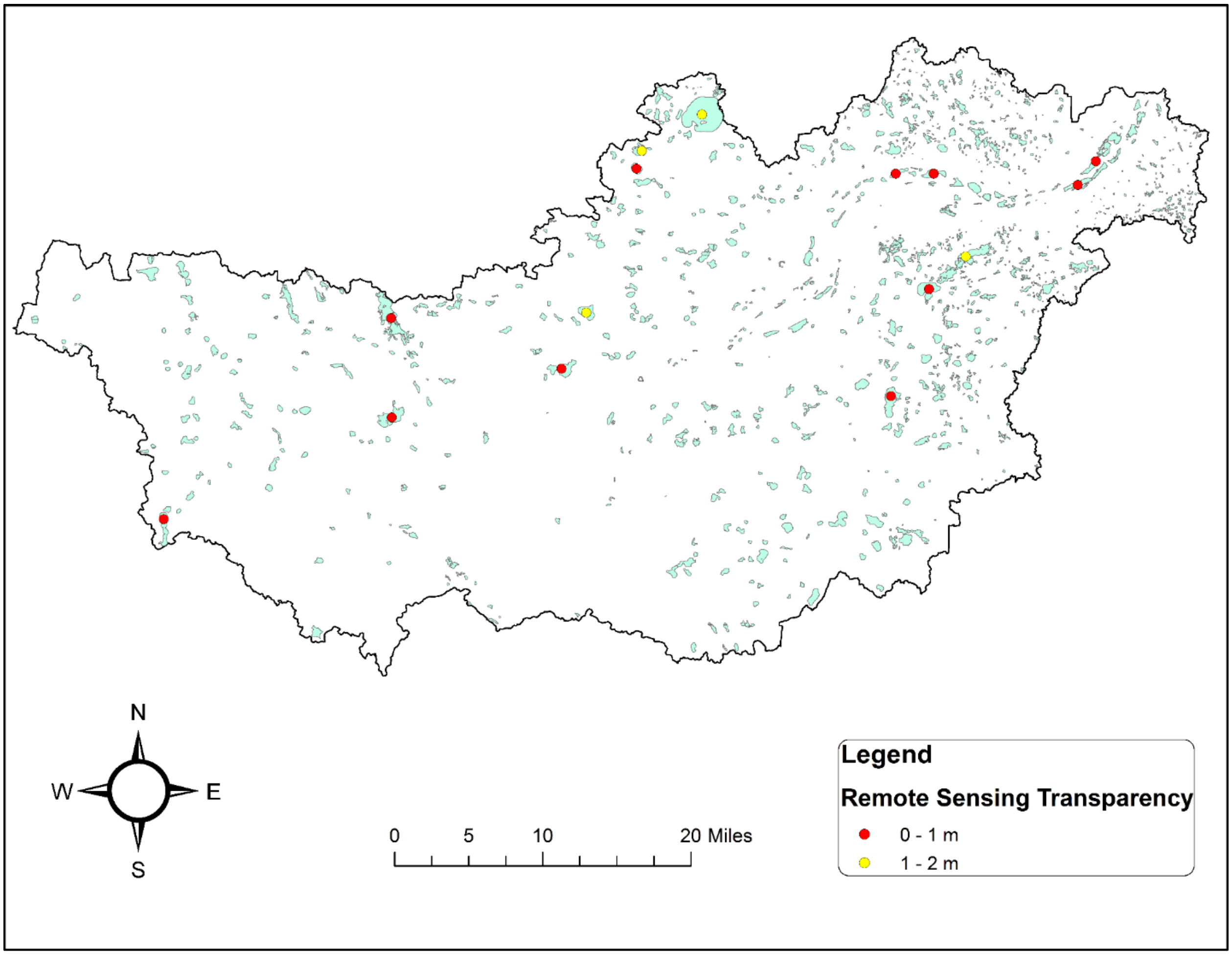


Figure 52. Remotely sensed Secchi transparency on lakes in the Lower Minnesota River Watershed.

Summaries and recommendations

Pollutant load

When compared with other major watersheds throughout the state, the Lower Minnesota has elevated average annual NO3+NO2-N, TSS and TP FWMCs, similar to other agricultural regions in southern and northwestern Minnesota. However, even among agricultural watersheds, the TSS and TP FWMCs measured on High Island Creek in Henderson are among the highest measured within the WPLMN. FWMCs for TSS and TP on High Island dramatically increase between Arlington and Henderson due to increased streambank/bluff erosion between the sites and additional inputs from gulley erosion within ravines contained in the lower "incised" portion of the watershed. NO3+NO2-N FWMCs between sites are similar. In 2013 and 2014, exceedances of the Central River Nutrient Region standard for TSS of 30 mg/L increased moving downstream on High Island Creek from 75% at the upstream station to 85% at the downstream station. While all TP samples collected from June through September from both sites exceeded the "summer" Central River Nutrient Region TP standard of 0.100 mg/L.

Average annual runoff in the watershed is amongst the highest measured in the state, at greater than 9.5 inches annually, similar to runoff totals observed in watersheds in southeastern and northeastern Minnesota.

Wetlands

Ninety percent of historic wetlands in the watershed have been removed from the landscape to improve agricultural productivity. Of what remains, 80% of wetlands in the watershed are in poor to fair condition. Macroinvertebrate indices are performing somewhat better compared to their floristic counterparts. Conditions are worse in the western two fifths of the watershed, in the temperate prairie ecoregion, and improve slightly moving to the eastern three fifths of the watershed, in the mixed woodlands ecoregion. Poor wetland conditions can be attributed to an abundance of invasive plants, which have a direct impact on composition and structure of the plant community and an abundance of tolerant macroinvertebrates. Invasive plants out compete native plants due to a tolerance of nutrient enrichment, hydrologic alteration and toxic pollutants, including chloride; similarly, sensitive macroinvertebrate species are lost due to degraded conditions resulting in a community shift to tolerant taxa. Future actions in the watershed should include restoration and protection strategies for remaining wetlands in the watershed. Special concern should be taken to protect the watersheds ORVW calcareous fens found in the lower terraces of the Minnesota River blufflands and wild rice waters.

Fish contaminants

High Island Creek and Rush River were chosen to represent the watershed's direct Minnesota River tributaries for fish consumption advisories as part of the IWM study conducted by the MPCA. Of the contaminants tested, only Mercury concentrations were found to be problematic in the Rush River, resulting in a new fish consumption impairment.

Of 46 lakes analyzed for mercury concentrations in fish tissue, 34 were listed for fish consumption impairments. PCBs were tested in 29 of the watershed's lakes, no fish consumption impairments were identified for PCBs. Of 13 lakes analyzed for PFOS concentrations in fish tissue, 6 had concentrations elevated enough to recommend fish consumption advisories of one meal per week due to elevated concentrations of PFOS.

Future fish contaminant monitoring within the watershed should include popular fishing lakes in rural portions of the watershed including Titlow and High Island lakes and other Minnesota River tributary streams that are actively fished. Monitoring should also include new testing of PCB levels in common carp in Snelling Lake to determine whether or not updated fish consumption advisories are needed in the lake.

Groundwater and stream flow

Groundwater quality in the Lower Minnesota River Watershed is generally good. Buried drift and Cretaceous aquifers can yield water with higher amounts of naturally occurring chemicals and surficial aquifers can be vulnerable to impacts from human activities, particularly in the more heavily populated areas of the watershed. Withdrawals are increasing within the watershed but not at a particularly significant rate. Stream flow appears to fluctuate but exhibits no trend. Continued monitoring of discharge and further study of groundwater/surface water interactions near High Island Creek may be helpful to determine whether low summer flows are a concern for that particular waterbody.

Lakes and streams

Lake water quality

Many lakes included in this watershed have a variety human-induced disturbance within their contributing watershed, which often leads to excessive nutrient loading to downstream waterbodies. Stressors associated with significantly disturbed urban land use are as pertinent to current and future lake water quality as disturbance from row crop agriculture. The watershed itself is unique due to the diversity of land use, public perception, local funding and active local government units. During past statewide assessment efforts, numerous lake basins within this watershed were deemed impaired, many will remain impaired for aquatic recreation use at this time based on new data available. Successful restoration strategies can be attributed to delistings for McMahon, Mitchell and Bryant lakes, revealing that effectively executed best management practices make good recreational water quality attainable. Recreational enjoyment is severely impacted when lakes have frequent heavy algae blooms throughout the summer months, which typically are fueled by unnaturally elevated nutrient concentrations. Poor recreational use potential can result in reduced economic benefits to local businesses that rely on healthy recreational opportunities in densely populated suburban areas. Controlling the nutrient inputs to these lakes can engage citizens at a local level. Keeping native shoreline buffers intact, preventing yard waste input, maintaining compliant septic systems, mitigating runoff from impervious surfaces and reducing or eliminating fertilizer use are all potential practices to investigate locally. Addressing larger scale issues such as altered surface hydrology, overland runoff and water treatment plant compliance would be potential areas for improvement as well. In some cases, internal loading on shallow lake basins can be difficult to manage with traditional practices, in those situations in lake management is one of a few options available when financial support exists. Devoting time and financial resources to develop long-term restoration and protection strategies will be required for these lakes to see water quality improvements, many areas this effort has long been underway.

Lake aquatic biology

Aquatic biology index data available from lakes allow for assessment of aquatic life not possible in previous assessments. Habitat limitations and poor water quality can inhibit thriving aquatic communities. Staring and Thole Lakes, however, have aquatic recreation impairments but are still maintaining healthy aquatic communities. It will be important to work to improve water quality so aquatic life does not degrade. Tolerant taxa such as common carp, black bullhead and fathead minnow were abundant and dominated the biomass in some lakes, resulting in low biological index scores. Winterkill on shallow lakes, such as Phelps and Cody, had adverse effects on fish communities, preventing a confident assessment of aquatic life. Protecting and improving aquatic habitat both in-lake and on adjacent shoreline is key to promoting strong natural reproduction and a healthy food web to provide the building blocks for diverse aquatic communities. Chloride data available on lake basins in the watershed show that concentrations do increase as to move into the metropolitan area. While concentrations in the lakes do not yet exceed the standard, chloride is conservative. It does not leave the lakes, once it enters them. Work to reduce over application of deicers on sidewalks, driveways, and roads will be critical to preventing impairments on urbanized lakes.

Stream aquatic biology

Overall stream aquatic biology is performing poorly throughout the watershed with impairments observed across all subwatersheds. Of 89 reaches assessed for aquatic life using biological indicators, only two reaches met general use standards for aquatic life, Eagle Creek and County Ditch 3; 15 met modified use standards. Seventy-five percent of stream reaches assessed for fish did not meet standards and 79% of those assessed for macroinvertebrates did not meet standards. Forty-seven reaches were impaired for both fish and macroinvertebrates, indicating that there are localized populations of fish and macroinvertebrates throughout the watershed that are meeting their respective standards.

Fish and macroinvertebrate communities in the watershed are generally dominated by taxa tolerant to degraded water quality and habitat conditions and have few to no sensitive species. No rare or threatened species were identified during monitoring.

Credit River Subwatershed was the only subwatershed within the Lower Minnesota to have an overall good stream habitat score (MSHA), but the Credit River Subwatershed only includes two stations on a single stream reach. Poor average subwatershed habitat scores were observed in Bevens Creek, City of Le Sueur – Minnesota River, Middle Branch Rush River, Judicial Ditch 1A, South Branch Rush River and North Branch Rush River. Good habitat conditions were present within the Lower Minnesota Watershed but were generally isolated to natural stream reaches. These reaches are often located towards the outlet of a subwatershed, near the confluence of the Minnesota River, or where streams begin to drop into the Minnesota River Valley. They typically have diverse instream structure, quality substrates, good sinuosity and depth variability and intact riparian buffers. Poorest habitat conditions were observed in actively maintained channelized stream reaches with limited riparian buffers, depth variability and stream structure, had ubiquitous channel types (run) and were dominated by fine sediments (sand, silt). Degraded habitat conditions observed are a result of both historic and actively maintained ditch systems, limited riparian buffers and as well as limited natural water storage on the landscape, attributed to impervious surfaces and wetland filling in the urban subwatersheds and drained wetlands and agricultural tile drainage in the rural subwatersheds. Limited water storage on the land causes increased runoff and pulses of flow during rain and snow melt events, causing increases instream flow, which leads to stream bank erosion and sedimentation of pools and riffles.

Stream water quality

Considerable monitoring, assessment, and implementation work was done in this watershed prior to this assessment effort, especially in urban areas. Suspended sediment concentrations throughout the watershed were high. Excess sediment is a common problem throughout the downstream reaches of most HUC-12 tributaries in the watershed, variability instream flows are continually impacting stream corridors and stream bank stability. Natural surface water storage in the headwater areas in many cases no longer exists, whether from land conversion for row crop agriculture or urban development. Elevated sediment and reduced clarity typically occurs more as hydrology becomes more erratic, growing exponentially worse in downstream waterbodies (e.g. Minnesota River, Mississippi River). Reaches of Rush River, Bevens Creek, High Island Creek, Buffalo Creek, Riley Creek, Carver Creek and Sand Creek previously listed impaired based parameters associated with sediment continue to indicate impairment. All previous chloride listings remained during this assessment effort, the majority had newer data available confirming the existing problem. Work to implement the Metro Chloride TMDL is actively working to address these issues. River eutrophication standards new to this assessment cycle highlighted multiple reaches where response potential was high to elevated phosphorus concentrations and resulted in six new listings based on eutrophication data. Elevated phosphorus concentrations were a common theme throughout many tributaries; evidence of eutrophication (excess algal or plant growth) was not observed by sampling efforts.

Bacteria concentrations were a persistent problem seen in many tributaries in this watershed, degrading aquatic recreational use potential of these waterbodies. Concentrated animal activity within stream or immediately adjacent to the flood plain is typically associated with high bacteria levels. Limiting access to streams and cleaning up pet waste in urban areas could lower bacteria levels. Investigation into the compliance of private septic systems could potentially be used address elevated bacteria concentrations in more rural portions of the watershed.

Elevated concentrations of TSS and NO_3+NO_2-N are a result of non-point source pollution from urban and agricultural sources. High concentrations of TP can be caused by both point sources like WWTPs and non-point sources of pollution like agriculture and sediments. Dramatic improvements on the landscape are needed to bring waters to attainment of water quality standards.

Efforts must continue to manage point source contributions from urban sources including industry and wastewater treatment plants but also must reign in unregulated non-point sources from agricultural and urban contributors.

Literature cited

Galatowitsch, S.A. 2012. Why invasive species stymie wetland restoration; Society of Wetland Scientists Research Brief, No. 2012-0001. 4 pp. http://www.sws.org/ResearchBrief/galatowitsch_2012_0001.pdf

Genet, J. A. 2015. Status and Trends of wetland s in Minnesota: Depressional Wetland Quality Assessment. Minnesota Pollution Control Agency, Biological Monitoring Program, St. Paul, Minnesota. 61 pp. https://www.pca.state.mn.us/sites/default/files/wq-bwm1-08.pdf

Minnesota Department of Health (MDH). MN Public Health Data Access, County Profiles. Retrieved on January 19, 2017 from https://apps.health.state.mn.us/mndata/profiles.

Minnesota Department of Natural Resources. 2001. Ground Water Provinces. Retrieved from http://www.dnr.state.mn.us/groundwater/provinces/index.html.

Minnesota Department of Natural Resources: State Climatology Office (2016a). Annual Precipitation Maps. Retrieved from http://climate.umn.edu/doc/annual_pre_maps.htm

Minnesota Department of Natural Resources (2016b), Water Use- Water Appropriations Permit Program. Retrieved from http://www.dnr.state.mn.us/waters/watermgmt_section/appropriations/wateruse.html

Minnesota Pollution Control Agency. 1999a. Baseline Water Quality of Minnesota's Principal Aquifers: Region 5, Southeast Minnesota.

Minnesota Pollution Control Agency. 1999b. Baseline Water Quality of Minnesota's Principal Aquifers: Region 6, Twin Cities Metropolitan Area.

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 5.2 *in* Biennial Report of the Clean Water Council. Minnesota Pollution Control Agency, St. Paul, Minnesota.

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). 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). 2015. Status and Trends of Wetlands in Minnesota: Vegetation Quality Baseline. wq-bwm-1-09. Minnesota Pollution Control Agency, St. Paul, MN. https://www.pca.state.mn.us/sites/default/files/wq-bwm1-09.pdf

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.

Minnesota State Demographic Center. 2017. Population: Data Estimates. Published July 2016, retrieved on March 2, 2017. https://mn.gov/admin/demography/data-by-topic/population-data/our-estimates/.

National Resource Conservation Service (NRCS). 2007. Rapid Watershed Assessment: Lower Minnesota (MN) HUC: 07020012. NRCS. USDA. https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_023175.pdf.

NOAA National Centers for Environmental information, Climate at a Glance: U.S. Time Series, Average Temperature, published January 2017, retrieved on January 18, 2017 from http://www.ncdc.noaa.gov/cag/

United States Department of Agriculture (USDA). Animal Feeding Operations. Date retrieved, March 2017. https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/plantsanimals/livestock/afo/

United States Department of Agriculture (USDA). 2012 Census of Agriculture, County Profile, Carver County, MN. Published 2012, retrieved Dec. 2016. https://www.agcensus.usda.gov/Publications/2012/Online_Resources/County_Profiles/Minnesota/cp27019.pdf

United States Department of Agriculture (USDA). 2012 Census of Agriculture, County Profile, Le Sueur County, MN. Published 2012, retrieved Dec. 2016. https://www.agcensus.usda.gov/Publications/2012/Online_Resources/County_Profiles/Minnesota/cp27079.pdf

United States Department of Agriculture (USDA). 2012 Census of Agriculture, County Profile, Nicollet County, MN. Published 2012, retrieved Dec. 2016. https://www.agcensus.usda.gov/Publications/2012/Online_Resources/County_Profiles/Minnesota/cp27103.pdf

United States Department of Agriculture (USDA). 2012 Census of Agriculture, County Profile, Scott County, MN. Published 2012, retrieved Dec. 2016. https://www.agcensus.usda.gov/Publications/2012/Online_Resources/County_Profiles/Minnesota/cp27139.pdf

United States Department of Agriculture (USDA). 2012 Census of Agriculture, County Profile, Sibley County, MN. Published 2012, retrieved Dec. 2016. https://www.agcensus.usda.gov/Publications/2012/Online_Resources/County_Profiles/Minnesota/cp27143.pdf

United States Geological Survey (2016), Western Corn Belt Plains Ecoregion Summary. Published July 2016, retrieved on March 2, 2017. https://landcovertrends.usgs.gov/gp/eco47Report.html

United States Geological Survey (2007), Ground Water Recharge in Minnesota. Retrieved from http://pubs.usgs.gov/fs/2007/3002/pdf/FS2007-3002_web.pdf

United States Geological Survey (2017). WaterWatch, Current Water data for Minnesota. Retrieved from https://waterwatch.usgs.gov/?m=real&r=mn.

Western Regional Climate Center. USA Divisional Climate Data, Time Series Plot #1. Retrieved October 26, 2016 from http://www.wrcc.dri.edu/spi/divplot1map.html.

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 wastewater 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.

Total Kjeldahl 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.

Unionized Ammonia (NH3) - Ammonia is present in aquatic systems mainly as the dissociated ion $NH4^{+}$, 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 $NH4^{+}$ ions and ^{-}OH ions (ammonium hydroxide). If pH levels increase, the ammonium hydroxide becomes toxic to both plants and animals.

Appendix 2.1 – Intensive watershed monitoring water chemistry stations in the Lower Minnesota River Watershed

EQuIS ID	Biological Station ID	AUID	Waterbody Name	Location	Aggregated 12-digit HUC
S000-843	90MN113	07020012-813	Silver Creek	At CR 41, 2 mi. SW of East Union	Bevens Creek
S005-722	14MN120	07020012-725	Forest Prairie Creek	Near outlet with Le Sueur Creek, just E of Le Sueur	Forest Prairie Creek
S007-876	14MN100	07020012-761	Trib. To Judicial Ditch 2	At Henderson Station Rd, 1 mi. E of Henderson	City of Le Sueur
S007-900	03MN074	07020012-724	Le Sueur Creek	At Jay St, 0.5 mi. E of Le Sueur	Le Sueur Creek
S001-764	14MN090	07020012-716	Raven Stream, West Branch	At 230th St., 4 mi. N of New Prague	Raven Stream
S001-366	99MN004	07020012-817	Porter Creek	At Xanadu Ave. in Helena	Porter Creek
S003-551	03MN030	07020012-806	Carver Creek	At CR 43, 1.5 mi. N of East Union	Carver Creek
S004-524	00MN006	07020012-513	Sand Creek	At 173rd St. off of Hwy 169, 2.5 mi. N of Jordan	Sand Creek
S004-587	14MN059	07020012-811	Credit River	At Hidden Valley Park 132nd St in Savage	Credit River
S005-360	90MN114	07020012-514	Bevens Creek	At CR 40, 0.5 mi. S of East Union	Bevens Creek
S007-901	96MN006	07020012-809	Nine Mile Creek	In Nine Mile Creek Park, Downstream of 106th St. in Bloomington	Nine Mile Creek
S007-906	14MN123	07020012-728	Unnamed Creek (Prior Lake Outlet Channel)	At Frontage Rd (M-213) East of Valley Fair in Shakopee	Trib. To Minnesota River
S007-907	97MN001	07020012-828	Purgatory Creek	At Pioneer Trail, 0.5 mi. S of Eden Prairie	City of Mendota Heights
S006-609	00MN013	07020012-575	Robert Creek	Upstream of Union Trail (CR 6)	City of Belle Plaine
S001-872	14MN116	07020012-834	High Island Creek	At CR 6 in Jessenland	Lower High Island Creek
S002-944	97MN012	07020012-826	Rush River, South Branch	At CR 18, 4.5 mi. W of Le Sueur	South Branch Rush River
S002-945	14MN121	07020012-550	Rush River, Middle Branch	At CR 9, 6 mi, S of New Rome	Middle Branch Rush River
S006-398	03MN026	07020012-509	Judicial Ditch 1 Branch A	At CR 3, 10 mi. W of Le Sueur	Judicial Ditch 1A
S006-399	03MN027	07020012-558	Rush River, North Branch	At. CR 9, 2 mi. S of New Rome	North Branch Rush River
S007-866	90MN110	07020012-521	Rush River	At 312th St, 2 mi. Sw of Henderson	Rush River
S007-867	14MN122	07020012-838	High Island Creek	At 210th St 1.5 mi S of New Auburn	High Island Creek
S007-784	03MN076	07020012-603	Barney Fry Creek	At Twp Rd. 25, 3 mi. SW of Le Sueur	City of LeSueur

Appendix 2.2 – Intensive watershed monitoring biological monitoring stations in the Lower Minnesota River Watershed

AUID	Biological Station ID	Waterbody Name	Biological Station Location	County	Aggregated 12-digit HUC
07020012-513	00MN006	Sand Creek	Upstream of Sawmill Rd, SE of Jordan	Scott	0702001208-01
07020012-830	00MN007	Brewery Creek	Downstream of 1st St NE, in Belle Plaine	Scott	0702001209-01
07020012-710	00MN008	Bluff Creek	Downstream of Great Plains Blvd, in Chaska	Carver	0702001211-01
07020012-710	00MN009	Bluff Creek	Upstream of Hwy 101 and RR (Rec Trail), in Chaska	Carver	0702001211-01
07020012-803	00MN010	Chaska Creek	Upstream of Creek Rd, in Chaska	Carver	0702001211-01
07020012-575	00MN013	Robert Creek	Upstream of Union Tr, E of Belle Plaine	Scott	0702001209-01
07020012-558	03MN027	Rush River, North Branch	Upstream of CR 9, 2 mi. S of New Rome	Sibley	0702001202-01
07020012-822	03MN029	Trib. to Raven Stream, East Branch	Upstream of Helena Blvd. 0.5 mi. N of New Prague	Scott	0702001208-03
07020012-806	03MN030	Carver Creek	Upstream of CR 43, 1.5 mi. N of East Union	Carver	0702001210-01
07020012-808	03MN058	Nine mile Creek, North Fork	Adjacent to Picture Dr, 1 mi. E of Atwood	Hennepin	0702001211-02
07020012-723	03MN059	Nine mile Creek, South Fork	Upstream of Creekridge Circle, in Edina	Hennepin	0702001211-02
07020012-824	03MN074	Le Sueur Creek	Upstream of Jay St, 0.5 mi. E of Le Sueur	Le Sueur	0702001201-01
07020012-602	03MN076	Barney Fry Creek	Adjacent to 358th Ave, 3 mi. SW of Le Sueur	Nicollet	0702001205-01
07020012-513	07MN034	Sand Creek	Upstream of 173rd St, off of Hwy 169, 2.5 mi. N of Jordan	Scott	0702001208-01
07020012-840	07MN056	Sand Creek	Downstream of Harlow Ave (CR 15), 1 mi. SE of Helena	Scott	0702001208-01
07020012-773	14MN029	County Ditch 48	Upstream of 338th St, 2.5 mi. W of Montgomery	Le Sueur	0702001208-01
07020012-772	14MN030	County Ditch 42	Upstream of 201st Ave, 3 mi. W of Montgomery	Le Sueur	0702001201-02
07020012-763	14MN031	Unnamed ditch to Forest Prairie Creek	Upstream of CR 155, 3 mi. E of Le Sueur	Le Sueur	0702001201-02
07020012-764	14MN032	County Ditch 34	Downstream of CR 33, 5 mi. E of Le Sueur	Le Sueur	0702001201-02
07020012-725	14MN033	Forest Prairie Creek	Downstream of CR 28, 5 mi. E of Le Sueur	Le Sueur	0702001201-02
07020012-725	14MN034	Forest Prairie Creek	Upstream of CR 119, 6 mi. NE of Le Sueur	Le Sueur	0702001201-02
07020012-767	14MN035	Judicial Ditch 4	Downstream of CR 118, 6 mi. NE of Le Sueur	Le Sueur	0702001201-02
07020012-768	14MN036	Unnamed trib. to Le Sueur Creek	Upstream of Fox Hollow Rd, 1 mi. SE of Le Sueur	Le Sueur	0702001201-01
07020012-797	14MN037	County Ditch 26	Downstream of 240th St, 3 mi. E of Arlington	Sibley	0702001206-01
07020012-845	14MN038	Bevens Creek	Downstream of 150th St, 4 mi. SE of NYA	Carver	0702001207-01
07020012-806	14MN039	Carver Creek	Upstream of CR 140, 2.5 mi. S of Waconia	Carver	0702001210-01
07020012-622	14MN040	Trib. to Carver Creek	Upstream of 102nd St, 0.5 mi. S of Waconia	Carver	0702001210-01
07020012-621	14MN041	Trib. to Carver Creek	Upstream of CR 10, 1.5 mi. SE of Waconia	Carver	0702001210-01
07020012-843	14MN042	Bevens Creek	Upstream of CR 16, 3 mi. SE of Hamburg	Sibley	0702001207-01

AUID	Biological Station ID	Waterbody Name	Biological Station Location	County	Aggregated 12-digit HUC
07020012-587	14MN043	Judicial Ditch 3	Upstream of CR 16, 2 mi. SE of Hamburg	Sibley	0702001207-01
07020012-588	14MN045	High Island Ditch 2	Downstream of CR 69, 1 mi. N of Arlington	Sibley	0702001206-01
07020012-798	14MN047	Trib. to Minnesota River	Adjacent to CR 60, 4 mi. NW of Belle Plaine	Sibley	0702001209-01
07020012-794	14MN048	Judicial Ditch 12	Adjacent to CR 13, 3 mi. W of Arlington	Sibley	0702001206-01
07020012-834	14MN049	High Island Creek	Upstream of 371st Ave, 2.5 mi. E of Arlington	Sibley	0702001206-01
07020012-610	14MN050	County Ditch 55	Downstream of 445th Ave, 2 mi. E of Gaylord	Sibley	0702001202-01
07020012-556	14MN052	Rush River, North Branch	Upstream of CR 67, 1 mi. E of Gaylord	Sibley	0702001202-01
07020012-783	14MN053	County Ditch 32 Branch A	Upstream of CR 15, 5 mi. W of New Sweden	Nicollet	0702001203-02
07020012-801	14MN054	County Ditch 30 Branch A	Downstream of CR 4, 8 mi. NW of Nicollet	Nicollet	0702001203-02
07020012-555	14MN055	Judicial Ditch 18	Upstream of Hwy 22, 1 mi. N of Gaylord	Sibley	0702001202-01
07020012-574	14MN056	Judicial Ditch 6	Downstream of 340th St, in Bernadotte	Sibley	0702001203-01
07020012-784	14MN058	County Ditch 9	Downstream of CR 4, 6 mi. E of Lafayette	Nicollet	0702001203-02
07020012-811	14MN059	Credit River	Upstream of first walking bridge in Hidden Valley Park (132nd St), in Savage	Scott	0702001211-03
07020012-791	14MN060	County Ditch 18	Downstream of CR 10, 1.5 mi. W of Gaylord	Sibley	0702001202-01
07020012-548	14MN061	Rush River	Upstream of 300th St, 4 mi. W of Henderson	Sibley	0702001204-01
07020012-796	14MN062	County Ditch 50	Upstream of Twp Rd 108, S of CR 62, 8 mi E of Arlington	Sibley	0702001204-01
07020012-611	14MN063	High Island Ditch 5	Downstream of 260th St, 2 mi. S of Arlington	Sibley	0702001206-01
07020012-561	14MN066	Trib. to Bakers Lake	Downstream of Hwy 15, 5 mi. S of Brownton	McLeod	0702001206-02
07020012-653	14MN067	High Island Creek	Upstream of Hwy 15, 4 mi S of Brownton	McLeod	0702001206-02
07020012-683	14MN068	County Ditch 39	Upstream of CR 57, 3.5 mi. SE of Stewart	McLeod	0702001206-02
07020012-591	14MN069	Judicial Ditch 24	Upstream of 40th St, 3.5 mi S of Stewart	McLeod	0702001206-02
07020012-682	14MN070	Judicial Ditch 15	Upstream of CR 17, 0.5 mi. W of Fernando	McLeod	0702001206-02
07020012-593	14MN071	Judicial Ditch 11	Upstream of Zane Ave, 4 mi. S of Stewart	McLeod	0702001206-02
07020012-590	14MN072	Judicial Ditch 11	Upstream of 661st Ave, 4 mi. S of Buffalo Lake	Sibley	0702001206-02
07020012-677	14MN074	County Ditch 49	Upstream of 641st Ave, 3 mi. NW of Gibbon	Sibley	0702001204-02
07020012-674	14MN075	County Ditch 11	Upstream of 270th St, 1 mi. N of Gibbon	Sibley	0702001204-02
07020012-786	14MN076	County Ditch 44	Downstream of CR 53, 4 mi. E of Gibbon	Sibley	0702001204-02
07020012-825	14MN077	County Ditch 5	Downstream of CR 8, 5 mi. E of Lafayette	Sibley	0702001203-01
07020012-849	14MN078	Trib. to St Catherine Lake	Downstream of Valley Forge Rd, 2.5 mi. N of Cedar Lake	Scott	0702001208-02
07020012-793	14MN080	County Ditch 75	Downstream of 376th Ln, 5 mi. NW of St. Peter	Nicollet	0702001205-01

AUID	Biological Station ID	Waterbody Name	Biological Station Location	County	Aggregated 12-digit HUC
07020012-792	14MN081	County Ditch 47 Branch A	Downstream of 375th Ave, 5.5 mi. W of St. Peter	Nicollet	0702001205-01
07020012-790	14MN083	County Ditch 56	Downstream of CR 67, 3 mi. W of Gaylord	Sibley	0702001202-01
07020012-555	14MN084	Rush River, North Branch (Judicial Ditch 18)	Downstream of CR 13, 6 mi. S Brownton	McLeod	0702001202-01
07020012-586	14MN085	Rush River, Middle Branch	Downstream of CR 25, 1.5 mi S of Winthrop	Sibley	0702001204-02
07020012-731	14MN086	Trib. to Judicial Ditch 11	Upstream of 661st Ave, 4 mi. S of Buffalo Lake	Sibley	0702001206-02
07020012-675	14MN087	County Ditch 22	Upstream of 270th St, 1 mi. N of Gibbon	Sibley	0702001204-02
07020012-636	14MN088	County Ditch 13	Downstream of CR 25, 3 mi. N of Lafayette	Sibley	0702001203-01
07020012-785	14MN089	Judicial Ditch 1	Downstream of CR 53, 1 mi. N of Lafayette	Sibley	0702001203-01
07020012-716	14MN090	Raven Stream, West Branch	Upstream of 230th St, 4 mi. N of New Prague	Scott	0702001208-03
07020012-824	14MN092	Le Sueur Creek	Upstream of 303rd Ave, 6 mi W of Le Center	Le Sueur	0702001201-01
07020012-824	14MN093	Le Sueur Creek	Upstream of CSAH 15, 5 mi. W of Le Center	Le Sueur	0702001201-01
07020012-629	14MN094	Judicial Ditch 22	Downstream of CR 53, 4 mi. N of Belle Plaine	Carver	0702001207-01
07020012-813	14MN095	Silver Creek	Upstream of CR 52, 4 mi. N of Belle Plaine	Carver	0702001207-01
07020012-580	14MN096	Trib. to Sand Creek	Downstream of Smith Dr, 4.5 mi. N of Jordan	Scott	0702001208-01
07020012-766	14MN097	County Ditch 8 and 53	Upstream of 340th St, 4 mi. N of Le Center	Le Sueur	0702001201-02
07020012-604	14MN099	County Ditch 13	Upstream of 190th St E, 2 mi. SE of Prior Lake	Scott	0702001211-04
07020012-761	14MN100	Trib. to Judicial Ditch 2	Downstream of Henderson Station Rd, 1 mi. E of Henderson	Le Sueur	0702001205-01
07020012-788	14MN102	Trib. to Rush River, North Branch	Upstream of 481St, 1 mi. S of Gaylord	Sibley	0702001202-01
07020012-824	14MN106	Le Seuer Creek	Upstream of 261st Ave., 3 mi. W of Le Center	Le Sueur	0702001201-01
07020012-615	14MN107	Unnamed ditch	Upstream of T-107, 1 mi. E of Arlington	Sibley	0702001206-01
07020012-519	14MN108	Eagle Creek	Upstream of Hwy 101 Frontage Rd, in Savage	Scott	0702001211-01
07020012-831	14MN109	Buffalo Creek (County Ditch 59)	Downstream of CSAH 17, 3 mi. SE of Arlington	Sibley	0702001206-01
07020012-834	14MN116	High Island Creek	Upstream of CR 6, in Jessenland	Sibley	0702001206-01
07020012-661	14MN118	County Ditch 30 (County Ditch 54)	Upstream of SE 7th Ave, 1 mi. NE of Montgomery	Le Sueur	0702001208-01
07020012-839	14MN119	County Ditch 30 (County Ditch 54)	Downstream of 320th St, 2 mi. NE of Montgomery	Le Sueur	0702001208-01
07020012-725	14MN120	Forest Prairie Creek	Downstream of 320th St, 2.5 mi. E of Le Sueur	Le Sueur	0702001201-02
07020012-550	14MN121	Rush River, Middle Branch	Upstream of CR 9, 6 mi. S of New Rome	Sibley	0702001204-02
07020012-838	14MN122	High Island Creek	Downstream of 210th St, 1.5 mi. S of New Auburn	Sibley	0702001206-02

AUID	Biological Station ID	Waterbody Name	Biological Station Location	County	Aggregated 12-digit HUC
07020012-728	14MN123	unnamed creek (Prior Lake Outlet)	Upstream of Frontage Rd (M-213) East of Valley Fair in Shakopee	Scott	0702001211-04
07020012-511	14MN124	Riley Creek	Downstream of CR 4, 2 mi. NE of Shakopee	Hennepin	0702001211-01
07020012-581	14MN125	Trib. to Minnesota River	Downstream of Beech St, at Carver County Government Building in Chaska	Carver	0702001211-01
07020012-835	14MN126	Trib. to Chaska Creek	Upstream of CR 140, 2 mi. W of Chaska	Carver	0702001211-01
07020012-684	14MN128	Trib. to Sand Creek	Upstream of CR 2, 2.5 mi. NE of New Prague	Scott	0702001208-01
07020012-840	14MN129	Sand Creek	Upstream of Drexel Ave, 1 mi. N of New Prague	Scott	0702001208-01
07020012-686	14MN130	Trib. to Cody Lake	Downstream of 80th St, 2 mi. W of Lonsdale	Rice	0702001208-01
07020012-819	14MN131	Raven Stream, East Branch	Upstream of 255th St, 2 mi. NW of New Prague	Scott	0702001208-03
07020012-842	14MN132	Raven Stream, West Branch	Upstream of Saint Benedict Rd, 3.5 mi. NW of New Prague	Scott	0702001208-03
07020012-842	14MN133	Raven Stream, West Branch	Downstream of Church Ave, 4 mi. W of New Prague	Scott	0702001208-03
07020012-628	14MN134	County Ditch 10	Upstream of Church Ave, 3.5 mi. SE of Belle Plaine	Scott	0702001208-03
07020012-738	14MN135	County Ditch 3	Downstream of 250th St, 3 mi. SE of Belle Plaine	Scott	0702001208-03
07020012-581	14MN201	East Creek	Upstream of Engler Blvd, 2 mi. N of Chaska	Carver	0702001211-01
07020012-813	14MN203	Silver Creek	Upstream of CR 41, 2 mi. SW of East Union	Carver	0702001207-01
07020012-828	14MN204	Purgatory Creek	Downstream of Pioneer Tr, in Eden Prairie	Hennepin	0702001211-01
07020012-825	14MN230	Rush River, South Branch	Downstream of CR 9, 2 mi. N of Norseland	Sibley	0702001203-01
07020012-521	90MN110	Rush River	Adajacent to 312th St, 2mi. SW of Henderson	Sibley	0702001204-01
07020012-832	90MN111	Buffalo Creek	Upstream of 270th St, 2.5 mi. NW of Henderson	Sibley	0702001206-01
07020012-514	90MN114	Bevens Creek	Upstream of CR 40, 0.5 mi. S of East Union	Carver	0702001207-01
07020012-811	90MN117	Credit River	Upstream of Murphy Lake Blvd (CR 75), 3.5 mi. E of Prior Lake	Scott	0702001211-03
07020012-520	91MN109	County Ditch 43	Upstream of 310th St, E of Hwy 22, 3.5 mi. S of Gaylord	Sibley	0702001204-02
07020012-809	96MN006	Nine Mile Creek	Downstream of 106th St W, in Ninemile Creek Park, in Bloomington	Hennepin	0702001211-02
07020012-834	97MN007	High Island Creek	Downstream of CR 9, 1 mi. NW of Arlington	Sibley	0702001206-01
07020012-826	97MN012	Rush River, South Branch	Upstream of CR 18, 4.5 mi. W of Le Sueur	Sibley	0702001203-01
07020012-817	99MN004	Porter Creek	Upstream of Xanadu Ave, in Helena	Scott	0702001208-02
07020012-582	99MN007	Assumption Creek	Downstream of Hwy 212, 1 mi. NW of Shakopee	Carver	0702001211-01
07020012-521	90MN110	Rush River	Adajacent to 312th St, 2mi. SW of Henderson	Sibley	0702001204-01

Appendix 3.1 – Minnesota statewide IBI thresholds and confidence limits

Class #	Class Name	Use Class	Exceptional Use Threshold	General Use Threshold	Modified Use Threshold	Confidence Limit
Fish						
1	Southern Rivers	2B, 2C	71	49	NA	±11
2	Southern Streams	2B, 2C	66	50	35	±9
3	Southern Headwaters	2B, 2C	74	55	33	±7
10	Southern Coldwater	2A	82	50	NA	±9
4	Northern Rivers	2B, 2C	67	38	NA	±9
5	Northern Streams	2B, 2C	61	47	35	±9
6	Northern Headwaters	2B, 2C	68	42	23	±16
7	Low Gradient	2B, 2C	70	42	15	±10
11	Northern Coldwater	2A	60	35	NA	±10
Invertebrates						
1	Northern Forest Rivers	2B, 2C	77	49	NA	±10.8
2	Prairie Forest Rivers	2B, 2C	63	31	NA	±10.8
3	Northern Forest Streams RR	2B, 2C	82	53	NA	±12.6
4	Northern Forest Streams GP	2B, 2C	76	51	37	±13.6
5	Southern Streams RR	2B, 2C	62	37	24	±12.6
6	Southern Forest Streams GP	2B, 2C	66	43	30	±13.6
7	Prairie Streams GP	2B, 2C	69	41	22	±13.6
8	Northern Coldwater	2A	52	32	NA	±12.4
9	Southern Coldwater	2A	72	43	NA	±13.8

Appendix 3.2 – 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	Use Class	Threshold	FIBI	Visit Date
HUC 12: 0702001201-01 (Le Sueur Creek)								
07020012-824	03MN074	Le Sueur Creek	75.12	2	2Bg	50	26.89	8/25/2015
07020012-824	03MN074	Le Sueur Creek	75.12	2	2Bg	50	36.04	7/22/2003
07020012-824	03MN074	Le Sueur Creek	75.12	2	2Bg	50	40.71	7/10/2014
07020012-824	14MN092	Le Sueur Creek	55.08	2	2Bg	50	41.04	7/10/2014
07020012-824	14MN106	Le Sueur Creek	28.6	3	2Bg	55	61.18	7/9/2014
07020012-762	14MN111	Unnamed ditch	1.62	3	2Bg	55	56.93	7/9/2014
07020012-823	07MN063	Le Sueur Creek	22.9	7	2Bm	15	5.59	8/16/2007
07020012-824	14MN093	Le Sueur Creek	38.93	2	2Bg	50	32.56	7/28/2014
HUC 12: 0702001201-02 (Forest Prairie Creek)								
07020012-764	14MN032	County Ditch 34	16.11	3	2Bg	55	0	7/9/2014
07020012-766	14MN097	County Ditch 8/53	7.64	3	2Bm	33	33.4	6/10/2014
07020012-766	14MN097	County Ditch 8/53	7.64	3	2Bm	33	43.59	8/6/2014
07020012-725	03MN075	Forest Prairie Creek	70.35	2	2Bg	50	35.73	7/21/2003
07020012-725	14MN033	Forest Prairie Creek	41.57	2	2Bg	50	9.25	8/7/2014
07020012-725	14MN034	Forest Prairie Creek	31.96	2	2Bg	50	12.5	7/17/2014
07020012-725	14MN120	Forest Prairie Creek	60.65	2	2Bg	50	48.74	8/28/2014
07020012-763	14MN031	Unnamed ditch	5.64	3	2Bg	55	0	6/10/2014
07020012-763	14MN031	Unnamed ditch	5.64	3	2Bg	55	0	7/9/2014
07020012-767	14MN035	Judicial Ditch 4	7.67	3	2Bm	33	0	7/9/2014
07020012-772	14MN030	County Ditch 42	4.13	3	2Bm	33	0	7/9/2014
HUC 12: 0702001202-01 (North Branch Rush River)								
07020012-626	03MN073	County Ditch 2	4.81	3	2Bg	55	0	7/7/2003
07020012-768	14MN036	Unnamed creek	5.6	3	2Bg	55	48.02	8/20/2015
07020012-768	14MN036	Unnamed creek	5.6	3	2Bg	55	54.18	6/9/2014
07020012-791	14MN060	County Ditch 18	14.61	3	2Bm	33	13.68	7/30/2014
07020012-555	14MN055	Rush River, North Branch (Judicial Ditch 18)	31.33	2	2Bm	35	7.73	7/16/2014
07020012-555	14MN084	Rush River, North Branch (Judicial Ditch 18)	15.36	3	2Bm	33	20.33	7/16/2014

National Hydrography Dataset (NHD) Assessment Segment AUID	Biological Station ID	Stream Segment Name	Drainage Area Mi^2	Fish Class	Use Class	Threshold	FIBI	Visit Date
07020012-788	14MN102	Unnamed ditch	12.56	3	2Bm	33	49.72	7/31/2014
07020012-790	14MN083	County Ditch 56	6.95	3	2Bm	33	51.07	7/30/2014
07020012-556	14MN052	Rush River, North Branch (County Ditch 55)	69.28	2	2Bm	35	6.51	7/15/2014
07020012-556	14MN052	Rush River, North Branch (County Ditch 55)	69.28	2	2Bm	35	20.97	8/28/2014
07020012-610	14MN050	Unnamed ditch (County Ditch 55)	9.44	7	2Bm	15	22.2	7/31/2014
HUC 12: 0702001203-01 (Rush River South Branch)								
07020012-609	10EM099	County Ditch 13A	1.77	3	2Bg	55	13.78	7/6/2010
07020012-636	14MN088	County Ditch 13	10.25	7	2Bm	15	17.83	7/29/2014
07020012-785	14MN089	Judicial Ditch 1	18.14	7	2Bm	15	16.05	7/29/2014
07020012-574	14MN056	Judicial Ditch 6	48.32	2	2Bm	35	46.59	7/29/2014
07020012-825	03MN025	Rush River, South Branch	83.16	2	2Bm	35	12.49	7/14/2003
07020012-825	14MN077	Rush River, South Branch	16.65	7	2Bm	15	15.17	8/5/2014
07020012-825	14MN105	Rush River, South Branch	168.18	2	2Bm	35	19.26	7/23/2014
07020012-825	14MN230	Rush River, South Branch	83.25	2	2Bm	35	17.57	8/31/2015
07020012-825	14MN230	Rush River, South Branch	83.25	2	2Bm	35	30.08	7/15/2014
07020012-585	14MN103	County Ditch 40A	4.53	7	2Bg	42	11.11	6/9/2014
07020012-783	14MN053	County Ditch 32A	5.63	7	2Bm	15	7.22	7/14/2014
07020012-784	14MN058	County Ditch 9	6.86	3	2Bm	33	30.62	7/14/2014
07020012-801	14MN054	County Ditch 30A	14.97	7	2Bm	15	8.89	7/30/2014
07020012-826	97MN012	Rush River, South Branch	178.87	2	2Bg	50	21.6	8/14/1998
07020012-826	97MN012	Rush River, South Branch	178.87	2	2Bg	50	29.85	7/16/2014
07020012-826	97MN012	Rush River, South Branch	178.87	2	2Bg	50	32.26	9/11/1997
HUC 12: 0702001204-02 (Rush River Middle Branch)								
07020012-586	14MN085	Rush River, Middle Branch (CD 23 & 24)	44.43	2	2Bm	35	23.05	7/29/2014
07020012-674	14MN075	County Ditch 11	6.34	3	2Bm	33	35.24	6/9/2014
07020012-674	14MN075	County Ditch 11	6.34	3	2Bm	33	35.38	7/16/2014
07020012-675	14MN087	County Ditch 22	16.4	3	2Bm	33	36.37	7/16/2014
07020012-677	14MN074	County Ditch 49	7.29	7	2Bm	15	0	7/15/2014
07020012-786	14MN076	County Ditch 44	7.4	3	2Bm	33	8.94	7/29/2014
07020012-520	91MN109	County Ditch 43	5.3	7	2Bg	42	0	7/31/2014

National Hydrography Dataset (NHD) Assessment Segment AUID	Biological Station ID	Stream Segment Name	Drainage Area Mi²	Fish Class		Threshold	FIBI	Visit Date
07020012-551	01MN028	County Ditch 42	8	3	2Bm	33	37.2	6/28/2001
07020012-551	14MN220	County Ditch 42	7.84	3	2Bm	33	2.61	6/9/2014
07020012-551	14MN220	County Ditch 42	7.84	3	2Bm	33	36.37	7/14/2014
HUC 12: 0702001204-01 (Rush River)								
07020012-521	03MN028	Rush River	402.48	1	2Bg	49	30.36	6/20/2003
07020012-521	03MN028	Rush River	402.48	1	2Bg	49	44.69	7/21/2003
07020012-521	90MN110	Rush River	399.5	1	2Bg	49	40.94	7/31/2014
07020012-548	14MN061	Rush River	204.78	2	2Bg	50	40.5	8/13/2014
07020012-548	97MN010	Rush River	189.39	2	2Bg	50	34.22	9/5/1997
07020012-796	14MN062	County Ditch 50	10.25	3	2Bg	55	50.38	8/5/2014
07020012-548	14MN082	Rush River	188.01	2	2Bg	50	36.97	7/23/2014
HUC 12: 0702001205-01 (City of Le Sueur – Minnesota River)								
07020012-602	03MN076	Barney Fry Creek	26.52	3	2Bg	55	33.04	7/7/2003
07020012-602	03MN076	Barney Fry Creek	26.52	3	2Bg	55	39.25	7/29/2014
07020012-602	03MN076	Barney Fry Creek	26.52	3	2Bg	55	44.79	8/20/2015
07020012-792	14MN081	County Ditch 47A	11.71	3	2Bm	33	15.34	7/29/2014
07020012-793	14MN080	County Ditch 75	7.12	3	2Bm	33	17.03	7/29/2014
07020012-761	14MN100	Unnamed creek	14.48	3	2Bm	33	26.4	7/10/2014
HUC 12: 0702001206-02 (Upper High Island Creek)								
07020012-590	14MN072	Judicial Ditch 11	19.54	7	2Bm	15	0	7/15/2014
07020012-590	14MN072	Judicial Ditch 11	19.54	7	2Bm	15	0	8/25/2014
07020012-590	14MN072	Judicial Ditch 11	19.54	7	2Bm	15	7.72	8/6/2015
07020012-590	14MN072	Judicial Ditch 11	19.54	7	2Bm	15	17.36	8/2/2016
07020012-591	14MN069	Judicial Ditch 24	10.67	7	2Bm	15	18.25	7/16/2014
07020012-593	14MN071	Judicial Ditch 11	47.94	2	2Bm	35	0	7/16/2014
07020012-731	14MN086	Unnamed ditch	8.7	3	2Bg	55	0	7/15/2014
07020012-682	14MN070	Judicial Ditch 15	16.24	7	2Bm	15	0.04	7/16/2014
07020012-653	07MN083	High Island Creek	79.42	2	2Bm	35	0	8/20/2015
07020012-653	07MN083	High Island Creek	79.42	2	2Bm	35	13.21	8/3/2016
07020012-653	07MN083	High Island Creek	79.42	2	2Bm	35	18.25	8/30/2007

National Hydrography Dataset (NHD) Assessment Segment AUID	Biological Station ID	Stream Segment Name	Drainage Area Mi^2	Fish Class		Threshold	FIBI	Visit Date
07020012-653	14MN067	High Island Creek	93.16	2	2Bm	35	8.72	8/12/2015
07020012-653	14MN067	High Island Creek	93.16	2	2Bm	35	18.15	8/3/2016
07020012-653	14MN067	High Island Creek	93.16	2	2Bm	35	33.14	8/13/2014
07020012-683	14MN068	County Ditch 39	9.63	3	2Bm	33	33.05	7/16/2014
07020012-838	14MN122	High Island Creek	129.98	2	2Bg	50	13.9	7/30/2014
07020012-838	14MN122	High Island Creek	129.98	2	2Bg	50	14.25	8/12/2015
07020012-838	14MN122	High Island Creek	129.98	2	2Bg	50	24.09	8/3/2016
HUC 12: 0702001206-01 (Lower High Island Creek)								
07020012-794	14MN048	Judicial Ditch 12	6.28	3	2Bm	33	26.74	7/17/2014
07020012-588	14MN045	High Island Ditch 2	17.08	3	2Bm	33	33.62	8/5/2014
07020012-832	90MN111	Buffalo Creek	27.42	3	2Bg	55	39.73	8/4/2014
07020012-832	90MN111	Buffalo Creek	27.42	3	2Bg	55	48	7/27/2010
07020012-832	90MN111	Buffalo Creek	27.42	3	2Bg	55	54.12	7/26/2001
07020012-795	14MN110	Unnamed ditch	2.06	7	2Bg	42	0	8/25/2015
07020012-831	14MN109	Buffalo Creek (County Ditch 59)	15.35	7	2Bm	15	18.89	7/17/2014
07020012-797	14MN037	County Ditch 26	8.38	3	2Bg	55	51.28	8/4/2014
07020012-834	01MN062	High Island Creek	206.3	2	2Bg	50	52.09	8/16/2001
07020012-834	14MN049	High Island Creek	191.88	2	2Bg	50	13.61	8/13/2015
07020012-834	14MN049	High Island Creek	191.88	2	2Bg	50	31.64	8/13/2014
07020012-834	14MN049	High Island Creek	191.88	2	2Bg	50	38.51	8/2/2016
07020012-834	14MN116	High Island Creek	239.87	2	2Bg	50	52	8/12/2014
07020012-834	15MN301	High Island Creek	205.28	2	2Bg	50	29.57	8/1/2016
07020012-834	15MN301	High Island Creek	205.28	2	2Bg	50	36.81	8/11/2015
07020012-834	15MN302	High Island Creek	207.54	2	2Bg	50	44.03	8/4/2016
07020012-834	15MN302	High Island Creek	207.54	2	2Bg	50	45.68	8/12/2015
07020012-834	97MN007	High Island Creek	162.47	2	2Bg	50	3.67	9/15/1997
07020012-834	97MN007	High Island Creek	162.47	2	2Bg	50	7.86	8/12/2015
07020012-834	97MN007	High Island Creek	162.47	2	2Bg	50	25.63	7/30/2014
07020012-834	97MN007	High Island Creek	162.47	2	2Bg	50	29.74	8/2/2016
07020012-834	97MN007	High Island Creek	162.47	2	2Bg	50	31.59	9/3/2014

National Hydrography Dataset (NHD) Assessment Segment AUID	Biological Station ID	Stream Segment Name	Drainage Area Mi^2	Fish Class		Threshold	FIBI	Visit Date
07020012-615	14MN107	Unnamed ditch	4.29	3	2Bg	55	0	8/6/2014
HUC 12: 0702001207-01 (Bevens Creek)								
07020012-781	14MN112	County Ditch 29	5.23	3	2Bg	55	0	7/21/2014
07020012-843	14MN042	Bevens Creek	29.14	3	2Bm	33	49.31	8/6/2014
07020012-813	14MN095	Silver Creek	12.11	3	2Bg	55	21.22	7/8/2014
07020012-629	14MN094	Judicial Ditch 22	13.87	3	2Bm	33	0	7/8/2014
07020012-813	14MN203	Silver Creek	35.27	2	2Bg	50	30.35	8/11/2014
07020012-813	14MN203	Silver Creek	35.27	2	2Bg	50	33.59	8/24/2015
07020012-514	00MN012	Bevens Creek	129.36	2	2Bg	50	39.15	9/26/2000
07020012-514	90MN114	Bevens Creek	129.38	2	2Bg	50	47.4	7/30/2014
07020012-848	15EM014	Bevens Creek	89.08	2	2Bg	50	37.92	8/10/2015
07020012-848	15EM014	Bevens Creek	89.08	2	2Bg	50	47.01	8/24/2015
07020012-845	14MN038	Bevens Creek	65.38	2	2Bm	35	21.03	8/11/2014
HUC 12: 0702001208-01 (Sand Creek)								
07020012-686	14MN130	Unnamed creek	13.94	7	2Bm	15	0.07	9/11/2014
07020012-739	10EM151	Unnamed ditch	3	7	2Bm	15	0	8/2/2010
07020012-840	07MN056	Sand Creek	92.94	2	2Bg	50	28.93	7/28/2014
07020012-840	07MN056	Sand Creek	92.94	2	2Bg	50	35.55	8/2/2007
07020012-840	07MN056	Sand Creek	92.94	2	2Bg	50	38.18	9/1/2015
07020012-684	14MN128	Unnamed creek	14.21	3	2Bm	35	53.71	7/9/2014
07020012-773	14MN029	County Ditch 48	2.73	7	2Bg	42	0	6/10/2014
07020012-773	14MN029	County Ditch 48	2.73	7	2Bg	42	0	7/18/2014
07020012-839	14MN119	Sand Creek	54.72	2	2Bm	35	0	9/2/2014
07020012-840	14MN129	Sand Creek	66.86	2	2Bg	50	39.03	7/28/2014
07020012-513	00MN006	Sand Creek	235.14	2	2Bg	50	26.76	7/28/2014
07020012-513	00MN006	Sand Creek	235.14	2	2Bg	50	28.21	9/21/2000
07020012-513	00MN006	Sand Creek	235.14	2	2Bg	50	41.44	8/13/2015
07020012-513	07MN034	Sand Creek	252.44	2	2Bg	50	35.5	8/17/2015
07020012-513	07MN034	Sand Creek	252.44	2	2Bg	50	37.36	7/26/2007
07020012-513	07MN034	Sand Creek	252.44	2	2Bg	50	44.53	8/12/2014

National Hydrography Dataset (NHD) Assessment Segment AUID	Biological Station ID	Stream Segment Name	Drainage Area Mi^2	Fish Class		Threshold	FIBI	Visit Date
07020012-579	01MN058	Unnamed creek (Picha Creek)	8.05	3	2Bg	55	11.47	7/28/2008
07020012-579	01MN058	Unnamed creek (Picha Creek)	8.05	3	2Bg	55	45.37	8/8/2001
07020012-579	01MN058	Unnamed creek (Picha Creek)	8.05	3	2Bg	55	45.68	7/24/2001
07020012-579	01MN058	Unnamed creek (Picha Creek)	8.05	3	2Bg	55	48.08	7/8/2014
07020012-580	14MN096	Unnamed creek (Picha Creek)	15.87	3	2Bg	55	39.25	7/8/2014
07020012-513	01MN044	Sand Creek	233.85	2	2Bg	50	18.28	7/24/2001
07020012-513	01MN044	Sand Creek	233.85	2	2Bg	50	37.48	7/25/2007
07020012-513	07MN033	Sand Creek	236.98	2	2Bg	50	39.91	7/26/2007
07020012-538	07MN055	Sand Creek	161.17	2	2Bg	50	29.2	8/2/2007
07020012-579	14MN200	Unnamed creek (Picha Creek)	9.53	3	2Bg	55	16.26	7/8/2014
07020012-580	15EM078	Unnamed creek (Picha Creek)	15.83	3	2Bg	55	59.88	7/2/2015
07020012-732	10EM103	Unnamed creek	6.49	3	2Bg	55	33.81	8/13/2015
07020012-732	10EM103	Unnamed creek	6.49	3	2Bg	55	43.47	7/15/2010
HUC 12: 0702001208-03 (Raven Stream)								
07020012-822	03MN029	Unnamed creek	9.61	3	2Bg	55	2.79	6/10/2014
07020012-822	03MN029	Unnamed creek	9.61	3	2Bg	55	43.56	7/3/2003
07020012-822	03MN029	Unnamed creek	9.61	3	2Bg	55	46.42	6/17/2015
07020012-822	03MN029	Unnamed creek	9.61	3	2Bg	55	48.9	7/8/2014
07020012-819	14MN131	Raven Stream, East Branch	22.74	3	2Bm	33	56.13	7/9/2014
07020012-716	14MN090	Raven Stream	66.48	2	2Bg	50	40.46	7/29/2014
07020012-842	14MN132	Raven Stream, West Branch	37.66	2	2Bg	50	29.49	7/29/2014
07020012-628	14MN134	County Ditch 10	16.9	3	2Bm	33	54.92	7/10/2014
07020012-737	10EM039	County Ditch 3	0.71	3	2Bg	55	0	7/2/2015
07020012-737	10EM039	County Ditch 3	0.71	3	2Bg	55	11.7	8/3/2010
07020012-738	14MN135	County Ditch 3	10.61	3	2Bg	55	63.1	7/14/2014
07020012-842	14MN133	Raven Stream, West Branch	13.04	3	2Bg	55	51.79	7/10/2014
HUC 12: 0702001208-02 (Porter Creek)								
07020012-849	14MN078	Unnamed creek	10.24	3	2Bm	33	32.86	7/9/2014
07020012-815	99MN003	Porter Creek	13.22	3	2Bg	55	46.05	6/25/1999
07020012-817	99MN004	Porter Creek	64.04	2	2Bg	50	27.17	7/29/2014

National Hydrography Dataset (NHD) Assessment Segment AUID	Biological Station ID	Stream Segment Name	Drainage Area Mi²	Fish Class		Threshold	FIBI	Visit Date
07020012-817	99MN004	Porter Creek	64.04	2	2Bg	50	41.12	6/25/1999
07020012-817	99MN004	Porter Creek	64.04	2	2Bg	50	41.31	8/31/2015
HUC 12: 0702001209-01 (City of Belle Plaine – Minnesota River)								
07020012-575	00MN013	Robert Creek	11.06	3	2Bg	55	45.37	9/11/2000
07020012-575	00MN013	Robert Creek	11.06	3	2Bg	55	48.23	7/28/2014
07020012-575	00MN013	Robert Creek	11.06	3	2Bg	55	55.22	8/20/2015
07020012-575	91MN112	Robert Creek	9.72	3	2Bg	55	39.38	8/16/2001
07020012-575	91MN112	Robert Creek	9.72	3	2Bg	55	46.24	7/24/2001
07020012-575	91MN112	Robert Creek	9.72	3	2Bg	55	50.84	7/20/2010
07020012-798	14MN047	Unnamed creek	9.4	3	2Bg	55	49.69	7/28/2014
07020012-830	00MN007	Unnamed creek (Brewery Creek)	4.62	3	2Bg	55	48.83	6/29/2015
07020012-830	00MN007	Unnamed creek (Brewery Creek)	4.62	3	2Bg	55	53.74	7/10/2014
07020012-830	00MN007	Unnamed creek (Brewery Creek)	4.62	3	2Bg	55	55.92	9/11/2000
HUC 12: 0702001210-01 (Carver Creek)								
07020012-621	14MN041	Unnamed creek	6.31	3	2Bm	33	45.49	8/6/2014
07020012-622	14MN040	Unnamed creek	32.06	2	2Bm	35	66.69	8/27/2014
07020012-806	03MN030	Carver Creek	74	2	2Bg	50	22.88	8/11/2014
07020012-806	03MN030	Carver Creek	74	2	2Bg	50	30.82	6/23/2015
07020012-806	03MN030	Carver Creek	74	2	2Bg	50	37.5	8/11/2003
07020012-806	14MN039	Carver Creek	30.67	2	2Bg	50	26.34	8/6/2014
07020012-621	14MN041	Unnamed creek	6.31	3	2Bm	33	45.49	8/6/2014
HUC 12: 0702001211-01 (City of Mendota Heights – Minnesota River)								
07020012-803	00MN010	Chaska Creek	14.69	3	2Bg	55	29.03	7/31/2014
07020012-803	00MN010	Chaska Creek	14.69	3	2Bg	55	65.16	9/24/2000
07020012-835	14MN126	Unnamed creek	6.3	3	2Bm	33	47.5	7/8/2014
07020012-581	01MN008	Unnamed creek (East Creek)	10.45	3	2Bg	55	33.42	7/24/2001
07020012-581	14MN201	Unnamed creek (East Creek)	10.41	3	2Bg	55	32.45	8/25/2014
07020012-582	99MN007	Unnamed creek (Assumption Creek)	1.48	10	2Ag	50	19.86	7/2/1999
07020012-582	99MN007	Unnamed creek (Assumption Creek)	1.48	10	2Ag	50	34.21	6/16/2015
07020012-582	99MN007	Unnamed creek (Assumption Creek)	1.48	10	2Ag	50	39.93	6/11/2014

National Hydrography Dataset (NHD) Assessment Segment AUID	Biological Station ID	Stream Segment Name	Drainage Area Mi^2	Fish Class		Threshold	FIBI	Visit Date
07020012-582	99MN007	Unnamed creek (Assumption Creek)	1.48	10	2Ag	50	44.26	7/7/2014
07020012-710	00MN009	Bluff Creek	5.67	10	2Ag	50	25.23	7/7/2014
07020012-710	00MN009	Bluff Creek	5.67	10	2Ag	50	35.36	7/22/2000
07020012-581	14MN125	Unnamed creek (East Creek)	11.75	3	2Bg	55	57.61	6/10/2014
07020012-710	00MN008	Bluff Creek	5.7	10	2Ag	50	16.77	8/3/2015
07020012-710	00MN008	Bluff Creek	5.7	10	2Ag	50	18.23	7/8/2014
07020012-710	00MN008	Bluff Creek	5.7	10	2Ag	50	20.02	6/17/2015
07020012-710	00MN008	Bluff Creek	5.7	10	2Ag	50	27.49	7/22/2000
07020012-511	14MN124	Riley Creek	10.27	3	2Bg	55	0	7/10/2014
07020012-828	14MN204	Purgatory Creek	26.67	3	2Bg	55	56.27	7/7/2014
07020012-828	97MN001	Purgatory Creek	26.49	3	2Bg	55	68.03	9/16/1997
07020012-519	14MN108	Eagle Creek	2.47	10	2Ag	50	51.65	6/5/2014
07020012-519	14MN108	Eagle Creek	2.47	10	2Ag	50	51.85	8/25/2014
07020012-519	99MN008	Eagle Creek	2.09	10	2Ag	50	39.79	7/2/1999
HUC 12: 0702001211-04 (Trib. to Minnesota River - Prior Lake Outlet Channel)								
07020012-728	14MN123	Unnamed creek (Prior Lake Outlet Channel)	46.6	2	2Bg	50	31.09	6/16/2015
07020012-604	14MN099	Unnamed creek (County Ditch 13)	7.93	3	2Bm	33	25.27	7/28/2014
HUC 12: 0702001211-03 (Credit River)								
07020012-811	14MN059	Credit River	46.16	2	2Bg	50	41.96	9/10/2014
07020012-811	14MN059	Credit River	46.16	2	2Bg	50	48.2	8/28/2014
07020012-811	90MN117	Credit River	23.31	3	2Bg	55	42.62	7/17/2014
07020012-811	90MN117	Credit River	23.31	3	2Bg	55	53.34	7/19/2010
07020012-811	90MN117	Credit River	23.31	3	2Bg	55	61.62	8/8/2001
HUC 12: 0702001211-02 (Nine Mile Creek)								
07020012-723	03MN059	Ninemile Creek, South Fork	17.45	3	2Bg	55	17.18	7/7/2014
07020012-723	03MN059	Ninemile Creek, South Fork	17.45	3	2Bg	55	55.35	8/12/2003
07020012-723	03MN059	Ninemile Creek, South Fork	17.45	3	2Bg	55	56.95	7/20/2015
07020012-723	03MN059	Ninemile Creek, South Fork	17.45	3	2Bg	55	69.25	7/2/2007
07020012-807	00MN011	Ninemile Creek	8.54	3	2Bg	55	56.69	6/18/2000
07020012-807	03MN094	Ninemile Creek	8.54	3	2Bg	55	32.99	7/1/2003

National Hydrography Dataset (NHD) Assessment Segment AUID	Biological Station ID	Stream Segment Name	Drainage Area Mi²	Fish Class		Threshold	FIBI	Visit Date
07020012-807	03MN094	Ninemile Creek	8.54	3	2Bg	55	44.19	7/6/2005
07020012-807	03MN094	Ninemile Creek	8.54	3	2Bg	55	44.88	7/2/2007
07020012-807	03MN094	Ninemile Creek	8.54	3	2Bg	55	64.33	6/22/2004
07020012-809	03MN098	Ninemile Creek	37.68	2	2Bg	50	0	7/3/2003
07020012-809	03MN098	Ninemile Creek	37.68	2	2Bg	50	23	7/3/2007
07020012-809	03MN098	Ninemile Creek	37.68	2	2Bg	50	28.15	7/27/2004
07020012-809	03MN098	Ninemile Creek	37.68	2	2Bg	50	36.46	7/7/2005
07020012-809	03MN099	Ninemile Creek	45.27	2	2Bg	50	0.56	7/17/2003
07020012-809	03MN099	Ninemile Creek	45.27	2	2Bg	50	27.82	9/1/2005
07020012-809	03MN099	Ninemile Creek	45.27	2	2Bg	50	29.5	7/3/2007
07020012-809	03MN099	Ninemile Creek	45.27	2	2Bg	50	42.65	7/28/2004
07020012-809	03MN100	Ninemile Creek	45.69	2	2Bg	50	28.2	7/19/2007
07020012-809	03MN100	Ninemile Creek	45.69	2	2Bg	50	42.35	9/2/2005
07020012-809	03MN100	Ninemile Creek	45.69	2	2Bg	50	43.28	7/8/2003
07020012-809	03MN100	Ninemile Creek	45.69	2	2Bg	50	65.26	7/26/2004
07020012-809	96MN004	Ninemile Creek	45.75	2	2Bg	50	25.13	7/7/1997
07020012-809	96MN004	Ninemile Creek	45.75	2	2Bg	50	45.24	8/19/1998
07020012-809	96MN004	Ninemile Creek	45.75	2	2Bg	50	47.54	9/30/1997
07020012-809	96MN004	Ninemile Creek	45.75	2	2Bg	50	50.45	8/6/1996
07020012-809	96MN005	Ninemile Creek	45.7	2	2Bg	50	43.85	8/7/1996
07020012-809	96MN006	Ninemile Creek	45.68	2	2Bg	50	45.94	8/7/1996
07020012-809	96MN006	Ninemile Creek	45.68	2	2Bg	50	52.63	9/9/2014
07020012-719	03MN096	Ninemile Creek, South Fork	1.87	7	2Bg	42	12.26	7/19/2005
07020012-719	03MN096	Ninemile Creek, South Fork	1.87	7	2Bg	42	22.97	8/12/2003
07020012-719	03MN096	Ninemile Creek, South Fork	1.87	7	2Bg	42	26.02	6/21/2004
07020012-723	03MN097	Ninemile Creek, South Fork	18.01	7	2Bg	42	0	6/18/2004
07020012-723	03MN097	Ninemile Creek, South Fork	18.01	7	2Bg	42	11.19	6/16/2003
07020012-723	03MN097	Ninemile Creek, South Fork	18.01	7	2Bg	42	13	7/1/2005
07020012-808	03MN058	Ninemile Creek	13.56	3	2Bm	33	28.26	7/7/2014
07020012-808	03MN058	Ninemile Creek	13.56	3	2Bm	33	30.63	8/12/2003

National Hydrography Dataset (NHD) Assessment Segment AUID	Biological Station ID	Stream Segment Name	Drainage Area Mi^2	Fish Class		Threshold	FIBI	Visit Date
07020012-808	03MN095	Ninemile Creek	13.67	3	2Bm	33	22.02	6/16/2003
07020012-808	03MN095	Ninemile Creek	13.67	3	2Bm	33	42.69	7/1/2005
07020012-808	03MN095	Ninemile Creek	13.67	3	2Bm	33	56.02	6/7/2004
07020012-912	99MN002	Unnamed creek (Black Dog Lake Inlet)	0.25	3	2Bg	55	42.02	6/21/1999
07020012-659	99MN006	Unnamed creek (Black Dog Creek)	0.03	3	2Bg	55	18.28	6/26/1999
07020012-914	99MN001	Unnamed creek (Kennaley's Creek)	0.15	10	2Ag	50	35.86	6/18/1999

Appendix 3.3 – Biological monitoring results-macroinvertebrate IBI (assessable reaches)

National Hydrography Dataset (NHD) Assessment Segment AUID	Biological Station ID	Stream Segment Name	Drainage Area Mi²	Use Class	Invert Class	Threshold	FIBI	Visit Date
HUC 12: 0702001201-01 (Le Sueur Creek)								
07020012-824	03MN074	Le Sueur Creek	75.12	2Bg	5	37	40.37	8/12/2014
07020012-824	03MN074	Le Sueur Creek	75.12	2Bg	5	37	52.56	8/20/2003
07020012-824	14MN092	Le Sueur Creek	55.08	2Bg	5	37	17.76	8/24/2015
07020012-824	14MN106	Le Sueur Creek	28.6	2Bg	5	37	19.58	8/12/2014
HUC 12: 0702001201-02 (Forest Prairie Creek)								
07020012-764	14MN032	County Ditch 34	16.11	2Bg	5	37	20.27	8/11/2014
07020012-766	14MN097	County Ditch 8/53	7.64	2Bm	6	30	31.15	8/13/2014
07020012-725	14MN033	Forest Prairie Creek	41.57	2Bg	5	37	12.06	8/11/2014
07020012-725	14MN034	Forest Prairie Creek	31.96	2Bg	6	43	44.8	8/11/2014
07020012-725	14MN120	Forest Prairie Creek	60.65	2Bg	5	37	22.08	8/11/2014
07020012-763	14MN031	Unnamed ditch	5.64	2Bg	6	43	27.72	8/11/2014
07020012-767	14MN035	Judicial Ditch 4	7.67	2Bm	6	30	28.47	8/3/2015
07020012-772	14MN030	County Ditch 42	4.13	2Bm	6	30	22.19	8/13/2014
07020012-772	14MN030	County Ditch 42	4.13	2Bm	6	30	29.86	8/13/2014
HUC 12: 0702001202-01 (North Branch Rush River)								
07020012-768	14MN036	Unnamed creek	5.6	2Bg	5	37	34.09	8/12/2014
07020012-555	14MN055	Rush River, North Branch (Judicial Ditch 18)	31.33	2Bm	7	22	14.06	8/18/2014
07020012-788	14MN102	Unnamed ditch	12.56	2Bm	7	22	21.9	8/19/2014
07020012-790	14MN083	County Ditch 56	6.95	2Bm	7	22	11.23	8/19/2014
07020012-556	14MN052	Rush River, North Branch (County Ditch 55)	69.28	2Bm	7	22	19.02	8/19/2014
HUC 12: 0702001203-01 (South Branch Rush River)								
07020012-768	10EM099	County Ditch 13A	1.77	2Bg	7	41	5	8/2/2010
07020012-636	14MN088	County Ditch 13	10.25	2Bm	7	22	13.33	8/18/2014
07020012-785	14MN089	Judicial Ditch 1	18.14	2Bm	7	22	18.46	8/18/2014
07020012-573	01MN060	Judicial Ditch 1 (Judicial Ditch 6)	36.79	2Bm	7	22	17.68	9/18/2001
07020012-825	03MN025	Rush River, South Branch	83.16	2Bm	5	24	23.37	8/23/2003
07020012-825	14MN077	Rush River, South Branch	16.65	2Bm	7	22	19.38	8/18/2014

National Hydrography Dataset (NHD) Assessment Segment AUID	Biological Station ID	Stream Segment Name	Drainage Area Mi²	Use Class	Invert Class	Threshold	FIBI	Visit Date
07020012-825	14MN105	Rush River, South Branch	168.18	2Bm	7	22	33.04	8/18/2014
07020012-825	14MN230	Rush River, South Branch	83.25	2Bm	5	24	20.46	8/26/2015
07020012-825	14MN230	Rush River, South Branch	83.25	2Bm	5	24	21.99	8/12/2014
07020012-826	97MN012	Rush River, South Branch	178.87	2Bg	5	37	27.48	8/12/2014
HUC 12: 0702001203-02 (Judicial Ditch 1A)								
07020012-585	14MN103	County Ditch 40A	4.53	2Bg	7	41	20.85	8/14/2014
07020012-783	14MN053	County Ditch 32A	5.63	2Bm	7	22	14.52	8/14/2014
07020012-801	14MN054	County Ditch 30A	14.97	2Bm	7	22	12.43	8/14/2014
HUC 12: 0702001204-02 (Middle Branch Rush River)								
07020012-586	14MN085	Rush River, Middle Branch (CD 23 & 24)	44.43	2Bm	5	24	15.16	8/18/2014
07020012-675	14MN087	County Ditch 22	16.4	2Bm	7	22	11.87	8/19/2014
07020012-675	14MN087	County Ditch 22	16.4	2Bm	7	22	40.36	8/19/2014
07020012-677	14MN074	County Ditch 49	7.29	2Bm	7	22	15.91	8/18/2014
07020012-786	14MN076	County Ditch 44	7.4	2Bm	7	22	9.87	8/18/2014
07020012-551	01MN028	County Ditch 42	8	2Bm	5	24	31.02	9/17/2002
07020012-551	14MN220	County Ditch 42	7.84	2Bm	5	24	9.73	8/19/2014
HUC 12: 0702001204-01 (Rush River)								
07020012-521	03MN028	Rush River	402.48	2Bg	5	37	51.85	8/20/2003
07020012-521	03MN028	Rush River	402.48	2Bg	5	37	59.11	9/9/2003
07020012-521	90MN110	Rush River	399.5	2Bg	5	37	34	8/12/2014
07020012-548	14MN061	Rush River	204.78	2Bg	5	37	27.15	8/11/2014
07020012-796	14MN062	County Ditch 50	10.25	2Bg	5	37	27.18	8/11/2014
07020012-548	14MN082	Rush River	188.01	2Bg	5	37	18.07	8/12/2014
HUC 12: 0702001205-01 (City of Le Sueur – Minnesota River)								
07020012-602	03MN076	Barney Fry Creek	26.52	2Bg	5	37	14.73	8/12/2014
07020012-792	14MN081	County Ditch 47A	11.71	2Bm	7	22	23.2	8/12/2014
07020012-793	14MN080	County Ditch 75	7.12	2Bm	7	22	31.83	8/12/2014
HUC 12: 0702001206-02 (Upper High Island Creek)								
07020012-591	14MN069*	Judicial Ditch 24	10.67	2Bm				8/19/2014
07020012-593	14MN071	Judicial Ditch 11	47.94	2Bm	7	22	6.08	8/19/2014

National Hydrography Dataset (NHD) Assessment Segment AUID	Biological Station ID	Stream Segment Name	Drainage Area Mi²	Use Class	Invert Class	Threshold	FIBI	Visit Date
07020012-680	04MN006	County Ditch 31	6.9	2Bg	7	41	44.42	9/7/2004
07020012-682	14MN070	Judicial Ditch 15	16.24	2Bm	7	22	10.08	8/19/2014
07020012-653	14MN067	High Island Creek	93.16	2Bm	7	22	10.73	8/20/2014
07020012-683	14MN068	County Ditch 39	9.63	2Bm	7	22	17.4	8/19/2014
07020012-838	14MN122	High Island Creek	129.98	2Bg	5	37	12.99	8/18/2014
HUC 12: 0702001206-01 (Lower High Island Creek)								
07020012-832	90MN111	Buffalo Creek	27.42	2Bg	5	37	22.74	8/12/2014
07020012-832	90MN111	Buffalo Creek	27.42	2Bg	5	37	32.89	8/2/2010
07020012-832	90MN111	Buffalo Creek	27.42	2Bg	5	37	33.11	9/17/2002
07020012-795	14MN110	Unnamed ditch	2.06	2Bg	7	41	27.42	8/19/2014
07020012-831	14MN109	Buffalo Creek (County Ditch 59)	15.35	2Bm	7	22	25.15	8/19/2014
07020012-834	01MN062	High Island Creek	206.3	2Bg	5	37	61.16	9/17/2001
07020012-834	14MN049	High Island Creek	191.88	2Bg	5	37	24.66	8/11/2014
07020012-834	14MN116	High Island Creek	239.87	2Bg	6	43	37.24	8/14/2014
07020012-834	14MN116	High Island Creek	239.87	2Bg	6	43	44.87	8/14/2014
07020012-834	97MN007	High Island Creek	162.47	2Bg	5	37	19.35	8/19/2014
HUC 12: 0702001207-01 (Bevens Creek)								
07020012-781	14MN112	County Ditch 29	5.23	2Bg	6	43	12.52	8/19/2014
07020012-843	14MN042	Bevens Creek	29.14	2Bm	6	30	18.38	8/19/2014
07020012-584	14MN115	Unnamed ditch	0.79	2Bg	6	43	13.9	9/3/2014
07020012-813	14MN095	Silver Creek	12.11	2Bg	6	43	21.47	8/20/2014
07020012-813	14MN203	Silver Creek	35.27	2Bg	5	37	27.33	8/20/2014
07020012-514	90MN114	Bevens Creek	129.38	2Bg	5	37	26.11	8/20/2014
07020012-848	15EM014	Bevens Creek	89.08	2Bg	5	37	30.05	9/21/2015
07020012-845	14MN038	Bevens Creek	65.38	2Bm	6	30	42.84	9/3/2014
HUC 12: 0702001208-01 (Sand Creek)								
07020012-686	14MN130	Unnamed creek	13.94	2Bm	6	30	22.69	8/13/2014
07020012-739	10EM151	Unnamed ditch	3	2Bm	6	30	2.41	8/23/2010
07020012-840	07MN056	Sand Creek	92.94	2Bg	6	37	37.51	8/26/2014
07020012-684	14MN128	Unnamed creek	14.21	2Bm	6	30	29.39	8/13/2014

National Hydrography Dataset (NHD) Assessment Segment AUID	Biological Station ID	Stream Segment Name	Drainage Area Mi^2	Use Class	Invert Class	Threshold	FIBI	Visit Date
07020012-773	14MN029	County Ditch 48	2.73	2Bg	6	43	7.34	8/13/2014
07020012-839	14MN119	Sand Creek	54.72	2Bm	6	30	31.59	8/13/2014
07020012-840	14MN129	Sand Creek	66.86	2Bg	6	43	22.49	8/13/2014
07020012-513	00MN006	Sand Creek	235.14	2Bg	5	37	27.29	8/26/2014
07020012-513	07MN034	Sand Creek	252.44	2Bg	6	43	38.92	8/20/2014
07020012-579	01MN058	Unnamed creek (Picha Creek)	8.05	2Bg	5	37	26.83	9/17/2002
07020012-579	01MN058	Unnamed creek (Picha Creek)	8.05	2Bg	5	37	27.25	8/26/2014
07020012-579	14MN200	Unnamed creek (Picha Creek)	9.53	2Bg	5	37	33.82	8/26/2014
07020012-580	15EM078	Unnamed creek (Picha Creek)	15.83	2Bg	5	37	18.91	9/21/2015
07020012-732	10EM103	Unnamed creek	6.49	2Bg	5	37	30.69	9/21/2015
07020012-732	10EM103	Unnamed creek	6.49	2Bg	5	37	33.56	9/9/2010
HUC 12: 0702001208-03 (Raven Stream)								
07020012-822	03MN029	Unnamed creek	9.61	2Bg	5	37	20.22	8/18/2003
07020012-822	03MN029	Unnamed creek	9.61	2Bg	5	37	21.03	8/13/2014
07020012-819	14MN131	Raven Stream, East Branch	22.74	2Bm	5	24	31.96	8/13/2014
07020012-716	14MN090	Raven Stream	66.48	2Bg	5	37	33.08	8/18/2014
07020012-842	14MN132	Raven Stream, West Branch	37.66	2Bg	6	43	28.15	8/13/2014
07020012-628	14MN134	County Ditch 10	16.9	2Bm	6	30	23.57	8/18/2014
07020012-738	14MN135	County Ditch 3	10.61	2Bg	6	43	50.95	8/18/2014
07020012-842	14MN133	Raven Stream, West Branch	13.04	2Bg	6	43	29.53	8/18/2014
HUC 12: 0702001208-02 (Porter Creek)								
07020012-817	99MN004	Porter Creek	64.04	2Bg	5	37	17.01	8/18/2014
HUC 12: 0702001209-01 (City of Belle Plaine – Minnesota River)								
07020012-575	00MN013	Robert Creek	11.06	2Bg	6	43	41.86	8/19/2014
07020012-575	91MN112	Robert Creek	9.72	2Bg	6	43	26.03	9/17/2001
07020012-575	91MN112	Robert Creek	9.72	2Bg	6	43	39.03	9/17/2002
07020012-575	91MN112	Robert Creek	9.72	2Bg	6	43	43.33	8/2/2010
07020012-798	14MN047	Unnamed creek	9.4	2Bg	5	37	28.56	8/19/2014
07020012-830	00MN007	Unnamed creek (Brewery Creek)	4.62	2Bg	5	37	21.38	8/19/2014
07020012-830	00MN007	Unnamed creek (Brewery Creek)	4.62	2Bg	5	37	26.77	8/19/2014

National Hydrography Dataset (NHD) Assessment Segment AUID	Biological Station ID	Stream Segment Name	Drainage Area Mi^2	Use Class	Invert Class	Threshold	FIBI	Visit Date
HUC 12: 0702001210-01 (Carver Creek)								
07020012-621	14MN041	Unnamed creek	6.31	2Bm	6	30	32.25	9/3/2014
07020012-622	14MN040	Unnamed creek	32.06	2Bm	6	30	37.78	9/3/2014
07020012-806	03MN030	Carver Creek	74	2Bg	5	37	25.14	9/4/2014
07020012-806	03MN030	Carver Creek	74	2Bg	5	37	27.66	8/18/2003
07020012-806	14MN039	Carver Creek	30.67	2Bg	5	37	11.91	9/3/2014
HUC 12: 0702001211-01 (City of Mendota Heights – Minnesota River)								
07020012-803	00MN010	Chaska Creek	14.69	2Bg	5	37	14.4	9/3/2014
07020012-835	14MN126*	Unnamed creek	6.3	2Bm				9/4/2014
07020012-581	01MN008	Unnamed creek (East Creek)	10.45	2Bg	5	37	28.98	9/17/2001
07020012-581	14MN201	Unnamed creek (East Creek)	10.41	2Bg	5	37	29.6	9/4/2014
07020012-582	99MN007	Unnamed creek (Assumption Creek)	1.48	2Ag	9	43	64.7	9/4/2014
07020012-710	00MN009	Bluff Creek	5.67	2Ag	9	43	58.65	9/3/2014
07020012-581	14MN125	Unnamed creek (East Creek)	11.75	2Bg	5	37	20.8	9/3/2014
07020012-710	00MN008	Bluff Creek	5.7	2Ag	9	43	65.03	9/3/2014
07020012-511	14MN124	Riley Creek	10.27	2Bg	5	37	17.84	9/3/2014
07020012-828	14MN204	Purgatory Creek	26.67	2Bg	5	37	23.28	9/15/2014
07020012-519	14MN108	Eagle Creek	2.47	2Ag	9	43	57.04	9/11/2014
HUC 12: 0702001211-04 (Trib. to Minnesota River (Prior Lake Outlet Channel)								
07020012-728	14MN123	Unnamed creek (Prior Lake Outlet Channel)	46.6	2Bg	5	37	24.4	9/11/2014
07020012-604	14MN099	Unnamed creek (County Ditch 13)	7.93	2Bm	6	30	43.65	8/26/2014
HUC 12: 0702001211-03 (Credit River)								
07020012-811	14MN059	Credit River	46.16	2Bg	5	37	30.01	9/11/2014
07020012-811	90MN117	Credit River	23.31	2Bg	5	37	15.83	9/9/2010
07020012-811	90MN117	Credit River	23.31	2Bg	5	37	19.42	8/26/2014
07020012-811	90MN117	Credit River	23.31	2Bg	5	37	39.08	9/17/2002

National Hydrography Dataset (NHD) Assessment Segment AUID	Biological Station ID	Stream Segment Name	Drainage Area Mi^2	Use Class	Invert Class	Threshold	FIBI	Visit Date
HUC 12: 0702001211-02 (Nine Mile Creek)								
07020012-723	03MN059	Ninemile Creek, South Fork	17.45	2Bg	5	37	22.21	9/15/2014
07020012-723	03MN059	Ninemile Creek, South Fork	17.45	2Bg	5	37	27.19	8/18/2003
07020012-809	96MN006	Ninemile Creek	45.68	2Bg	5	37	23.16	9/11/2014
07020012-808	03MN058	Ninemile Creek	13.56	2Bm	5	24	19.74	9/15/2014
07020012-808	03MN058	Ninemile Creek	13.56	2Bm	5	24	26.63	8/18/2003

*No MIBI score because no available habitat was available to sample – not assessed.

Appendix 4.1 – Fish species found during biological monitoring surveys

Common Name	Quantity of Stations Where Present	Quantity of Individuals Collected
American brook lamprey	1	1
Bigmouth Buffalo	13	85
Bigmouth Shiner	85	5832
Black Bullhead	45	605
Black Crappie	16	86
Blacknose Dace	91	6438
Blackside Darter	25	108
Bluegill	22	124
Bluntnose Minnow	36	1423
Brassy Minnow	56	2706
Brook Stickleback	93	2487
Brown Bullhead	1	5
Brown Trout	1	20
Bullhead Minnow	8	96
Central Mudminnow	65	693
Central Stoneroller	78	5260
Channel Catfish	12	272
Channel Shiner	4	73
Common Carp	57	2007
Common Shiner	47	972
Creek Chub	117	9337
Emerald Shiner	20	6442
Fantail Darter	7	341
Fathead Minnow	132	13475
Freshwater Drum	6	19
Gizzard Shad	9	178
Golden Redhorse	4	18
Golden Shiner	10	23
Green Sunfish	47	1966
Highfin Carpsucker	1	1
Hornyhead Chub	17	154
Hybrid Sunfish	9	27
Iowa Darter	11	116
Johnny Darter	83	3165
Lamprey Ammocete	1	4
Largemouth Bass	29	176
Logperch	7	215
Mimic Shiner	6	227
Northern Hogsucker	6	71
Northern Pike	20	62
Northern Redbelly Dace	1	72
Orangespotted Sunfish	16	144
Pumpkinseed	9	28
Quillback	7	62
Sand Shiner	39	4322
Shorthead Redhorse	12	163
Shortnose Gar	3	5
Silver Chub	2	2
Silver Redhorse	4	16
Slenderhead Darter	15	283
Smallmouth Buffalo	4	20
Spotfin Shiner	36	2934
Stonecat	15	150
Tadpole madtom	7	21

Common Name	Quantity of Stations Where Present	Quantity of Individuals Collected
Walleye	45	550
Weed Shiner	1	1
White Bass	2	14
White Crappie	1	1
White Sucker	103	3624
Yellow Bullhead	12	50
Yellow Perch	14	121

*Table Includes only non – Minnesota River stations

Appendix 4.2 – Macroinvertebrate species found during biological monitoring surveys

Invertebrate Taxa	Number of Stations Where Present	Number of Individuals Collected
Ablabesmyia	59	212
Acari	46	106
Acentrella	3	7
Acentrella parvula	21	68
Acentrella turbida	9	38
Acroneuria abnormis	1	1
Aedes	1	6
Aeshna	8	8
Aeshna umbrosa	9	5
Aeshnidae	8	13
Agnetina	1	1
Amphipoda	4	10
Anafroptilum	4	5
Anax	1	1
Anax junius	6	3
Anisoptera	1	1
Anopheles	10	30
Antocha	1	1
Aplexa elongata	1	5
Aquarius	4	5
Argia	2	2
Atherix	6	29
Atrichopogon	15	44
Baetidae	12	29
Baetis	39	562
Baetis brunneicolor	23	610
Baetis flavistriga	35	304
Baetis intercalaris	37	290
Belostoma	1	3
Belostoma flumineum	36	57
Berosus	7	20
Bezzia/Palpomyia	2	4
Boyeria	3	5
Boyeria vinosa	5	4
Brachycentrus occidentalis	1	17
Branchiobdellida	26	238
Brillia	33	162
Caecidotea	15	265
Caenis	13	84
Caenis diminuta	64	1080
Caenis hilaris	19	67
Callibaetis	12	68
Calopterygidae	5	10
Calopteryx	7	37
Calopteryx aequabilis	2	7
Calopteryx maculata	3	6
Cambaridae	3	2
Capniidae	1	1
Cardiocladius	4	4

Invertebrate Taxa	Number of Stations Where Present	Number of Individuals Collected
Ceratopogonidae	17	57
Ceratopogoninae	5	11
Ceratopsyche	20	376
Ceratopsyche alhedra	4	108
Ceratopsyche bronta	1	1
Ceratopsyche morosa	24	339
Ceratopsyche slossonae	6	16
Ceratopsyche sparna	2	22
Chaoborus	1	1
Cheumatopsyche	76	2469
Chironomini	15	23
Chironomus	45	239
Cladopelma	4	10
Cladotanytarsus	17	31
Coenagrionidae	33	479
Conchapelopia	19	48
Coptotomus	2	2
Corduliidae	10	23
Corixidae	46	339
Corynoneura	25	53
Crambidae	4	8
Crangonyx	2	22
Cricotopus	67	719
Cryptochironomus	37	98
Cryptotendipes	4	11
Culex	5	16
Culicidae	15	359
Dasyhelea	4	4
Decapoda	1	3
Desmopachria convexa	3	3
Dicrotendipes	62	507
Diphetor hageni	1	1
Dixidae	1	22
Dubiraphia	32	294
Dytiscidae	6	13
Elmidae	2	4
Empididae	15	16
Enallagma	3	10
Enchytraeus	4	12
Endochironomus	24	201
Enochrus	2	2
Ephydridae	29	73
Erioptera	2	3
Eukiefferiella	17	83
Fallceon	4	12
Ferrissia	14	58
Forcipomyia	3	5
Forcipomyiinae	3	7
Fossaria	8	15
Fridericia	1	2
Gammarus	14	363
Gerridae	6	6

Invertebrate Taxa	Number of Stations Where Present	Number of Individuals Collected
Gerris	1	1
Glossosoma nigrior	1	1
Glyptotendipes	45	469
Gomphus graslinellus	1	
Gyraulus	12	57
Haliplidae	3	3
Haliplus	9	25
Helichus	11	79
Helisoma anceps	1	4
Helophorus	1	1
Hemerodromia	24	50
Heptagenia	56	818
Heptageniidae	25	275
Hesperocorixa	1	1
Hetaerina	1	1
Hexagenia	1	1
Hirudinea	62	163
Hyalella	65	2646
Hydraena	6	7
Hydrobiidae	1	1
Hydrochus	5	6
Hydrophilidae	4	7
Hydropsyche	19	186
Hydropsyche betteni	15	250
Hydropsyche incommoda	4	19
Hydropsyche simulans	2	21
Hydropsychidae	40	469
Hydroptila	26	85
Hydroptilidae	9	17
Hydrozoa	1	3
Hygrotus	1	1
Isonychia	6	13
Kloosia/Harnischia	1	1
Labiobaetis dardanus	25	185
Labiobaetis frondalis	4	6
Labiobaetis propinquus	19	53
Labrundinia	33	124
Laccophilus	3	2
Larsia	1	1
Leptoceridae	8	9
Leptophlebiidae	1	8
Lestes	1	1
Leucrocuta	22	149
Limnephilidae	1	2
Limnephilus	1	4
Limnophyes	21	38
Limnoporus	3	7
Limonia	4	3
Liodessus	2	2
Lopescladius	1	1
Lymnaeidae	37	257
Maccaffertium	5	8

Invertebrate Taxa	Number of Stations Where Present	Number of Individuals Collected
Maccaffertium luteum	1	1
Macronychus glabratus	9	44
Mayatrichia ayama	1	1
Mesovelia	1	1
Metrobates	1	2
Micropsectra	19	89
Microtendipes	15	28
Microvelia	4	4
Muscidae	3	3
Naididae	2	2
Nais	5	55
Nanocladius	28	43
Nectopsyche	3	5
Nectopsyche diarina	31	97
Nemata	22	73
Nematoda	1	2
Nematomorpha	1	1
Neoplasta	1	3
Neoplea	1	1
Neoplea striola	29	180
Neoporus	4	7
Nilotanypus	5	6
Nixe	3	7
Notonecta	3	3
Notonectidae	2	2
Ochthebius	4	4
Odontomyia	4	4
Odontomyia /Hedriodiscus	8	11
Oecetis furva	6	8
Oecetis testacea	1	1
Oligochaeta	76	733
Optioservus	5	20
Orconectes	76	556
Orthocladiinae	22	38
Orthocladius	13	39
Palmacorixa	1	1
Parachironomus	9	34
Paracladopelma	2	3
Paracymus	1	1
Parakiefferiella	2	2
Paralauterborniella nigrohalterale	1	1
Paramerina	8	32
Parametriocnemus	14	33
Paraphaenocladius	1	1
Paratanytarsus	54	769
Paratendipes	36	352
Peltodytes	4	14
Perlesta	1	1
Phaenopsectra	48	181
Phryganeidae	3	4
Physa	5	172
Physella	79	2625

Invertebrate Taxa	Number of Stations Where Present	Number of Individuals Collected
Physidae	7	24
Pisidiidae	60	397
Planorbella	33	462
Planorbidae	9	16
Planorbula	4	4
Planorbula armigera	2	9
Plauditus	2	5
Polycentropodidae	2	5
Polycentropus	2	2
Polypedilum	108	4129
Potamyia flava	1	1
Pristina	1	1
Procladius	37	145
Procloeon	7	15
Promenetus exacuous	1	1
Psectrocladius	1	1
Pseudocloeon	1	2
Pseudosuccinea columella	4	14
Psychoda	8	10
Psychodidae	1	1
Ptilostomis	2	4
Ranatra	5	5
Rhagovelia	1	1
Rheocricotopus	15	42
Rheotanytarsus	65	1033
Rheumatobates	6	19
Saetheria	11	21
Sciomyzidae	6	15
Scirtes	1	1
Serromyia	1	1
Sigara	23	144
Simulium	70	4116
Sisyra	1	2
Somatochlora	5	11
Somatochlora walshii	3	3
Stagnicola	28	313
Stempellinella	3	3
Stenacron	19	54
Stenelmis	24	99
Stenochironomus	27	94
Stictochironomus	1	1
Stratiomyidae	8	18
Stylaria	2	2
Sweltsa	1	1
Syrphidae	1	3
Tabanidae	1	1
Tanypodinae	28	37
Tanypus	5	11
Tanytarsini	26	34
Tanytarsus	60	300
Telopelopia okoboji	2	2
Thienemanniella	33	118

Invertebrate Taxa	Number of Stations Where Present	Number of Individuals Collected
Thienemannimyia	7	46
Thienemannimyia Gr.	83	876
Tipula	18	52
Tipulidae	2	3
Trepaxonemata	9	51
Triaenodes	1	3
Tribelos	2	4
Trichocorixa	16	35
Trichoptera	2	2
Tricorythodes	31	205
Tropisternus	4	3
Tubificinae	6	11
Tvetenia	14	93
Veliidae	1	1
Xenochironomus xenolabis	2	2
Zavreliella marmorata	1	1
Zavrelimyia	9	111

Appendix 5 – Minnesota Stream Habitat Assessment results

Habitat information documented during each fish sampling visit is provided. This table 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 aggregated HUC-12 Subwatershed.

Le Sueur Creek Aggregated 12 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	03MN073	County Ditch 2	0	13	17.4	4	6	40.4	Poor
5	03MN074	Le Sueur Creek	2.5	11.38	18.34	12.5	24.75	69.46	Good
1	07MN063	Le Sueur Creek	1	9	9	6	7	32	Poor
2	14MN036	Unnamed creek	3.75	12.83	17.8	10.33	25.33	70.05	Good
2	14MN092	Le Sueur Creek	1.25	8.25	16.7	7	14.5	47.7	Fair
1	14MN093	Le Sueur Creek	0	10.5	16.7	11	15	53.2	Fair
3	14MN098	County Ditch 51	0.83	11.33	10.12	12	20.67	54.95	Fair
2	14MN106	Le Sueur Creek	0	5.5	12.3	10	20	47.8	Fair
1	14MN111	Unnamed ditch	0	8	8	12	6	34	Poor
Average Habitat Results: *Le Sueur Creek Aggregated 12 HUC*			**1.04**	**9.98**	**14.04**	**9.43**	**15.47**	**49.95**	**Fair**
1	03MN075	Forest Prairie Creek	2.5	13	17.95	11	29	73.45	Good
2	14MN030	County Ditch 42	0	6.75	7.6	8	6.5	28.85	Poor
3	14MN031	Unnamed ditch	0.833	10.17	8.97	11.33	18.67	49.97	Fair
2	14MN032	County Ditch 34	0	12	17.48	12	27.5	68.98	Good
2	14MN033	Forest Prairie Creek	1.25	11.25	16.975	12.5	27.5	69.475	Good
2	14MN034	Forest Prairie Creek	0	10.5	12.55	11	19	53.05	Fair
3	14MN035	Judicial Ditch 4	0	7.67	11.87	5.33	12	36.87	Poor
4	14MN097	County Ditch 8/53	0	7.63	9.48	7.75	9.75	34.6	Poor
2	14MN120	Forest Prairie Creek	2.5	9.75	17.78	11	25.5	66.53	Good

# 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
Average Habitat Results: ***Forest Prairie Creek Aggregated 12 HUC***			**0.79**	**9.86**	**13.41**	**9.99**	**19.49**	**53.53**	**Fair**
3	03MN022	Unnamed ditch	0	5	9.87	5	7	26.87	Poor
4	03MN027	Rush River, North Branch (County	0.125	4.5	16.31	4.75	9.25	34.94	Poor
1	14MN050	Unnamed ditch (County Ditch 55)	0	6.5	5	9	9	29.5	Poor
3	14MN052	Rush River, North Branch (County	0	4	15.57	6	7.67	33.23	Poor
2	14MN055	Rush River, North Branch (Judicial	0	6.25	16.1	5	5	32.35	Poor
1	14MN060	County Ditch 18	0	6	11.25	7	7	31.25	Poor
2	14MN083	County Ditch 56	0	7.5	12.35	8.5	11	39.35	Poor
1	14MN084	Rush River, North Branch (Judicial	0	6.5	18.85	7	15	47.35	Fair
2	14MN102	Unnamed ditch	0	6.5	17	3.5	5.5	32.5	Poor
Average Habitat Results: ***North Branch Rush River Aggregated 12***			**0.01**	**5.86**	**13.59**	**6.19**	**8.49**	**34.15**	**Poor**
1	03MN025	Rush River, South Branch	0.5	6.5	14.8	14	8	43.8	Poor
1	10EM099	County Ditch 13A	0	7	17.8	8	20	52.8	Fair
1	03MN025	Rush River, South Branch	0	7	3	12	4	26	Poor
2	14MN056	Judicial Ditch 6	0	7.5	12	3	5.5	28	Poor
2	14MN077	Rush River, South Branch	0	7.25	9.93	6.5	10	33.68	Poor
2	14MN088	County Ditch 13	0	6.75	5.5	5.5	7	24.75	Poor
2	14MN089	Judicial Ditch 1	0	7.5	5.075	6	11	29.58	Poor
2	14MN105	Rush River, South Branch	0	3.75	16	6	8.5	34.25	Poor
3	14MN230	Rush River, South Branch	0	6.17	15.17	8	11.67	41	Poor
2	97MN012	Rush River, South Branch	0.63	3.5	15.33	10.5	22	51.95	Fair
Average Habitat Results: ***South Branch Rush River Aggregated 12***			**0.11**	**6.29**	**11.46**	**7.95**	**10.77**	**36.58**	**Poor**
5	03MN026	Judicial Ditch 1A	0	5.6	16.1	6.4	10.4	38.5	Poor
1	07MN082	Judicial Ditch 1A	0	9	10	5	7	31	Poor
2	14MN053	County Ditch 32A	0	8	4.9	6	7	25.9	Poor
2	14MN054	County Ditch 30A	0	7	6	6.5	5.5	25	Poor

1	14MN057	County Ditch 40A	0	8	2	5	4	19	Poor
# 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	14MN058	County Ditch 9	0	8	12.1	4	10	34.1	Poor
2	14MN103	County Ditch 40A	0	7	6.5	7	5.5	26	Poor
3	14MN104	County Ditch 40A	0	7.5	6.7	8.33	11.33	33.87	Poor
Average Habitat Results: *Judicial Ditch 1A Aggregated 12 HUC*			**0**	**7.51**	**8.04**	**6.03**	**7.59**	**29.17**	**Poor**
2	03MN028	Rush River	2.5	9.5	13.7	6.5	16.5	48.7	Fair
2	14MN061	Rush River	0	4.75	19.25	8	17	49	Fair
2	14MN062	County Ditch 50	0	5.25	17.5	8.5	19	50.25	Fair
2	14MN082	Rush River	0	6.25	18.43	8.5	18.5	51.68	Fair
2	90MN110	Rush River	3.125	9	14.5	9	18	53.625	Fair
Average Habitat Results: *Rush River Aggregated 12 HUC*			**1.125**	**6.95**	**16.676**	**8.1**	**17.8**	**50.65**	**Fair**
3	01MN012	Rush River, Middle Branch (County	0	3	16.72	5.67	4	29.38	Poor
1	01MN028	County Ditch 42	0.5	7	20.15	5	12	44.65	Poor
3	03MN021	County Ditch 42	0	8	6.83	5	8.33	28.17	Poor
1	03MN024	Rush River, Middle Branch (County	0	6	14	5	11	36	Poor
1	07MN081	Rush River, Middle Branch (County	0	8.5	16.3	6	17	47.8	Fair
2	14MN074	County Ditch 49	0	8.75	6.5	11	8.5	34.75	Poor
2	14MN075	County Ditch 11	0	9	19.05	8.5	15	51.55	Fair
2	14MN076	County Ditch 44	0	8	5.5	7	8.5	29	Poor
2	14MN085	Rush River, Middle Branch (County	0	6	16.2	6	9.5	37.7	Poor
2	14MN087	County Ditch 22	0	8.25	16.4	9	19.5	53.15	Fair
1	14MN101	County Ditch 42	0	7	8.2	9	16	40.2	Poor
2	14MN121	Rush River, Middle Branch (County	0	4.33	14.32	5.67	10.67	34.98	Poor
3	14MN220	County Ditch 42	0	7.17	16.95	7.33	16.67	48.12	Fair
1	91MN109	County Ditch 43	0	7	10	12	7	36	Poor

Average Habitat Results: *Middle Branch Rush River Aggregated 12*			**0.04**	**7**	**13.37**	**7.30**	**11.69**	**39.39**	**Poor**
3	03MN076	Barney Fry Creek	2.92	10.5	21.27	9	21	64.68	Fair
# Visits	**Biological Station ID**	**Reach Name**	**Land Use (0-5)**	**Riparian (0-15)**	**Substrate (0-27)**	**Fish Cover (0-17)**	**Channel Morph.**	**MSHA Score (0-100)**	**MSHA Rating**
2	14MN080	County Ditch 75	0	6.25	8.8	5	8	28.05	Poor
2	14MN081	County Ditch 47A	0	4.75	8.95	3.5	3.5	20.7	Poor
1	14MN100	Unnamed creek	5	4.5	22	11	20	62.5	Fair
Average Habitat Results: *City of Le Sueur- Minnesota River*			**1.98**	**6.5**	**15.23**	**7.13**	**13.13**	**43.98**	**Poor**
1	01MN062	High Island Creek	2.5	7.5	23	6	26	65	Fair
1	14MN037	County Ditch 26	2.5	7	20.2	15	23	67.7	Good
1	14MN045	High Island Ditch 2	0	6	5.5	6	11	28.5	Poor
1	14MN048	Judicial Ditch 12	0	5.5	16.85	6	12	40.35	Poor
4	14MN049	High Island Creek	2.38	5.25	19.46	9	20.25	56.34	Fair
1	14MN063	High Island Ditch 5	0	7.5	14.2	7	15	43.7	Fair
1	14MN107	Unnamed ditch	0	8.5	17.2	12	25	62.7	Good
2	14MN109	Buffalo Creek (County Ditch 59)	0	4	11.18	7.5	11	33.68	Poor
3	14MN110	Unnamed ditch	0	7.5	3	3.67	4	18.17	Poor
2	14MN116	High Island Creek	2.5	7.25	12.1	6	11	38.85	Poor
2	15MN301	High Island Creek	2.5	9	18.85	14	23.5	67.85	Good
2	15MN302	High Island Creek	5	10.75	18.75	12.5	23.5	70.5	Good
4	90MN111	Buffalo Creek	3.75	8.88	19.69	12.5	19	63.81	Fair
5	97MN007	High Island Creek	0.25	8.1	12.17	8.8	15.4	44.72	Poor
Average Habitat Results: *Lower High Island Creek Aggregated 12*			**1.53**	**7.34**	**15.15**	**9.00**	**17.12**	**50.13**	**Fair**
3	07MN083	High Island Creek	0	5.67	10.07	6.67	10	32.4	Poor
1	14MN066	Unnamed ditch (Bakers Lake Inlet)	0	7	9	6	8	30	Poor
3	14MN067	High Island Creek	0	6.5	10.1	5	9.33	30.93	Poor
2	14MN068	County Ditch 39	0	7	16	10	13.5	46.5	Fair
2	14MN069	Judicial Ditch 24	0	7	3.5	6.5	5.5	22.5	Poor

2	14MN070	Judicial Ditch 15	0	7.5	8.5	5	6.5	27.5	Poor
2	14MN071	Judicial Ditch 11	0	7.25	15.85	5.5	11	39.6	Poor
4	14MN072	Judicial Ditch 11	0	6.5	4.75	7.5	3	21.75	Poor
# Visits	**Biological Station ID**	**Reach Name**	**Land Use (0-5)**	**Riparian (0-15)**	**Substrate (0-27)**	**Fish Cover (0-17)**	**Channel Morph.**	**MSHA Score (0-100)**	**MSHA Rating**
2	14MN086	Unnamed ditch	0	6.5	4	5	9	24.5	Poor
4	14MN122	High Island Creek	1.56	8.75	15.84	7.5	18.5	52.15	Fair
Average Habitat Results: ***Upper High Island Creek Aggregated 12***			**0.156**	**6.97**	**9.76**	**6.47**	**9.43**	**32.78**	**Poor**
2	14MN038	Bevens Creek	0	7.5	9.95	11.5	14.5	43.45	Poor
2	14MN042	Bevens Creek	0	6.75	17.25	8	13	45	Fair
2	14MN043	Unnamed creek	0	6.25	5.5	7	6.5	25.25	Poor
1	14MN044	Unnamed ditch	1.5	5.5	8	1	3	19	Poor
2	14MN046	County Ditch 4A	0	5.25	8.5	6	5	24.75	Poor
1	14MN094	Judicial Ditch 22	0	5.5	8.6	4	10	28.1	Poor
2	14MN095	Silver Creek	0	10	12.3	6.5	11	39.8	Poor
2	14MN112	County Ditch 29	0	5.25	5.5	9	3.5	23.25	Poor
2	14MN113	Unnamed creek	0	5.5	5.65	7.5	9	27.65	Poor
3	14MN114	Unnamed ditch	0.17	7.17	7.77	10	7.67	32.77	Poor
1	14MN115	Unnamed ditch	0	6.5	2	8	9	25.5	Poor
4	14MN203	Silver Creek	2.5	10.63	16.89	8.75	17	55.76	Fair
3	15EM014	Bevens Creek	5	10.33	18.4	12.67	23	69.4	Good
2	90MN114	Bevens Creek	2.5	6.75	19.325	9	21	58.58	Fair
Average Habitat Results: ***Bevens Creek Aggregated 12 HUC***			**0.83**	**7.06**	**10.40**	**7.78**	**10.94**	**37.02**	**Poor**
3	00MN006	Sand Creek	2.67	10	18.23	11.67	27.33	69.9	Good
2	01MN044	Sand Creek	3.75	11	20.05	8.5	25	68.3	Good
5	01MN058	Unnamed creek (Picha Creek)	0	5.5	17.56	10.6	22.4	56.06	Fair
1	03MN077	County Ditch 30 (County Ditch 54)	0	12	11.25	7	15	45.25	Fair
1	07MN033	Sand Creek	1	9	18.2	2	24	54.2	Fair
4	07MN034	Sand Creek	4.38	9.25	14.85	9.5	18.25	56.23	Fair

1	07MN055	Sand Creek	5	14	17.7	7	25	68.7	Good
4	07MN056	Sand Creek	2.31	7.63	16.43	12	22.25	60.61	Fair
3	10EM103	Unnamed creek	0.42	10.17	18.12	6.33	20.33	55.37	Fair
# Visits	**Biological Station ID**	**Reach Name**	**Land Use (0-5)**	**Riparian (0-15)**	**Substrate (0-27)**	**Fish Cover (0-17)**	**Channel Morph.**	**MSHA Score (0-100)**	**MSHA Rating**
1	10EM151	Unnamed ditch	0	12	3	12	4	31	Poor
3	14MN029	County Ditch 48	0.83	8.5	4	6.33	5.67	25.33	Poor
1	14MN096	Unnamed creek (Picha Creek)	2.5	9	15.9	6	14	47.4	Fair
2	14MN118	County Ditch 30 (County Ditch 54)	2	8.25	1.5	5	4.5	21.25	Poor
2	14MN119	Sand Creek	0.5	7.25	13.225	4.5	2.5	27.98	Poor
2	14MN128	Unnamed creek	0.875	7.5	12.15	6	8	34.53	Poor
2	14MN129	Sand Creek	1.625	9	10.375	9.5	17.5	48	Fair
2	14MN130	Unnamed creek	1.75	8.75	5.5	6	9	31	Poor
2	14MN200	Unnamed creek (Picha Creek)	2.5	9	19.7	7	15	53.2	Fair
2	15EM078	Unnamed creek (Picha Creek)	3.13	10.58	16	4.5	15.5	49.63	Fair
Average Habitat Results: *Sand Creek Aggregated 12 HUC*			**1.75**	**9.40**	**13.48**	**7.63**	**15.88**	**48.14**	**Fair**
1	14MN078	Unnamed Creek	3	11	15.8	8	10	47.8	Fair
3	99MN004	Porter Creek	1.67	9.67	18.77	12.33	21	63.43	Fair
Average Habitat Results: *Porter Creek Aggregated 12 HUC*			**2.34**	**10.34**	**17.29**	**10.17**	**15.5**	**55.62**	**Fair**
5	03MN029	Unnamed creek	1.2	12.6	16.84	10.4	20.6	61.64	Fair
2	10EM039	County Ditch 3	0	11.75	6	5.5	4	27.25	Poor
2	14MN090	Raven Stream	0	8.25	16.5	12.5	21	58.25	Fair
2	14MN131	Raven Stream, East Branch	0	7	14.45	9	15.5	45.95	Poor
2	14MN132	Raven Stream, West Branch	1.25	9.25	8.9	6.5	12.5	38.4	Poor
2	14MN133	Raven Stream, West Branch	0	9.25	11.95	9.5	16.5	47.2	Fair
2	14MN134	County Ditch 10	2.5	8.25	12.4	11.5	12	46.65	Fair
2	14MN135	County Ditch 3	0	7.5	15.73	5.5	12.5	41.23	Poor

# Visits	Biological Station ID	Reach Name	Land Use (0-5)	Riparian (0-15)	Substrate (0-27)	Fish Cover (0-17)	Channel Morph.	MSHA Score (0-100)	MSHA Rating
Average Habitat Results: *Raven Stream Aggregated 12 HUC*			**0.62**	**9.23**	**12.85**	**8.8**	**14.33**	**45.82**	**Fair**
3	00MN007	Unnamed creek (Brewery Creek)	1.17	7.67	15.97	12.67	23.33	60.8	Fair
3	00MN013	Robert Creek	2.08	9.5	13	6	6	36.58	Poor
2	14MN047	Unnamed creek	2.5	7.5	17.38	7.5	12	46.88	Fair
# Visits	**Biological Station ID**	**Reach Name**	**Land Use (0-5)**	**Riparian (0-15)**	**Substrate (0-27)**	**Fish Cover (0-17)**	**Channel Morph.**	**MSHA Score (0-100)**	**MSHA Rating**
3	91MN112	Robert Creek	1.67	13.17	19.63	7	19.67	61.13	Fair
Average Habitat Results: *City of Belle Plain-Minnesota River*			**1.86**	**9.46**	**16.50**	**8.29**	**15.25**	**51.35**	**Fair**
4	03MN030	Carver Creek	1.81	9.5	20.63	14.75	25.75	72.44	Good
2	03MN060	Unnamed ditch	0.5	11	8	10.5	10	40	Poor
2	14MN039	Carver Creek	0.625	9	13.425	12	15.5	50.55	Fair
2	14MN040	Unnamed creek	0	8.75	7.975	8.5	6	31.225	Poor
2	14MN041	Unnamed creek	1	8.75	10.65	8	9	37.4	Poor
Average Habitat Results: *Carver Creek Aggregated 12 HUC*			**0.79**	**8.4**	**12.14**	**10.75**	**13.25**	**46.32**	**Fair**
4	00MN008	Bluff Creek	2.625	10	16.15	10	17	55.58	Fair
1	00MN009	Bluff Creek	3.5	12	15.9	7	18	56.4	Fair
2	00MN010	Chaska Creek	2.75	9	19.6	10	17.5	58.85	Fair
1	01MN008	Unnamed creek (East Creek)	2.75	8	16	7	21	54.75	Fair
3	14MN108	Eagle Creek	2.58	10.83	15.8	12.33	24.33	65.88	Fair
1	14MN124	Riley Creek	3.5	10	20.7	12	27	73.2	Good
2	14MN125	Unnamed creek (East Creek)	0.88	9.75	16.98	12	15	54.6	Fair
1	14MN126	Unnamed creek	0	12	1	1	5	19	Poor
2	14MN201	Unnamed creek (East Creek)	2	11	18.13	11.5	24	66.63	Good
2	14MN204	Purgatory Creek	2	13	18.65	12.5	24.5	70.65	Good
4	99MN007	Unnamed creek (Assumption Creek)	4.31	12.13	16.55	12	20.5	65.49	Good

Average Habitat Results: ***City of Mendota Heights-Minnesota River***			**2.45**	**10.70**	**15.95**	**9.76**	**1944**	**58.28**	**Fair**
3	03MN058	Ninemile Creek	0	7.17	18.18	7.67	9.67	42.68	Poor
5	03MN059	Ninemile Creek, South Fork	0.85	9.4	16.48	14	21.6	62.33	Fair
1	03MN094	Ninemile Creek	2	8	12.4	8	17	47.4	Fair
1	03MN098	Ninemile Creek	2	8	14	6	20	50	Fair
1	03MN099	Ninemile Creek	5	11.5	16.6	10	21	64.1	Fair
# Visits	**Biological Station ID**	**Reach Name**	**Land Use (0-5)**	**Riparian (0-15)**	**Substrate (0-27)**	**Fish Cover (0-17)**	**Channel Morph.**	**MSHA Score (0-100)**	**MSHA Rating**
1	03MN100	Ninemile Creek	0	13	20.2	7	29	69.2	Good
2	96MN006	Ninemile Creek	2.75	11.5	20.98	13.5	27.5	76.23	Good
Average Habitat Results: ***Ninemile Creek Aggregated 12 HUC***			**1.8**	**9.80**	**16.98**	**9.45**	**20.82**	**58.85**	**Fair**
3	14MN059	Credit River	3	11.5	20.3	12.33	25	72.13	Good
4	90MN117	Credit River	2.75	13	20.38	10.75	26	72.88	Good
Average Habitat Results: ***Credit River Aggregated 12 HUC***			**2.88**	**12.25**	**20.34**	**11.54**	**25.5**	**72.51**	**Good**
2	14MN099	Unnamed creek (County Ditch 13)	0	8.25	8.05	8.5	9	33.8	Poor
2	14MN123	Unnamed creek (Prior Lake Outlet Channel)	1.25	11.5	18.38	14	24	69.13	Good
Average Habitat Results: ***Trib. to Minnesota River Aggregated 12***			0.63	9.88	13.22	11.25	16.5	51.47	**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)