Mississippi River (St. Cloud) Watershed Monitoring and Assessment Report

Minnesota Pollution Control Agency

October 2012

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

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Document number: wq-ws3-07010203b

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Executive Summary

The Mississippi River (St. Cloud) Watershed (HUC 8: 07010203) is located within the south-central portion of the Upper Mississippi River Basin and encompasses an area of 691,200 acres (1,080 square miles). There are 374 lakes and 907 miles of river in the watershed. Major rivers and streams include: Mayhew Creek, Rice Creek, Clearwater River, Elk River, and the St. Francis River. In addition to major rivers and streams, water quality data from several lakes were reviewed during this assessment, some of these lakes include: Clearwater, Elk, Mink, Maple, Sugar, Cedar, Clear, and Pleasant. The Mississippi River flows through this watershed, but will be covered in a separate report specific to the Upper Mississippi River.

In 2009 the Minnesota Pollution Control Agency (MPCA) undertook an intensive watershed monitoring (IWM) effort of the Mississippi River (St. Cloud) Watershed's surface waters. Fifty-two sites were sampled for biology at the outlet of variable sized sub-watersheds within the Mississippi River (St. Cloud) Watershed. In 2011, a holistic approach was taken to assess surface waterbodies within the watershed for aquatic life, recreation, and consumption use support; 21 streams and 69 lakes were assessed as part of this effort. Not all lake and stream assessment units (AUIDs) were assessed due to insufficient data, modified channel condition, their status as limited resource waters, or because they were Mississippi River main stem AUIDs.

Thirty-four of the lakes within the Mississippi River (St. Cloud) Watershed are fully supporting for aquatic recreation, and 38 are non-supporting. Elevated nutrients and bacteria are common water quality concerns for lakes in the watershed. Aquatic consumption advisories occur on 9 of the 15 lakes where fish contaminant data were available. Mercury concentrations in analyzed fish tissues are the cause of these impairments.

I. Introduction

Water is one of Minnesota's most abundant and precious resources. The Minnesota Pollution Control Agency (MPCA) is charged under both federal and state law with the responsibility of protecting the water quality of Minnesota's water resources. The MPCA's water management efforts are tied to the 1972 Federal Clean Water Act (CWA) requiring 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 the U.S. Environmental Protection Agency (EPA) a summary of the status of the state's surface waters and to develop a list of water bodies that do not meet established standards. Such waters are referred to as "impaired waters" and the state must take appropriate actions to restore these waters, including the development of Total Maximum Daily Loads (TMDLs). A TMDL is a comprehensive study identifying all pollution sources causing or contributing to impairment and the reductions needed to restore a water body so that it can 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 be successful preventing and addressing problems, decision makers need good information about the status of the resources, potential and actual threats, options for addressing the threats, and data on how effective management actions have been. 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 of 2006 provided a policy framework and the initial resources to state and local governments to accelerate efforts to monitor, assess, restore, and protect surface waters. Funding from the Clean Water Fund created by the passage of the Clean Water, Land, and Legacy Amendment to the state constitution, allows a continuation of this work. In response, the MPCA has developed a watershed monitoring strategy which uses an effective and efficient integration of water monitoring programs to provide a more comprehensive assessment of water quality and expedite the restoration and protection process. This has permitted the MPCA to establish a goal to assess the condition of Minnesota's surface waters via a 10-year cycle, and provides an opportunity to more fully integrate MPCA water resource management efforts in cooperation with local government and stakeholders to allow for coordinated development and implementation of water quality restoration and improvement projects.

The rationale behind the watershed approach is to intensively monitor the 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 efforts. This monitoring strategy was implemented in the Mississippi River (St. Cloud) watershed beginning in the summer of 2009. This report provides a summary of all water quality assessment results in the Mississippi River (St. Cloud) watershed and incorporates all data available for the assessment process including watershed monitoring, volunteer monitoring, and monitoring conducted by local government units. Consequently, there is an opportunity to begin to address most, if not all, impairments through a coordinated TMDL process at a watershed scale, rather than a reach-by-reach and parameter by parameter approach often historically employed. A 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, restoring, and preserving the quality of Minnesota's water resources.

It is important to note that although water quality monitoring data were collected on the main stem of the Mississippi River, these data will not be presented in this report. Currently, the MPCA is not conducting aquatic life use assessments on large mainstem rivers that cross major watershed boundaries, such as the Mississippi River at St. Cloud. These data will be presented in a more comprehensive large river report, which is separate from the following report. However, data from tributary streams to the Mississippi River and lakes within the watershed will be reported in the subsequent pages of this report.

II. The Watershed Monitoring Approach

The watershed monitoring approach is a 10-year rotation for monitoring and assessing waters of the state on the level of Minnesota's 81 major watersheds (Figure 1). The primary feature of the watershed approach is that it provides a unifying focus on the water resources within a watershed as the starting point for water quality assessment, planning, implementation, and result measures. 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 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).

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

Load monitoring network

The Major Watershed Load Monitoring Program (MWLMP) is designed to measure and compare regional differences and long-term trends in water quality of Minnesota's major rivers. Initiated in 2007 and funded by Minnesota's Clean Water Fund, the MWLMP's multi-agency monitoring approach combines stream flow data from the United States Geological Survey (USGS) and Minnesota Department of Natural Resources (MDNR) flow gauging stations with water quality data collected by the Metropolitan Council Environmental Services, local monitoring organizations and MPCA staff to compute annual pollutant loads. The MWLMP monitors and computes pollutant loads at 79 stream sites across Minnesota.

Pollutant sources affecting rivers can be quite variable from one watershed to the next depending on land use, climate, soils, slopes, and other factors. Elevated levels of total suspended solids (TSS) and nitrate plus nitrite-nitrogen (nitrate-N) are generally regarded as "non-point" source derived pollutants originating from many smaller diffuse sources such as agricultural or urban runoff, or air deposition.

Excess total phosphorus and dissolved orthophosphate can be attributed to natural, “non-point”, and “point” or end of pipe sources such as industrial or waste water treatment plants. Major “non-point” sources of phosphorus include dissolved phosphorus from fertilizers and phosphorus adsorbed to, and transported with, sediment during runoff.

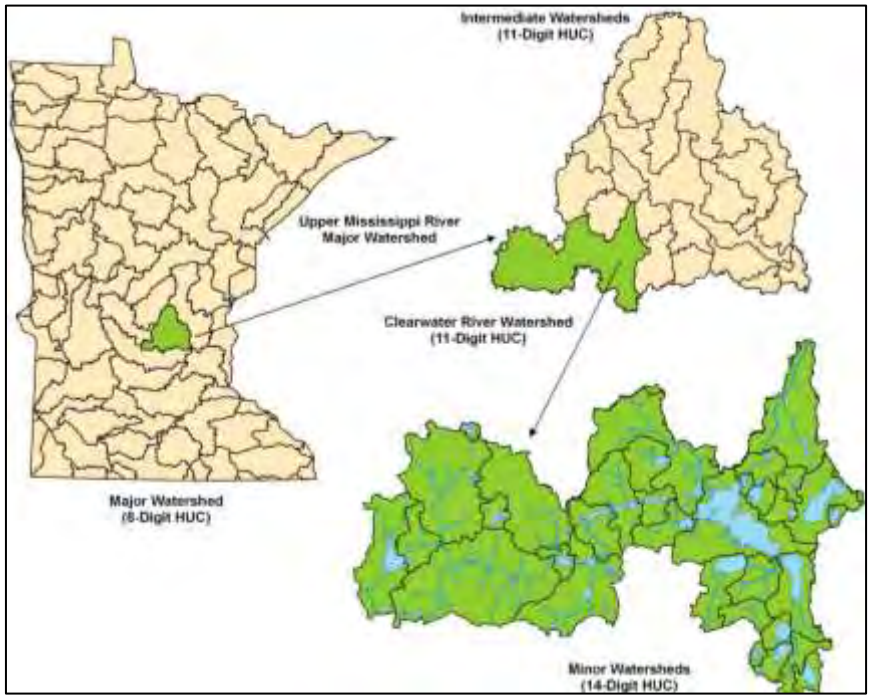
Within a given watershed, pollutant sources and source contributions can also be quite variable from one runoff event to the next depending on factors such as crop/canopy development, soil saturation level, and precipitation type and intensity. Surface erosion and in-stream sediment concentrations will typically be much higher during rain events prior to canopy development rather than after post-canopy events where less surface runoff and more foliage interception and soil infiltration occur. Precipitation type and intensity influence the major course of storm runoff, routing water through several potential pathways including overland, groundwater and drain tile flow. These pathways influence the type and levels of pollutants transported in runoff.

In addition to providing comparative and trend information, data that is collected and generated by the MWLMP will also be used to assist in developing watershed models for TMDLs, as well as watershed protection and restoration plans. It will also be used to put the IWM data into a longer-term context.

Intensive watershed monitoring

Stream monitoring

Figure 2. Overview of the intensive watershed monitoring design



The IWM strategy utilizes a nested watershed design allowing the aggregation of watersheds from a coarse to a fine scale (Figure 2). The foundation of this comprehensive approach is the 81 major watersheds within Minnesota. Streams are broken into segments by hydrologic unit codes (HUC) to define separate waterbodies within a watershed. Sampling occurs in each major watershed once every 10 years. In this approach, intermediate-sized (approx. HUC-11) and “minor” (14-digit HUC) watersheds are sampled along with the major watershed outlet to provide a complete assessment of water quality (Figure 2). River/stream sites are selected near the outlet at all watershed scales. This approach provides holistic assessment coverage of rivers and streams without monitoring every single stream reach (See Figure 3 for an illustration of the monitoring site coverage within the Mississippi River (St. Cloud) watershed).

The outlet of the major watershed is sampled for biology, water chemistry, and fish contaminants to allow for the assessment of aquatic life, aquatic recreation, and aquatic consumption use-support. Each HUC-11 outlet is sampled for biology and water chemistry for the assessment of aquatic life and aquatic recreation use-support (Figure 7). Watersheds at this scale generally consist of major tributary streams with drainage areas ranging from 75 to 150 mile^2. Lastly, most minor watersheds (typically 10-20 mile^2) are sampled for biology (fish and macroinvertebrates) to assess aquatic life use-support (Figure 8).

The second step of the IWM effort consists of follow-up monitoring at areas determined to have impaired waters. This follow-up monitoring is designed to collect the information needed to initiate the stressor identification process in order to identify the source(s) and cause(s) of impairment to be addressed in TMDL development and implementation.

Lake monitoring

The MPCA conducts and supports lake monitoring for a variety of objectives. Lake condition monitoring activities are focused on assessing the recreational use-support of lakes and identifying trends over time. The MPCA also assesses lakes for aquatic consumption use-support, based on fish-tissue and water-column concentrations of toxic pollutants. Lake monitoring was brought into the watershed monitoring framework in 2009. The MPCA conducts its own lake monitoring and also funds monitoring by local groups such as counties, soil and water conservation districts (SWCDs), watershed districts, nonprofits and educational institutions via Surface Water Assessment Grants (SWAGs). Many SWAG grantees invite citizen participation in their monitoring projects. These local partners and citizens greatly expand MPCA's overall capacity to conduct lake monitoring.

Even when pooling MPCA and local resources, we are not able to monitor all lakes in Minnesota. The primary focus of MPCA monitoring is lakes $\geq$500 acres in size ("large lakes"). These resources typically have public access points, they generally provide the greatest aquatic recreational opportunity to Minnesota's citizens, and these lakes collectively represent 72 percent of the total lake area (greater than 10 acres) within Minnesota. Though our primary focus is on monitoring and assessing larger lakes, we are also committed to directly monitoring, or supporting the monitoring of small lakes between 100-499 acres for assessment purposes.

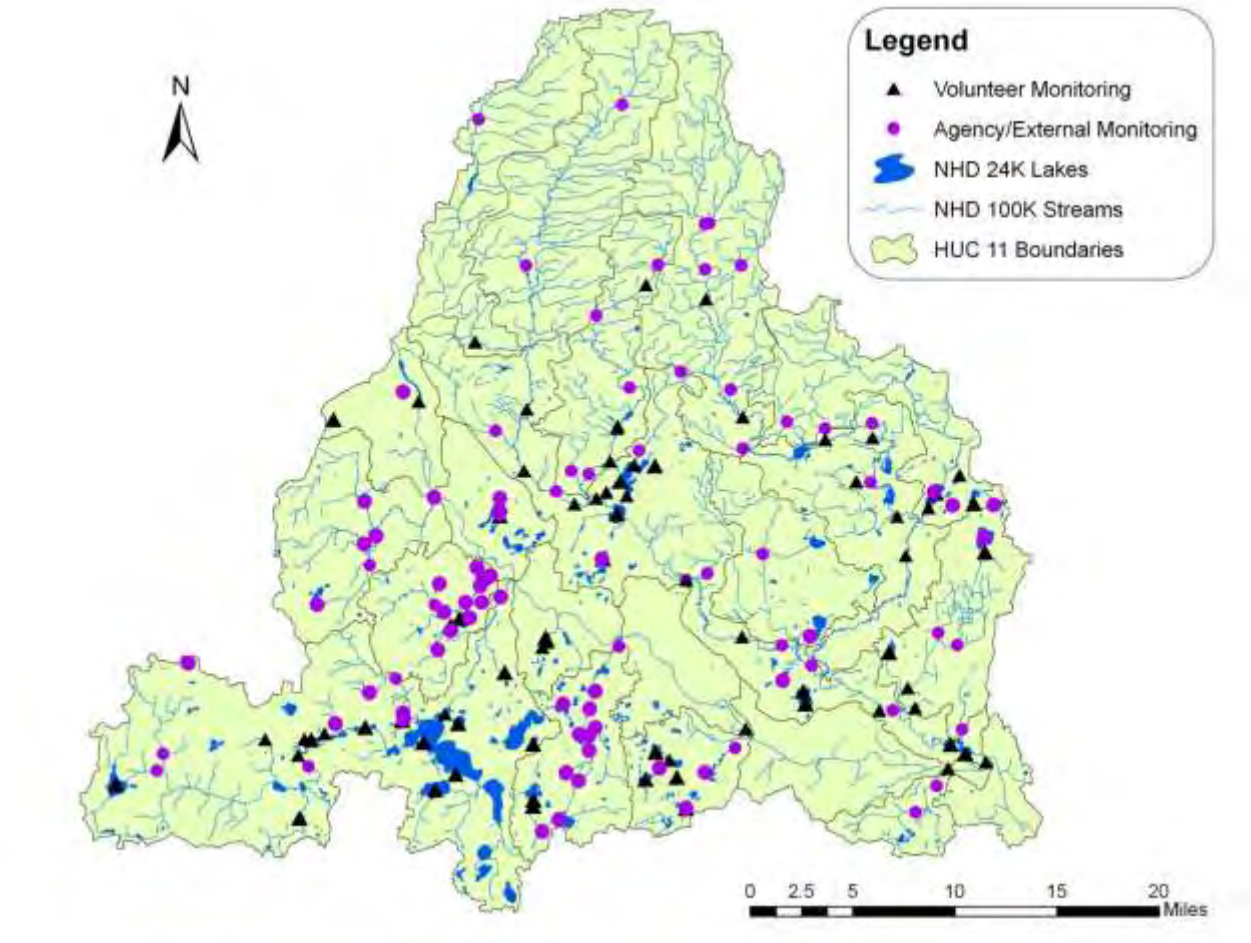
Citizen and local monitoring

Citizen monitoring is an important component of the watershed monitoring approach. The MPCA coordinates two programs aimed at encouraging citizen surface water monitoring: the Citizen Lake Monitoring Program (CLMP) and the Citizen Stream Monitoring Program (CSMP). Like the permanent load monitoring network that has been established at watershed outlets, sustained citizen monitoring can provide the long-term picture needed to help evaluate current status and trends. The advance identification of lake and stream sites that will be sampled by agency staff provides an opportunity to actively recruit volunteers to monitor those sites too, so that water quality data are available for the years before and after the intensive monitoring effort. This citizen-collected data helps agency staff interpret the results from the intensive monitoring effort, which only occurs once every 10 years. It also allows interested parties to track any water quality changes that occur in the years between the intensive monitoring events. Coordinating with volunteers to focus monitoring efforts where it will be most effective for watershed planning and tracking purposes helps local citizens/governments see how their efforts are being used to inform water quality management decisions and affect change. Figure 3 provides an illustration of the locations where volunteer citizen and agency/external monitoring data are being used for assessment in the Mississippi River (St. Cloud) Watershed.

The MPCA also passes through funding via SWAGs to local groups such as counties, SWCDs, watershed districts, nonprofits, and educational institutions to monitor lake and stream water quality. These local partners greatly expand our overall capacity to conduct sampling. Many SWAG grantees invite citizen participation in their monitoring projects.

The annual SWAG Request for Proposal (RFP) identifies the major watersheds that are scheduled for upcoming intensive monitoring activities. HUC-11 stream outlet chemistry sites and lakes less than 500 acres that need monitoring are identified in the RFP and local entities are invited to request funds to complete the sampling. Surface Water Assessment Grants grantees conduct detailed sampling efforts following the same established monitoring protocols and quality assurance procedures used by the MPCA. All of the lake and stream monitoring data from SWAG projects are combined with the MPCA's monitoring data to assess the condition of Minnesota lakes and streams.

Figure 3. Monitoring locations of local groups, citizens, and the MPCA monitoring staff in the Mississippi River (St. Cloud) Watershed



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

Water quality standards

Water quality standards are the fundamental benchmarks by which the quality of surface waters are measured and used to determine impairment. Use attainment status is a term describing the degree to which environmental indicators are either above or below criteria specified by Minnesota Water Quality Standards (Minn. R. ch. 7050 2008) (https://www.revisor.leg.state.mn.us/rules/?id=7050). 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. Protection of aquatic life means the maintenance of healthy, diverse, and successfully reproducing populations of aquatic organisms, including fish and invertebrates. Protection of recreation means the maintenance of conditions suitable for swimming and other forms of water recreation. Protection of consumption means protecting citizens who eat fish inhabiting Minnesota waters or receive their drinking water from waterbodies protected for this use.

Numeric water quality standards represent concentrations of specific pollutants in water that protect a specific designated use. Ideally, if the standard is not exceeded, the use will be protected. However, nature is very complex and variable, therefore the MPCA uses a variety of tools to fully assess designated uses. Assessment methodologies often differ by parameter and designated use. Furthermore, pollutant concentrations may be expressed in different ways such as chronic value, maximum value, final acute value, magnitude, duration, and frequency.

Narrative standards are statements of conditions in and on the water, such as biological condition, that protect their designated uses. Interpretations of narrative criteria for aquatic life support in streams are based on multi-metric biological indices including the Fish Index of Biological Integrity (F-IBI), which evaluates the health of the fish community, and the Macroinvertebrate Index of Biological Integrity (M-IBI), which evaluates the health of the aquatic invertebrate community. Biological monitoring is a direct means to assess aquatic life use support, as the aquatic community tends to integrate the effects of pollutants and stressors over time.

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 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 AUID), comprised of the USGS eight digit hydrologic unit code plus a three character code that is unique within each HUC. Lake and wetland identifiers are assigned by the MDNR. 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 status

Conceptually, the process for determining use attainment status of a waterbody is similar for each designated use: comparison of monitoring data to established water quality standards. However, the complexity of that process and the amount of information required to make accurate assessments varies between uses. In part, the level of complexity in the assessment process depends on the strength of the dose-response relationship; i.e., if chemical B exceeds water quality criterion X, how often is beneficial use Y truly not being attained. For beneficial uses related to human health, such as drinking water, the relationship is well understood and thus the assessment process is a relatively simple interpretation of 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 a comparison of the monitoring data to standards. This is largely an automated process performed by logic programmed into a database application and the results are referred to as 'Pre-assessments'. Pre-assessments are then reviewed by either a biologist or water quality professional, depending on whether the parameter is biological or chemical in nature. These reviews are conducted at the workstation of each reviewer (i.e., desktop) using computer applications to analyze the data for potential temporal or spatial trends as well as gain a better understanding of any attenuating circumstances that should be considered (e.g., flow, time/date of data collection, habitat).

The next step in the process is a Comprehensive Watershed Assessment meeting where reviewers convene to discuss the results of their desktop assessments for each individual waterbody. Implementing a comprehensive approach to water quality assessment requires a means of organizing and evaluating information to formulate a conclusion utilizing multiple lines of evidence. Occasionally, the evidence stemming from individual parameters are not in agreement and would result in discrepant assessments if the parameters were evaluated independently. However, the overall assessment

considers each piece of evidence to make a use attainment determination based on the preponderance of information available. See the *Guidance Manual for Assessing the Quality of Minnesota Surface Waters for the Determination of Impairment* 305(b) Report and 303(d) List (MPCA 2012) for guidelines and factors to consider when making such determinations.

Any new impairment determination (i.e., waterbody not attaining its beneficial use) is reviewed using GIS to determine if greater than 50 percent of the assessment unit is channelized. Currently, the MPCA is deferring any new impairments on channelized reaches until new aquatic life use standards have been developed as part of the tiered aquatic life use framework. For additional information see *Tiered Aquatic Life Use (TALU) Framework* (http://www.pca.state.mn.us/index.php?option=com_k2&Itemid=131&id=767&layout=item&view=item)

The last step in the assessment process is the Professional Judgment Group or PJG 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 have a vested interest in the outcomes of the assessment process. Information obtained during this meeting may be used to revise previous use attainment decisions. The result of this meeting is a compilation of the assessed waters which will be included in the watershed assessment report. 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.

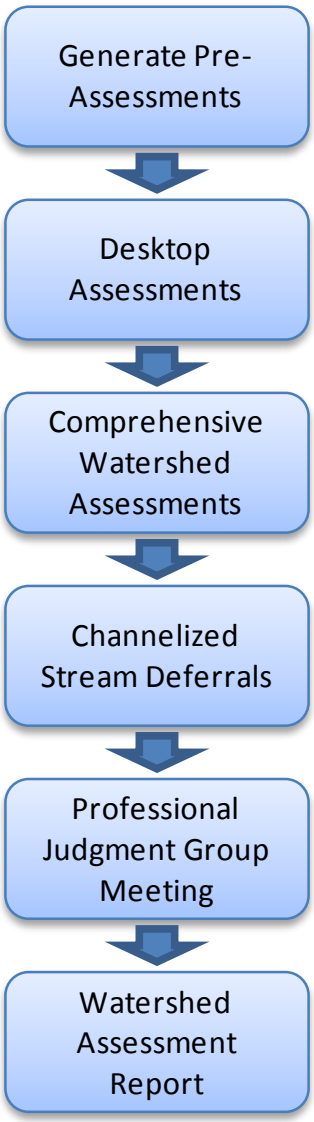
Data management

It is MPCA policy to use all credible and relevant monitoring data to assess surface waters. The MPCA relies on data it collects along with data from other sources, such as sister agencies, local government, and volunteers. The data must meet rigorous quality-assurance protocols before being used. The MPCA stores surface monitoring data in EPA's STORET system and all monitoring data required or paid for by MPCA is entered into EQuIS, MPCA's front end data portal to STORET. Projects funded by MPCA include Clean Water Act 319 projects, Clean Water Partnership projects, SWAG projects and more recently, TMDL projects. Many local projects not funded by MPCA choose to submit their data to the MPCA in STORET-ready format so that it may be utilized in the assessment process. Prior to each biennial assessment cycle, the MPCA publishes a "Call for Data" in the State Register and contacts partner organizations directly to request their monitoring data.

Period of record

The MPCA uses data collected over the most recent 10 year period for all water quality assessments. Generally, the most recent data from the 10-year assessment period is reviewed first when assessing toxic pollutants, eutrophication and fish contaminants. Also, the more recent data for all pollutant categories may be given more weight during the comprehensive watershed assessment or PJG meetings. The goal is to use data from the 10 year period that best represents the current water quality conditions. Using data over a 10 year period provides a reasonable assurance that data will have been collected over a range of weather and flow conditions and that all seasons will be adequately represented; however, data for the entire period is not required to make an assessment.

Figure 4. Flowchart of aquatic life use assessment process

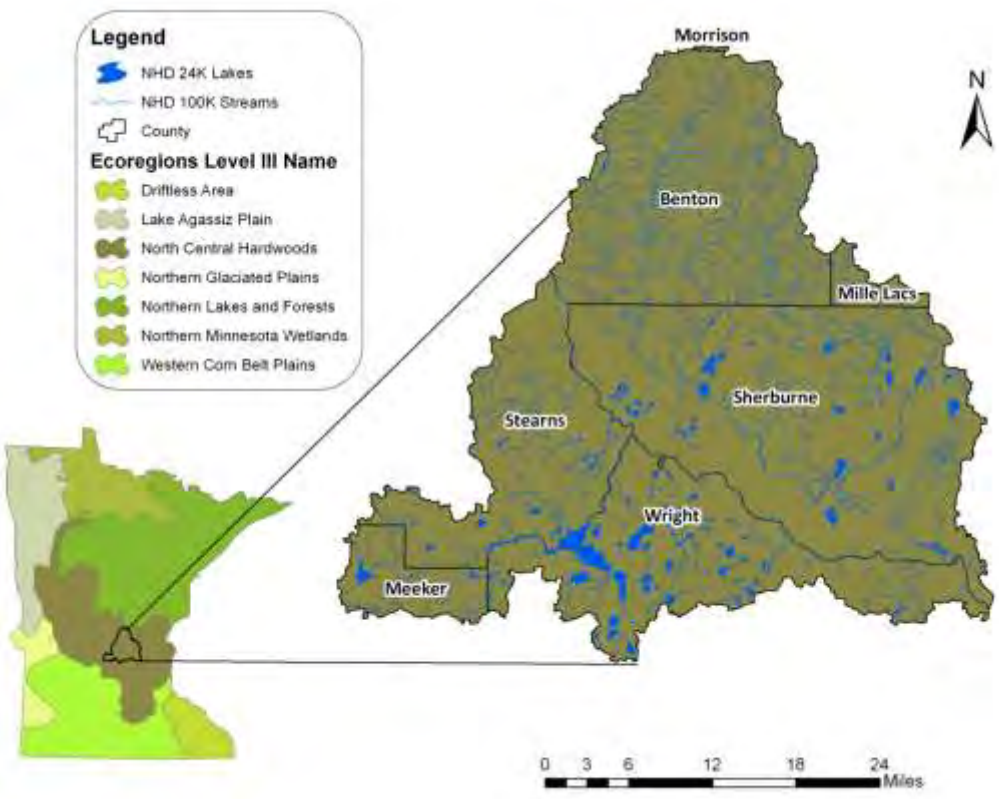


IV. Watershed Overview

Physical setting

The Mississippi River (St. Cloud) watershed originates at the confluence of the Sauk and Mississippi Rivers (upstream of CSAH 3, near St. Cloud, MN). This portion of the Mississippi River flows approximately 50 miles southeast, where it joins up with the North Fork of the Crow River (Figure 5). The Mississippi River (St. Cloud) watershed contains a total of 907 river miles, draining approximately 717,374 acres (1,121 sq. mi.). The watershed includes all or parts of 7 counties in central Minnesota: Benton, Meeker, Mille Lacs, Morrison, Sherburne, Stearns, and Wright counties (Figure 5). This portion of the Mississippi River has been designated as a wild and scenic river due to the abundance of wildlife, a high quality smallmouth bass fishery, a series of unique bluffs, and beaver islands (MPCA 2012, MNDNR 2011). The watershed is entirely contained within the North Central Hardwood Forests (NCHF) Ecoregion (Omernik, 1988). This ecoregion is characterized by glacial till, lacustrine basins, outwash plains, and rolling to hilly moraines and beach ridges. The NCHF is nestled between the Lakes and Forest Ecoregion to the North and the more agricultural ecoregions to the South (Omernik 1988) (Figure 5). Soils in the region are dominated by Mollisols and Alfisols, with outwash deposits comprised of gravel and sand.

Figure 5. The Mississippi River (St. Cloud) watershed within the North Central Hardwoods Ecoregion of central Minnesota



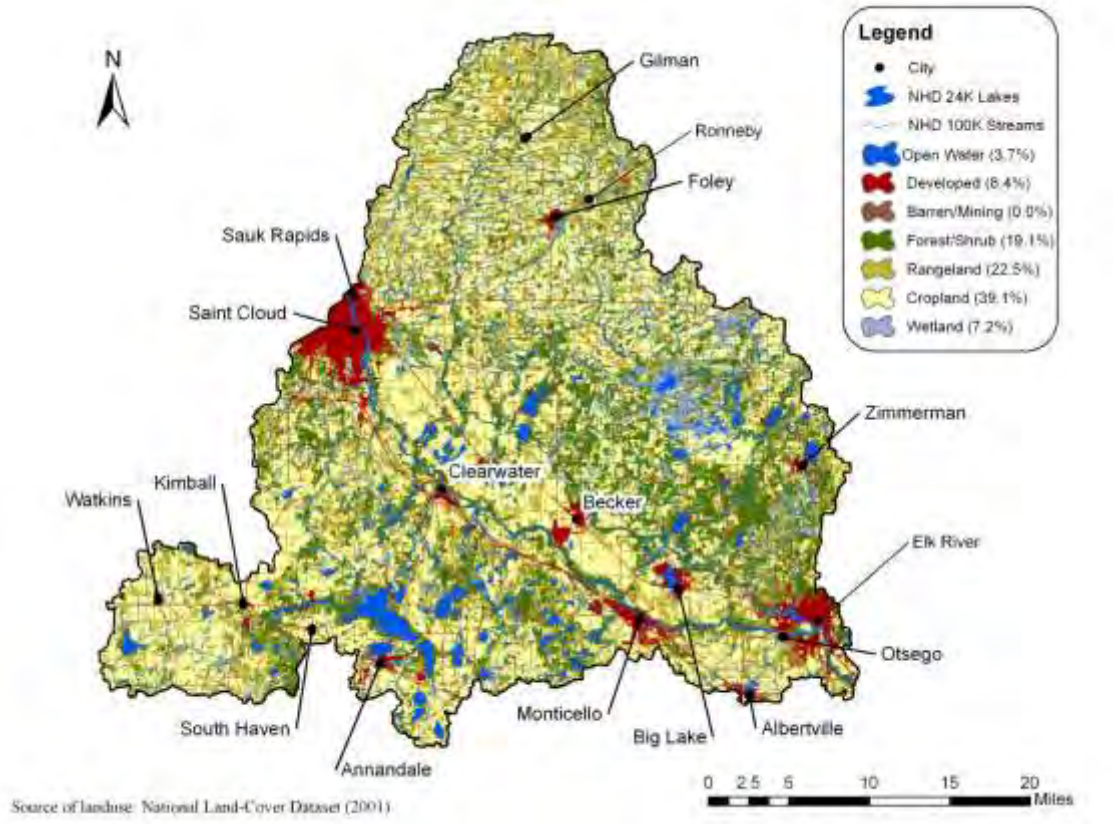
Land use summary

The Mississippi River (St. Cloud) watershed contains a myriad of land use types. They may be categorized as cropland (39.1 percent), rangeland (22.5 percent), forest/shrub (19.1 percent), developed (8.4 percent), wetland (7.2 percent), open water (3.7 percent) and barren/mining (0.01 percent) (Figure 6). The dominant land use type in this watershed is cropland which is often irrigated through center pivot irrigation systems. Cropland is predominately planted in corn, soybeans, and forage for livestock (USDA 2007a,b,c,d,e,f). Of the 717,374 acres[2] within this watershed, 642,562 acres[2] (approx. 89 percent) are privately owned (NRCS 2008). Of the seven counties in this watershed, Stearns County ranked first in the state for total value of agricultural products sold, and 87th in the nation (USDA 2007). Similarly, Stearns County ranked first in the state for value of livestock, poultry, and their products (USDA 2007). While the watershed is dominated by cropland, the other dominant land use types are rangeland and forest/shrub lands (Figure 6).

One hundred sixty-one thousand nine hundred and seventeen (161,917) people reside in the Mississippi River (St. Cloud) watershed; equating to 1 person per mile[2] (Minnesota State Demographic Center 2010). The majority of the populations live along I-94 (Monticello and Albertville) and Hwy 10 (St. Cloud, Sauk Rapids, Becker, and Otsego), which roughly splits the watershed in half. The remaining cities to the north include Gilman, Foley, and Zimmerman, with Annandale, Kimball, South Haven, and Watkins in the southwestern portion of the watershed.

Major population centers in the watershed include St. Cloud (65,741 people), Elk River (23,633 people), Otsego (13,562 people), Sauk Rapids (13,133 people), and Monticello (11,501 people).

Figure 6. Land use in the Mississippi River (St. Cloud) watershed



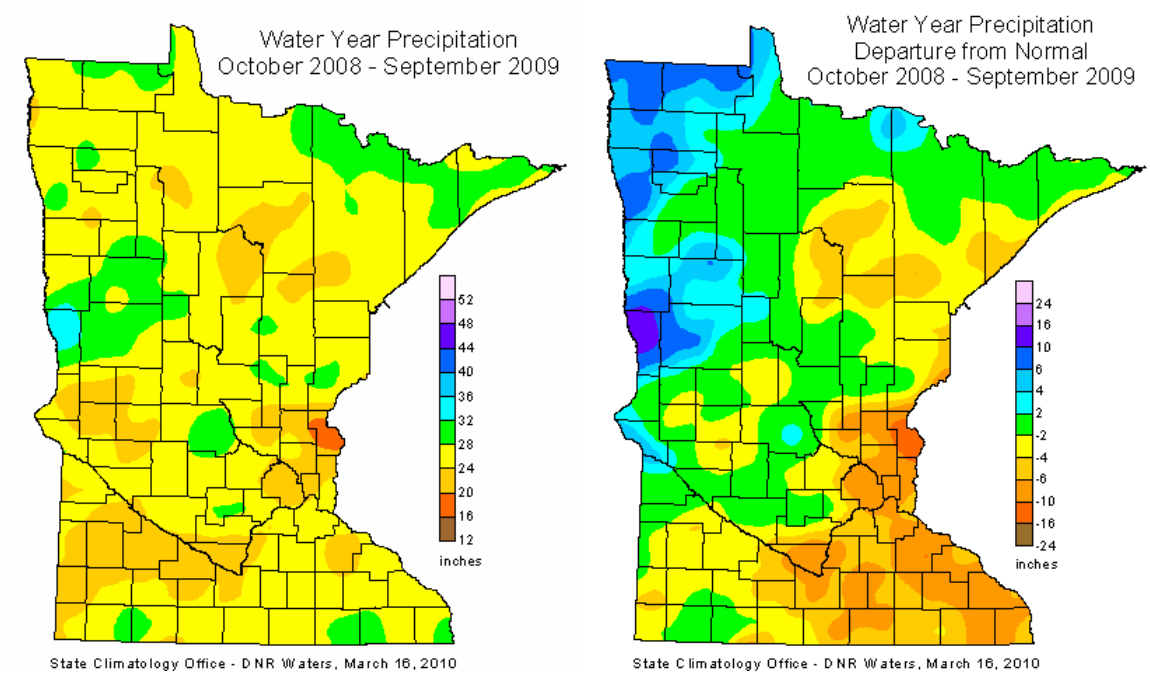
Surface water hydrology

The Mississippi River (St. Cloud) watershed is a flow-through watershed that receives flow in the city of Sauk Rapids, from the Mississippi River-Sartell watershed and the Sauk River Watershed. This segment of the Mississippi River flows southwest past the city of St. Cloud, in Sherburne County, then past Monticello, - eventually reaching the Mississippi River-Twin Cities watershed in the city of Elk River. From Sauk Rapids to the mouth, the river drops 80 feet with an overall mean gradient of nearly 4 feet per mile. Principal tributaries include the Elk, Clearwater, St. Francis, and Snake Rivers. The watershed has 21 minor watersheds (11 digit HUC) and 374 lakes, with the principal lakes being Clearwater, Sugar, Cedar, Clear, and Pleasant.

Climate and precipitation

Annual precipitation levels in the watershed generally range from 20 to 32 inches (Minnesota State Climatologists Office, 2012). During the October 2008-September 2009 water year, which encompasses the time span in which the majority of the data were collected in the watershed, the precipitation levels were slightly below normal to slightly higher than normal (Figure 7). Precipitation totals for counties within the watershed were: Benton County 27.17 inches, Meeker County 27.92 inches, Mille Lacs County 26.09 inches, Morrison County 24.47 inches, Sherburne County 23.57 inches, Stearns County 29.19 inches, and Wright County 25.50 inches.

Figure 7. Statewide precipitation levels during the 2009 water year



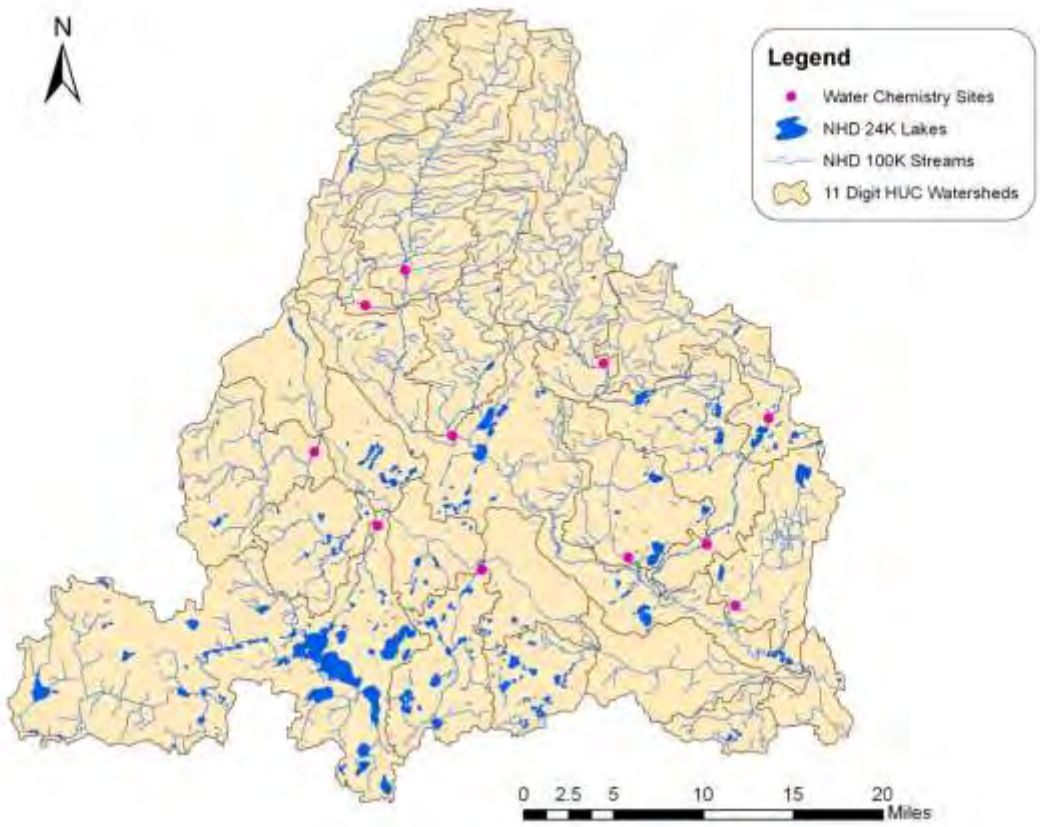
V. Watershed Wide Data Collection Methodology

The Mississippi River (St. Cloud) watershed includes a segment of the Mississippi River. Existing data from this small segment of the Mississippi River is not included in this report. Rather than report on results from small segments of large main stem rivers one watershed at a time, a separate monitoring strategy and reporting format is being developed that will focus on the full extent of these main stem rivers, providing a longitudinal context for interpreting the monitoring results from the headwaters to the mouth of each major basin. Rivers that will be monitored and assessed using this approach cut across 8 digit HUC boundaries and include the Minnesota, Upper Mississippi, St. Croix, Red, and Rainy Rivers.

Stream water sampling

A total of 37 water chemistry sites (Figure 8) were sampled in the summers of 2009 and 2010 throughout the Mississippi River (St. Cloud) watershed to provide data for water quality assessments and to help interpret the biological monitoring results. Monitoring took place cooperatively among staff from the MPCA, Sherburne City Planning and Zoning Department, Wright County Soil and Water Conservation District, Onanegozie Resource Conservation and Development, Stearns Soil and Water Conservation District, and trained citizen volunteers. These water chemistry sites were located near the outlets of intermediate (HUC-11) watersheds, per the MPCA's watershed monitoring approach. The HUC-11 outlet water chemistry data are summarized within each watershed unit summary, and include those parameters most commonly used to assess aquatic life and aquatic recreation). Not all water chemistry parameters of interest have developed water quality standards. McCollor and Heiskary (1993) developed ecoregion expectations for a number of water quality parameters in streams that provide a good basis for evaluating water quality data and estimating attainable water quality for an ecoregion. The expectations were based on the 75th percentile from a long term dataset of least impacted streams in Minnesota.

Figure 8. Water chemistry monitoring stations in the Mississippi River (St. Cloud) watershed



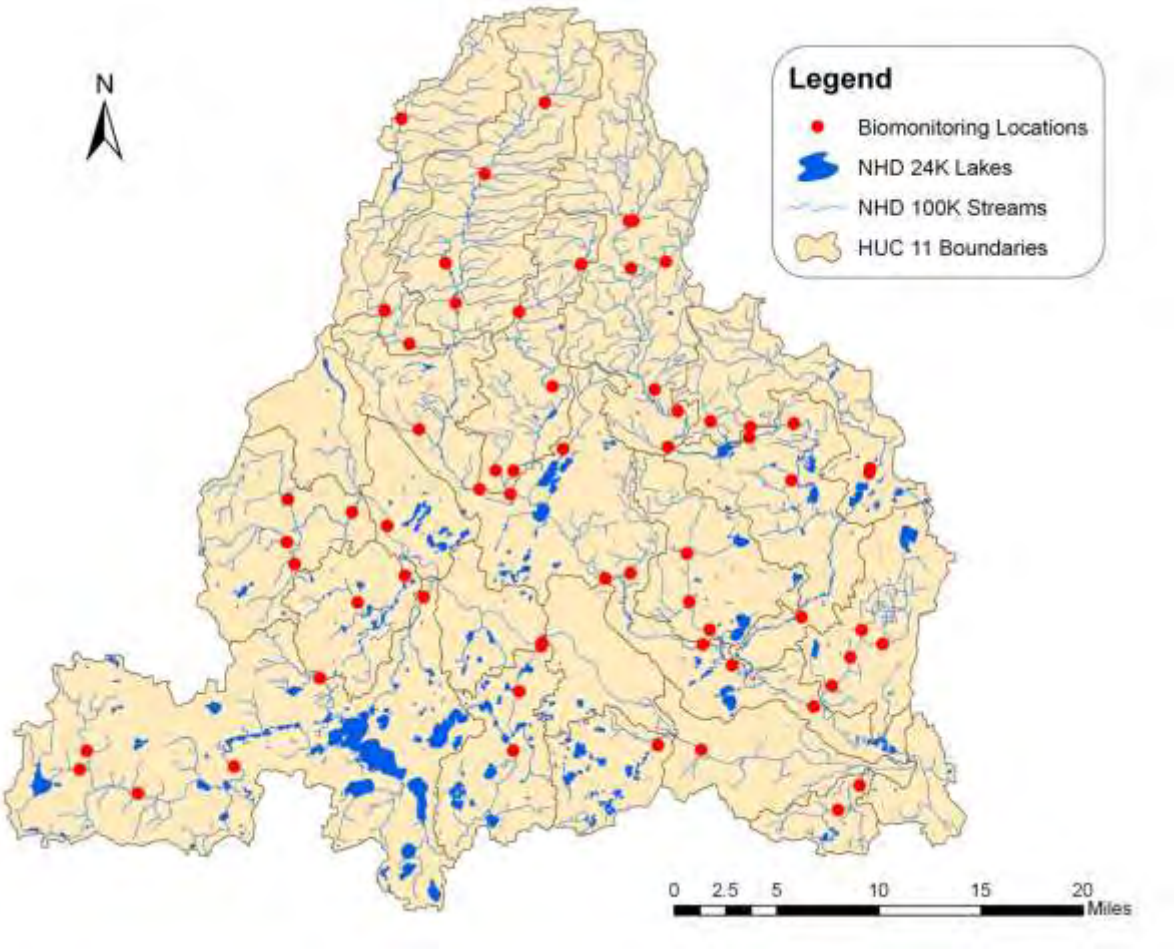
Stream biological sampling

The biological monitoring component of the IWM in the Mississippi River (St. Cloud) watershed was completed during the summer of 2009. A total of 52 biological monitoring stations were established and sampled during the summer months. These sites were located near the outlets of the 8 and 11 digit HUC watersheds and most minor HUC-14 watersheds (Figure 9). Of the 52 biological monitoring stations established in 2009, one station was established as part of a statewide random stream survey. Furthermore, 9 existing biological monitoring stations within the watershed were revisited in 2009. One station had been previously established in 1999, 3 stations were established in 2000 and 5 stations were established in 2007. The majority of these monitoring stations were initially established to represent a range of conditions for development of biological criteria. While data from the last 10 years was used for assessment, the majority of data used for assessment was collected in 2009.

To measure the health of the biological communities at each assessable biological monitoring station, Indices of Biological Integrity (IBI) were used, specifically the F-IBI and the M-IBI. The F-IBI and M-IBI partition streams into nine distinct classes to account for natural, physical, and biological differences associated with different regions of the state, drainage area, gradient, and water temperature (Appendix 4). Fish and macroinvertebrate communities within each class are more similar to each other than those occurring in other classes. By partitioning, or accounting for the natural variation within biological communities found in streams, any changes in IBI scores within a class should reflect real change due to human-induced impacts. Each class specific IBI has a unique suite of metrics, scoring

functions, impairment thresholds, and confidence intervals. Index of biological integrity scores higher than the upper confidence limit reflect good biological condition, while scores below the lower confidence limit reflect poor biological condition. When IBI scores fall within the confidence interval, interpretation and assessment of waterbody condition involves consideration of potential stressors, and draws upon additional information that may aid in understanding potential stressors within a water body, such as water chemistry, physical habitat, land use activities, etc. For individual biological monitoring station IBI scores, thresholds, and confidence intervals, refer to Appendix 4-6.

Figure 9. Biological monitoring locations in the Mississippi River (St. Cloud) watershed



Fish contaminants

Mercury and polychlorinated biphenyls (PCBs) were analyzed in fish tissue samples collected from Elk River and 15 lakes in the watershed. Fish from Elk River were collected in 1999 by the MDNR fisheries and in 2009 by the MPCA biomonitoring staff. Minnesota Department of Natural Resources fisheries collected the fish from the lakes.

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

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

Polychlorinated biphenyls in fish have not been monitored as intensively as mercury in the last three decades due to results from monitoring completed in the 1970s and 1980s. These studies identified that high concentrations of PCBs were only a concern downstream of large urban areas in large rivers, such as the Mississippi River and in Lake Superior. This implied that it was not necessary to continue widespread frequent monitoring of smaller river systems as is done with mercury. However, limited PCB monitoring was included in the watershed sampling design to ensure that this conclusion is still accurate. Impairment assessment for PCBs in fish tissue is based on the fish consumption advisories prepared by the Minnesota Department of Health. If the consumption advice is to restrict consumption of a particular fish species to less than a meal per week because of PCBs, the MPCA considers the lake or river impaired. The threshold concentration for impairment is 0.22 mg/kg PCBs and more restrictive advice is recommended for consumption (one meal per month).

Lake water sampling

Of the 374 lakes within the Mississippi River (St. Cloud) watershed, there are approximately 176 protected lakes greater than four hectares (10 acres). Protected lakes include lake basins and do not include wetlands or treatment ponds; this classification was adapted from the MDNR to aid in Lake Basin characterization. One lake, George (73-0611-00), is classified as a non-protected manmade lake but was assessed based on available data. Water clarity data was collected within the Melrose Deep Quarry (73-0701-00), also unprotected, however an assessment was not completed. A moderate amount of assessable lake water quality data has been collected in the watershed, with most lakes having little or no historical water quality data collected. Only 81 lakes have assessment level data. Of the 21 HUC-11 watersheds within the Mississippi River (St. Cloud) watershed, seven (Upper Elk River, Stony Brook and Rice, Upper St. Francis River, Lake Maria State Park, Monticello, Ostego, and Rice Lake) did not have lakes with assessment level data.

VI. Individual HUC-11 Watershed Results

Assessment results are presented for each HUC-11 watershed unit within the Mississippi River (St. Cloud) watershed, enabling the assessment of all surface waters at one time and the ability to develop comprehensive TMDL studies on a watershed wide basis, rather than the reach by reach and parameter by parameter approach that has been typically employed. This scale provides a robust assessment of water quality condition in the 11-digit watershed unit and is a practical size for the development, management and implementation of effective TMDLs and protection strategies. The primary objective of this monitoring strategy is to portray all the impairments within a watershed resulting from the complex and multi-step assessment and listing process. The graphics presented for each of the HUC-11 watershed units contain the assessment results from the most recent 2011 Assessment Cycle as well as any impairment listings carried forward from previous assessment cycles. Discussion of assessment results will focus primarily on the 2009 IWM effort but will also consider all available data from the last 10 years.

Given all of the potential sources of data and differing assessment methodologies for assessing indicators and designated uses, it is not feasible to provide results or summary tables for every monitoring station by parameter. However, in the proceeding pages, an individual account of each 11 HUC sub-watershed is provided. Within each account, readers are given a brief description of the watershed along with a series of tables including a 1) Stream Assessment table where an overall assessment result is provided for each AUID by each assessable parameter and designated use (i.e. aquatic life and aquatic recreation), 2) non-assessable AUID table where a general indication of condition is provided for channelized streams (where applicable), 3) a Stream Habitat Results table, 4) an Outlet Water Chemistry Results table, 5) a table describing Lake Water Chemistry (where applicable) and finally, a narrative that summarizes the unique components of the assessment and highlights noteworthy findings in the results.

Stream assessment

This table provides a summary of all assessable AUIDs by parameter within the watershed (where sufficient information was available to make an assessment). The tables denote the use support status of each individual water chemistry and biological parameter, as well as an overall use support assessment for aquatic life and aquatic recreation for each assessable AUID. The assessment for aquatic life is derived from analyzing biological data, dissolved oxygen (DO), turbidity, chloride, pH and NH3 to determine use status, while the assessment for aquatic recreation in streams is solely based on E. coli concentrations. Immediately following the AUID-specific use support results, the location of any assessed biological monitoring sites are listed. Water chemistry station locations are not provided because information collected as specific locations within each AUID are combined for the purposes of conducting waterbody assessments. Some AUIDs within the sub-watershed do not have sufficient information for assessment and are not included in this table. All AUIDs undergo a review to determine the degree (%) that they are channelized. AUIDs that are over 50 percent channelized are not assessed but are instead deferred pending new standards for aquatic life. The review process, adopted in 2006, does not result in changes to impairments identified during previous assessment cycles. Following the stream assessment table is a table describing a narrative biological condition of stations that could not be assessed due to their occurrence on channelized AUIDs, and is not an assessment for aquatic life for these systems. For more information regarding water chemistry parameters monitored in these studies refer to Appendix 1. A complete listing of all AUIDs within the watershed may be found in Appendix 3.

Stream habitat results

These tables convey the results of the Minnesota Stream Habitat Assessment (MSHA) surveys that are conducted during each fish sampling visit. The MSHA provides information on available fish habitat, land use and buffers along the immediate site reach, providing clues for impacts such as siltation or eutrophication which may lead to unhealthy fish and macroinvertebrate communities. The MSHA score is comprised of numerous scoring categories including land use, riparian zone, instream zone (substrate, embeddedness, cover types and amounts) and channel morphology (depth variability, sinuosity, stability, channel development, velocity) which are summed for a total possible score of 100 points. Total scores for each category and a summation of the total MSHA score are included. Where multiple visits occur at the same station, the relative scores from each visit have been averaged. The final row in each table displays average MSHA scores for each scoring category for that particular sub-watershed. A qualitative habitat rating was then assigned to each station: Good ≥ 66, Fair 45-65, or Poor ≤ 44.

Outlet water chemistry results

These summary tables display the water chemistry results for the intensive watershed station representing the outlet of the HUC-11 watershed. This data can provide valuable insight on water quality characteristics and potential parameters of concern within the watershed. While not all of the water chemistry parameters of interest have developed water quality standards, McCollor and Heiskary (1993) have developed ecoregion expectations for a number of water quality parameters in streams. These ecoregion expectations provide a good basis for evaluating water quality data and estimating attainable water quality for an ecoregion. The ecoregion expectations were based on the 75th percentile from a long term dataset of least impacted streams.

Lake water chemistry

This section provides a summary table including all lakes possessing sufficient data for aquatic recreation use assessments.

HUC-11 and HUC-8 figures

The figures presented for each of the following HUC-11 watershed units contain the assessment results from the most recent assessment cycle, as well as any impairment listings carried forward from previous assessment cycles. Following the results by HUC-11 watershed are a series of figures that provide an overall summary of assessment results by designated use, impaired waters, and fully supporting waters within the entire Mississippi River (St. Cloud) major watershed (HUC-8).

Upper Elk River Watershed Unit HUC 07010203010

The Upper Elk River Watershed Unit is located within the north-central portion of the Mississippi River (St. Cloud) watershed. This watershed unit spans nearly 83 square miles and encompasses a small portion of south-eastern Morrison County and is otherwise solely contained within Benton County. The watershed originates as a series of small channelized tributaries which predominately drain a mixture of rangeland (35.9 percent) and row crop agricultural (44.9 percent) landscapes. From its headwaters, the Elk River flows southerly past the town of Gilbert and the watershed unit ends upstream of the confluence of Mayhew Creek and the Elk River near State Highway 95. In 2009, the MPCA monitored one watershed assessment unit, which encompasses a 27 mile portion of the Elk River as defined below (Table 1).

Table 1. Aquatic life and recreation assessments on stream reaches in the Upper Elk River Watershed Unit. Reaches are organized upstream to downstream in the table.

AUID *Reach Name*, *Reach Description*	Reach Length (miles)	Use Class	Biological Station ID	Location of Biological Station	Aquatic Life Indicators: F-IBI	M-IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides	Bacteria	Aquatic Life	Aquatic Rec.
07010203-508 ***Elk River*** *Headwaters to Mayhew Cr.*	**27.14**	**2B**	09UM001	Downstream of CR 3, 1.5 mi. N of Gilman	EXS	EXS	IF	MTS	--	MTS	MTS	--	EX	NS	NS
			10EM138	Downstream of Little Rock Rd NE, 5.5 mi. NW of Foley											
			09UM004	Upstream of CR 3, 7 mi. NE of St Cloud											
			09UM005	Upstream of 35th St, 6 mi. NE of St Cloud											

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

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

Key for Cell Shading: = previous impairment or deferred impairment prior to 2012 reporting cycle; = new impairment; = full support of designated use.

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

†Reach was assessed based on use class included in table and existing use class as defined in Minn. Rule 7050 is different. MPCA is currently in the process of changing the existing use class for this AUID in rule based on an analysis of the biological community and temperature data.

Table 2. Minnesota Stream Habitat Assessment (MSHA) for the Upper Elk Watershed Unit

Visits	Site ID	Stream 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	09UM001	Elk River	0	8.5	19.6	13	18	59.1	Fair
1	10EM138	Elk River	0	15	21.5	9	32	77.5	Good
1	09UM004	Elk River	0	11	20.3	14	23	68.3	Good
1	09UM005	Elk River	2.5	12.5	18.1	10	22	65.1	Fair
Average Habitat Results: *Upper Elk River Watershed Unit*			0.625	11.75	19.875	11.5	23.75	67.5	Good

Qualitative habitat ratings

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

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

Poor: MSHA score below the median of the most-

Table 3. Outlet water chemistry results for the Upper Elk Watershed Unit

Station Location:	ELK R AT 35TH ST NE, 6.5 MI ENE OF SAUK RAPIDS, MN												
Equis ID:	S005-539												
Station #:	09UM005												
Parameter	DO	E. coli	NH_3	$NO_2 + NO_3$	TKN	pH	TP	TSS	TSVS	Spec. Cond.	Temp	T-tube (100)	T-tube (60)
Units	mg/L		mg/L	mg/L	mg/L	[H+]	mg/L	mg/L	mg/L	uS/cm	°C	cm	cm
# Samples	19.0	15.0	10.0	10.0	10.0	19.0	10.0	10.0	10.0	19.0	19.0	18.0	1.0
Minimum	5.0	26.0	< 0.05	0.1	0.5	6.7	0.1	<1	<1	221.0	13.0	52.0	24.0
Maximum	10.6	2400.0	0.1	0.7	1.3	8.5	0.2	6.4	2.0	446.0	22.6	100.0	24.0
Mean[1]	6.9	419.0	0.1	0.3	0.9	7.5	0.1	2.8	1.5	391.2	18.3	93.7	24.0
Median	6.4	190.0	0.1	0.2	0.9	7.5	0.1	2.4	1.2	414.0	18.0	100.0	24.0
WQ Standard[2]	5.0	126/1260	0.0			6.5-9.0		100.0				20.0	20.0
# WQ Exceedances[3]	0.0	11.0	3.0			0.0		0.0				0.0	0.0
NCHF 75th Percentile[4]			0.2	0.12			0.17	310			24		

[1]Geometric mean of all samples is provided for *E. coli*

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

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

[4]Based on 1970-1992 summer data; see *Selected Water Quality Characteristics of Minimally Impacted Streams from Minnesota's Seven Ecoregions* (McCollor and Heiskary 1993).

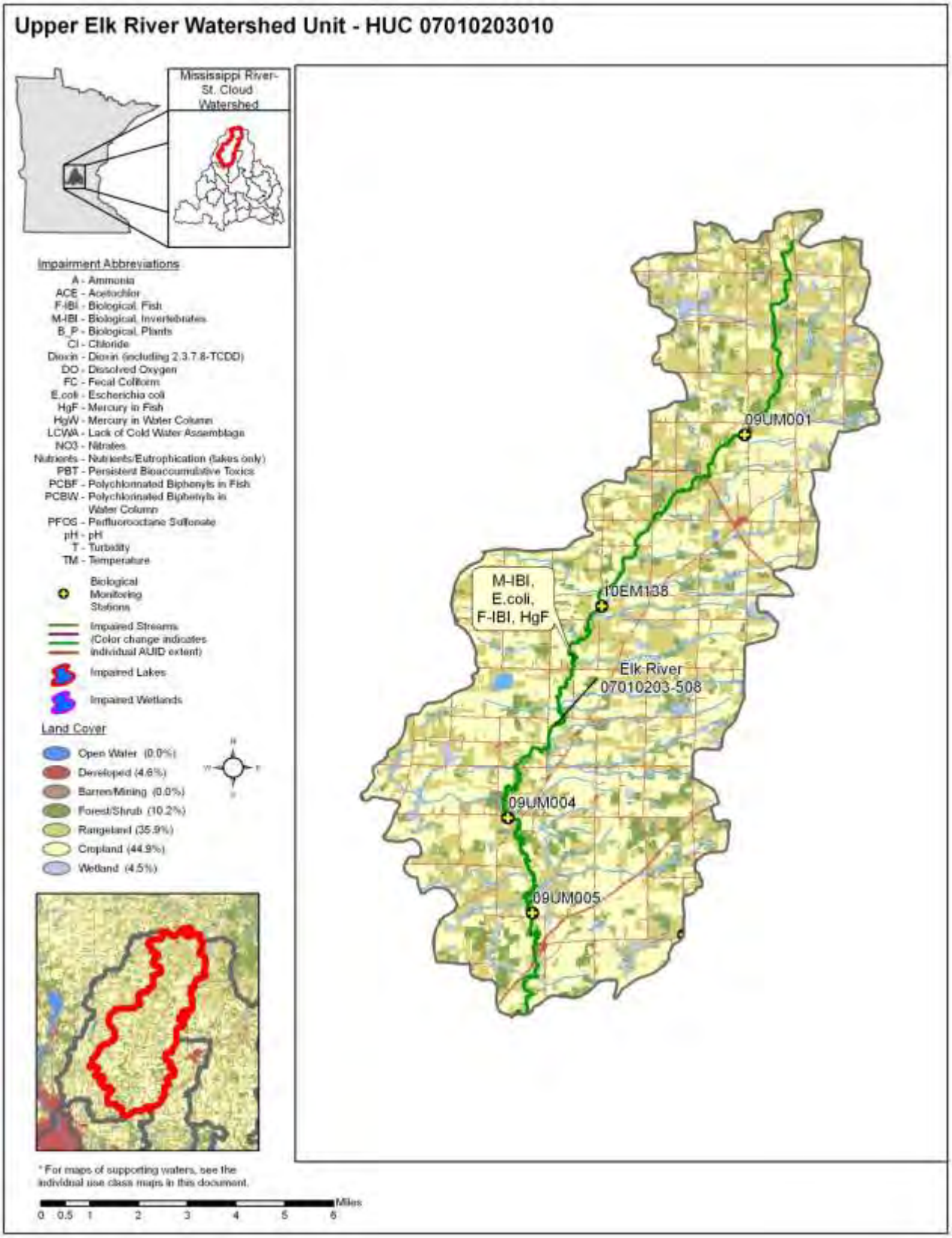
Summary

Within the Upper Elk watershed, one 27 mile long assessment unit (AUID) stretching from the headwaters near Brennyville to the confluence with Mayhew Creek was assessed for aquatic life during the 2011 assessment cycle. The assessment decision resulted in new impairments for the following aquatic life and aquatic recreational use parameters: both biological indicators (aquatic macroinvertebrates and fish) and bacteria (E. coli) (Figure 10). Water chemistry data were insufficient to make an assessment. A fish consumption advisory resulting from elevated concentrations of mercury in fish filets has been in place since 2001.

During the 2009 biological monitoring effort, fish were sampled at four locations, while aquatic macroinvertebrates were sampled from three locations; aquatic macroinvertebrate community data were not available for site 10EM138 during the 2011 assessment cycle. In general, no trends were observed in IBI scores. It is important to note that the fish IBI score for 10EM138 was above the upper confidence interval, which is likely a result of an extensive riparian buffer, numerous habitat types throughout the reach (MSHA = 77) and the presence of several sensitive taxa (e.g. hornyhead chub, blackside darter, rock bass and longnose dace). Similarly, fish and invertebrate IBI scores tended to compliment good habitat scores. Approximately 30 percent (~8 miles) of the upstream portions of the AUID appear to be channelized. The channelization was likely completed to drain wetlands and aid drainage of poorly drained soils in this region (NRCS 2007). Channelization often decreases habitat complexity, which can result in homogenous biological communities often consisting of few and tolerant species (Blann et al. 2009).

From the headwaters to Mayhew Creek, the landscape within the Upper Elk Watershed is largely (86 percent) comprised of disturbed (row crop, rangeland and developed) land uses. Portions of the riparian corridor near the headwaters lack riparian buffer strips; however the middle and downstream portions of the watershed contain extensive buffers, comprised of a mixed forest and grassland habitats. Best management practices for this watershed unit could include riparian buffer restoration, particularly in the upstream portions, through state funded conservation easements and federal conservation programs (e.g. cropland reserve preservation).

Figure 10. Currently listed impaired waters by parameter and land use characteristics in the Upper Elk River Watershed Unit



Mayhew Creek Watershed Unit HUC 7010203020

The Mayhew Creek Watershed Unit encompasses an area of 51 square miles in the northwestern portion of the Mississippi River (St. Cloud) watershed. The watershed unit is solely contained within Benton County. Mayhew Creek originates in a deciduous forest region and flows south through the watershed, which is predominately rangeland (35 percent) and row crop agriculture (43.9 percent). Portions of Mayhew Creek and its contributing tributaries have been channelized to allow water to flow more quickly off the landscape. This may have been done as a result of the poor drainage capabilities of the natural soils in this area (NRCS 2008). In 2009, the MPCA monitored two assessment units within this watershed unit (Figure 11).

Table 4. Aquatic life and recreation assessments on stream reaches in the Mayhew Creek Watershed Unit. Reaches are organized upstream to downstream in the table.

AUID ***Reach Name***, *Reach Description*	Reach Length (miles)	Use Class	Biological Station ID	Location of Biological Station	Aquatic Life Indicators: F-IBI	M-IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides	Bacteria	Aquatic Life	Aquatic Rec.
07010203-675 ***Mayhew Creek*** *Unnamed Creek to CD 7*	**2.13**	**2B**	09UM002	Downstream of 35th Ave., 1 mi. N. of Mayhew	EXS	EXS	--	--	--	--	--	--	--	NS	NA
07010203-509 ***Mayhew Creek*** *Mayhew Lake to Elk River*	**15.42**	**2B**	00UM042 09UM003	Upstream of Hwy 3, 5 mi. E of Sauk Rapids Upstream of CR8, 4.5 mi. E of St. Cloud	NA	NA	EXP	MTS	--	MTS	MTS	--	EX	NA*	NS

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

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

Key for Cell Shading: = previous impairment or deferred impairment prior to 2012 reporting cycle; = new impairment; = full support of designated use.

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

†Reach was assessed based on use class included in table and existing use class as defined in Minn. Rule 7050 is different. MPCA is currently in the process of changing the existing use class for this AUID in rule based on an analysis of the biological community and temperature data.

Table 5. Non-assessed biological stations on channelized AUIDs in the Mayhew Creek Watershed Unit

AUID ***Reach Name,*** *Reach Description*	Reach Length (miles)	Use Class	Biological Station ID	Location of Biological Station	FIBI	MIBI
07010203-509 ***Mayhew Creek*** *Mayhew Lake to Elk River*	**15.42**	**2B**	00UM042	Upstream of Hwy 3, 5 mi. E of Sauk Rapids	Fair (2)	Fair
07010203-509 ***Mayhew Creek*** *Mayhew Lake to Elk River*	**15.42**	**2B**	09UM003	Upstream of CR 8, 4.5 mi. E of St. Cloud	Good	Fair

See Appendix 7 for clarification of the good/fair/poor thresholds and Appendix 8 and Appendix 9 for fish and macroinvertebrate IBI results; respectively. Parentheses indicate the number of visits to a given site and those sites with multiple visits have been averaged to determine the rating depicted in the table. Individual visit ratings for each biological community are reported in Appendix 8 and Appendix 9.

Table 6. Minnesota Stream Habitat Assessment (MSHA) results for Mayhew Creek Watershed Unit

Visits	Site ID	Stream Name	Land Use (0-5)	Riparian (0-15)	Substrate (0-27)	Fish Cover (0-17)	Channel Morph. (0-36)	MSHA Score (0-100)	MSHA Rating
2	00UM042	Mayhew Creek	0	7.5	11	10.5	13	42	Poor
1	09UM003	Mayhew Creek	1	9	20	12	24	66	Fair
1	09UM002	Mayhew Creek	1.25	10	15.6	16	17	59.85	Fair
Average Habitat Results: *Mayhew Creek Watershed Unit*			0.75	8.83	15.53	12.83	18.00	55.95	Fair

Qualitative habitat ratings

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

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

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

Table 7. Outlet water chemistry data for the Mayhew Creek Watershed Unit

Station Location:	MAYHEW CK AT CSAH 8, 4.5 MI E OF ST. CLOUD, MN												
Equis ID:	S002-946												
Station #:	09UM003												
Parameter	DO	E. coli	NH_3	NO_2 + NO_3	TKN	pH	TP	TSS	TSVS	Spec. Cond.	Temp	T-tube (100)	T-tube (60)
Units	mg/L		mg/L	mg/L	mg/L	[H+]	mg/L	mg/L	mg/L	uS/cm	°C	cm	cm
# Samples	19	15	11	11	11	19	11	10	10	19	19	21	2
Minimum	0.48	17	< 0.05	0.09	1.09	6.69	0.09	<1	<1	280	12.5	37	12
Maximum	11	7100	0.07	0.41	1.97	8.02	0.4	4	2.4	429	24.32	100	30
Mean[1]	6.32	1126	0.03	0.22	1.6	7.33	0.21	2.5	1.6	386	19.04	91.9	21
Median	5.93	770	0.025	0.19	1.69	7.35	0.21	2.4	1.6	392	18.92	100	21
WQ Standard[2]	5	126/1260	0.04			6.5-9.0		100				20	20
# WQ Exceedances[3]	8	2	0			0		0				0	1
NCHF 75th Percentile[4]			0.2	0.12			0.17	310			24		

[1]Geometric mean of all samples is provided for *E. coli*
[2]Total suspended solids and Transparency tube standards are surrogate standards derived from the turbidity standard of 25
[3]Represents exceedances of individual maximum standard for E. coli (1260/100mL) or fecal coliform
[4]Based on 1970-1992 summer data; see *Selected Water Quality Characteristics of Minimally Impacted Streams from Minnesota's Seven Ecoregions* (McCollor and Heiskary 1993).

Table 8. Aquatic Recreation Use Assessments (ARUS) for lakes in the Mayhew Creek Watershed Unit

Name	DOW #	Area	Trophic Status	% Littoral	Max. Depth (ft)	Avg. Depth (ft)	CLMP Trend	Mean TP (ug/L)	Mean Chl-a (ug/L)	Mean Secchi (ft)	ARUS
Mayhew	05-0007-00	127	H	50.4	20	4.0	NT	170.9	50.25	2.45	NS

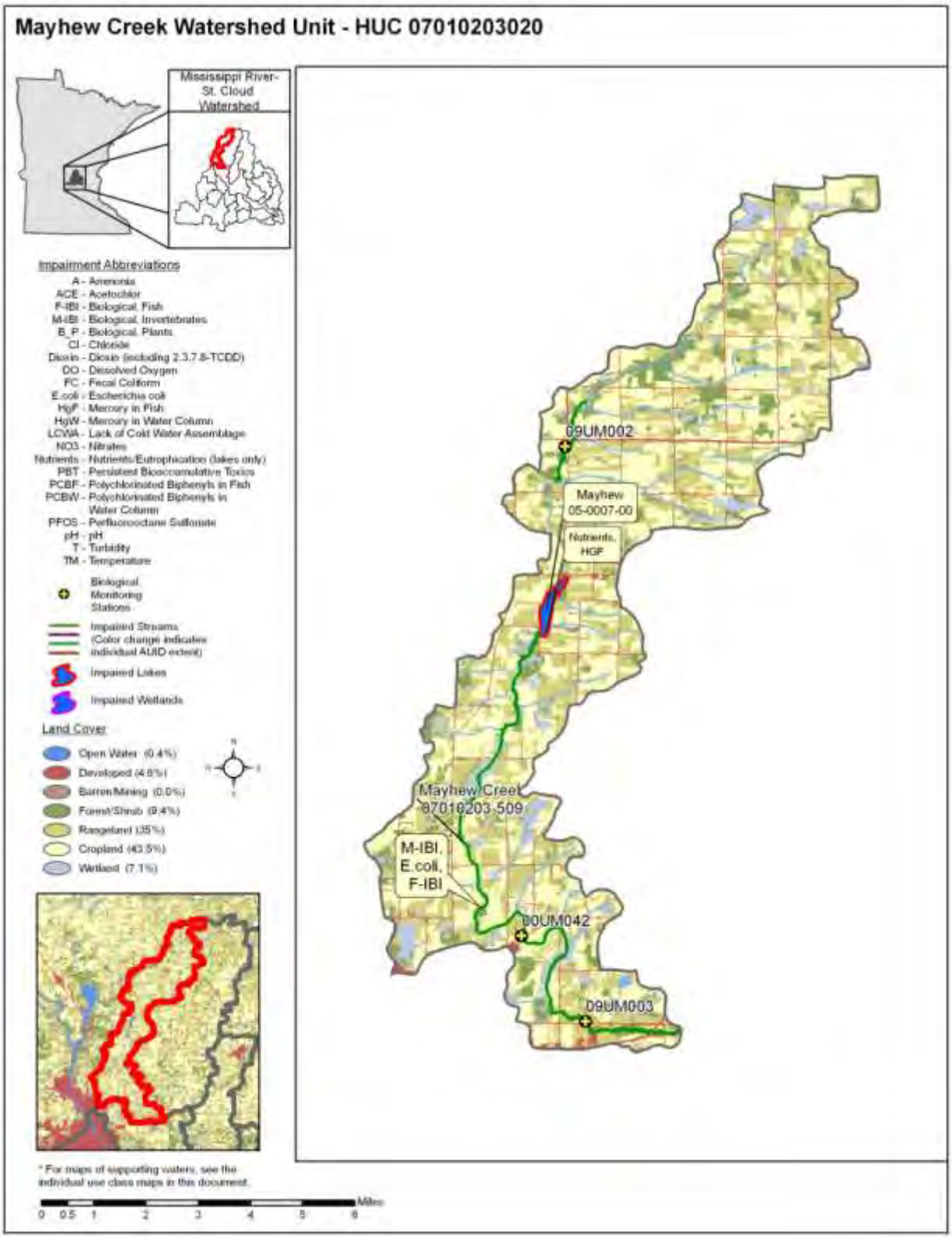
Abbreviations:
↑-- increasing/Improving Trend
↓--Decreasing/Declining Trend
NT – No Trend
H-Hypereutrophic
E – Eutrophic
M – Mesotrophic
O – Oligotrophic
FS—Full Support
NS – Non-Support
IF – Insufficient Information

Summary

During the 2011 assessment cycle, two stream assessment units (AUIDs; 675 and 509) and one lake (Mayhew Lake) were reviewed within the Mayhew Creek watershed unit. Biological data was collected from one sampling location (09UM002) along AUID 675 and two biological monitoring stations were visited in AUID 509. New impairments were identified for both biological parameters (aquatic macroinvertebrates and fish) for AUID 675. Previous impairments for fish (2002) and aquatic macroinvertebrates (2006) were carried forward for AUID 509, however during the current assessment cycle, new impairments for DO were deferred because greater than 50 percent of the AUID was channelized.

Overall, both fish and aquatic macroinvertebrate biological communities were poor. The poor biological performance is consistent with poor to fair stream habitat that was demonstrated by very poor riparian land use scores. Mayhew Lake was determined to be non-supporting for aquatic recreation use due to elevated nutrient concentrations (Table 8). This suggests that Mayhew Lake is a hypereutrophic environment, which is a probable explanation for the low DO concentrations observed downstream of Mayhew Lake and subsequently the poor biological communities observed. The downstream portion of Mayhew Creek exceeded the standards for DO and was determined to be non-supporting for aquatic recreation use due to elevated levels of bacteria (*E. Coli*).

Figure 11. Currently listed impaired waters by parameter and land use characteristics in the Mayhew Creek Watershed Unit



Stony Brook and Rice Creek Watershed Unit HUC 07010203030

The Stony Brook and Rice Creek Watershed Unit encompasses an area of 45.6 square miles and is located in the North-central portion of the Mississippi River (St. Cloud) watershed. Land uses in this watershed unit are characterized by row crop agriculture (44 percent), rangeland (20 percent) and forested areas (15 percent). Stony Brook originates north of the city of Foley and flows southerly into Rice Lake. The outlet of Rice Lake is the headwaters of Rice Creek; the stream flows south and empties into Elk River, west of Elk Lake. Many of the tributaries flowing into Stony Brook and Rice Creek have been channelized and often drain agricultural lands.

Table 9. Aquatic life and recreation assessments on stream reaches in the Stony Brook and Rice Creek Watershed Unit. Reaches are organized upstream to downstream in the table.

AUID ***Reach Name,*** *Reach Description*	Reach Length (miles)	Use Class	Biological Station ID	Location of Biological Station	Aquatic Life Indicators: F-IBI	M-IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides	Bacteria	Aquatic Life	Aquatic Rec.
07010203-546 ***Stony Brook*** *T36 R29W S17*	**10.96**	**2B**	09UM051 09UM007	Upstream of CR 50, 2.5 mi. NW of Duelm Upstream of CR10, 1 mi. S of Duelm	MTS	MTS	--	MTS	--	--	--	--	NA	FS	NA
07010203-512 ***Rice Creek*** *Rice Lake to Elk River*	**7.22**	**2C**	09UM049 09UM009	Upstream of 90th Ave S, 4 mi. NE of Clear Lake Downstream of 57th st SE, 3 mi. NE of Clear Lake	MTS	MTS	EXP	EXP	MTS	MTS	MTS	--	EX	NS	NS

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

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

Key for Cell Shading: = previous impairment or deferred impairment prior to 2012 reporting cycle; = new impairment; = full support of designated use.

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

†Reach was assessed based on use class included in table and existing use class as defined in Minn. Rule 7050 is different. MPCA is currently in the process of changing the existing use class for this AUID in rule based on an analysis of the biological community and temperature data.

Table 10. Non-assessed channelized sites in the Stony Brook and Rice Creek Watershed Unit

AUID *Reach Name*, *Reach Description*	Reach Length (miles)	Use Class	Biological Station ID	Location of Biological Station	Fish IBI	Invert IBI
07010203-685 ***Unnamed Creek*** *Unnamed Creek to Rice Ck*	**2.14**	**2B**	09UM008	Downstream of CR 61, 4 mi. N of Clear Lake	Poor	Fair

See Appendix 7 for clarification of the good/fair/poor thresholds and Appendix 8 and Appendix 9 for fish and macroinvertebrate IBI results; respectively. Parentheses indicate the number of visits to a given site and those sites with multiple visits have been averaged to determine the rating depicted in the table. Individual visit ratings for each biological community are reported in Appendix 8 and Appendix 9.

Table 11. Minnesota Stream Habitat Assessment (MSHA) results for the Stony Brook and Rice Creek Watershed Unit

			Land Use	Riparian	Substrate	Fish Cover	Channel Morph.	MSHA Score	MSHA
Visits	Site ID	Stream Name	(0-5)	(0-15)	(0-27)	(0-17)	(0-36)	(0-100)	Rating
1	09UM050	Stony Brook	2.5	14	3.2	14	13	46.7	Fair
1	09UM051	Stony Brook	2.5	11.5	16	6	22	58	Fair
1	09UM007	Stony Brook	2.5	11	12.8	12	23	62.3	Fair
1	09UM008	Trib. to Rice Creek	2.5	11	4	8	7	32.5	Poor
1	09UM049	Rice Creek	5	14	16.5	13	17	65.5	Fair
1	09UM009	Rice Creek	2.5	13	12.9	12	22	62.4	Fair
Average Habitat Results: *Stony Brook and Rice Creek*			3.0	12.1	12.4	10.2	18.2	56.1	Fair

Qualitative habitat ratings

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

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

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

Table 12. Outlet water chemistry results for the Rice Creek Watershed Unit

Station Location:	RICE CK AT CSAH-16 BRG, 2.5 MI N OF CLEAR LAKE, MN												
Equis ID:	S001-523												
Station #:	09UM009												
Parameter	DO	E. coli	NH_3	NO_{2+} NO_3	TKN	pH	TP	TSS	TSVS	Spec. Cond.	Temp	T-tube (100)	T-tube (60)
Units	mg/L		mg/L	mg/L	mg/L	[H+]	mg/L	mg/L	mg/L	uS/cm	°C	cm	cm
# Samples	26	15	11	11	11	26	11	11	10	26	46	21	40
Minimum	4.2	120	< 0.05	0.68	0.9	6.71	0.064	< 1	< 1	268	8.67	49	14
Maximum	13.9	2400	< 0.05	1.94	1.8	8.63	0.017	37	17	520	24.32	100	60
Mean[1]	7	677.33	-	1.19	1.45	7.7	0.12	12.18	7.4	434.12	18.62	71.86	42.4
Median	6.22	600	-	1.13	1.4	7.74	0.11	10	8	443	18.8	68	42.5
WQ Standard[2]	5	126/1260	0.04			6.5-9.0		100				20	20
# WQ Exceedances[3]	3	14	0			0		0				0	2
NCHF 75th Percentile[4]			0.2	0.12			0.17	310			24		

[1]Geometric mean of all samples is provided for *E. coli*

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

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

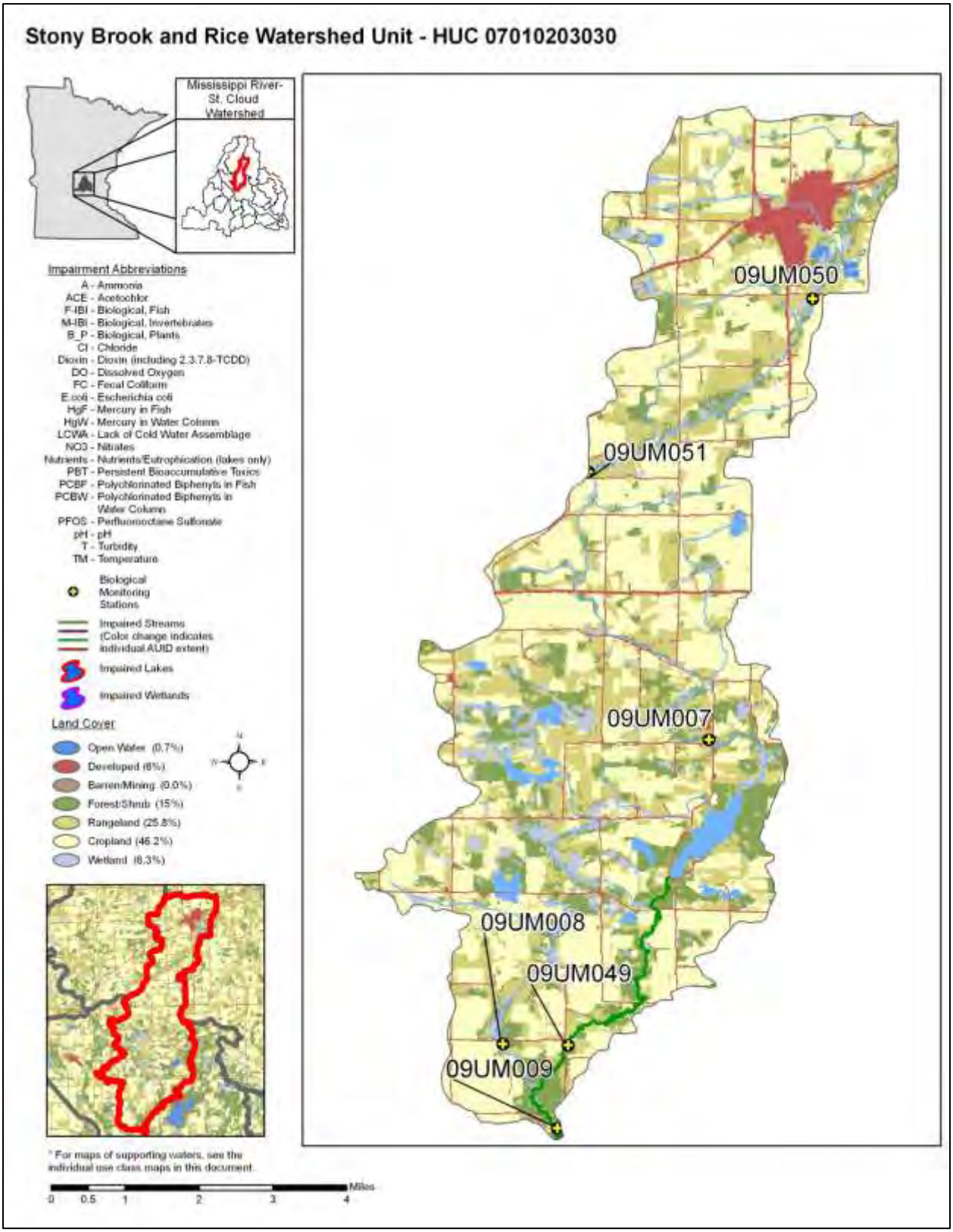
[4]Based on 1970-1992 summer data; see *Selected Water Quality Characteristics of Minimally Impacted Streams from Minnesota's Seven Ecoregions* (McCollor and Heiskary 1993).

Summary

A total of six biological monitoring stations along four assessment units (AUIDs) were reviewed during the 2011 assessment cycle. Dissolved oxygen and turbidity impairments were carried forward for the Rice Creek AUID (512). This AUID was also determined to be impaired for aquatic recreation use due to elevated levels of bacteria (E. coli) (Table 9). The upper reach of Stony Brook (downstream of Foley to just North of County Road 50) was not assessed for aquatic life use or aquatic recreation because at the present time the MPCA does not assess limited resource value waters (class 7 streams). Similarly, AUID 685 was not assessed because the stream at this point is extensively channelized.

In general, the observed biological communities were favorable, in particular the aquatic macroinvertebrate communities from AUIDs 512 and 546 were above average and included several sensitive taxa. Habitat conditions (MSHA scores), F-IBI, and M-IBI all tended to improve in an upstream to downstream manner; although overall habitat scores were generally only fair. A notable habitat characteristic of this watershed is that the riparian habitat was uniformly good across all sites. The two sites that performed very poor biologically (09UM008, 09UM050) had good riparian habitat; however their in-stream habitat was typified by fine substrates and a lack of fish cover. Unnamed tributary (09UM008) to Rice Creek is channelized and the observed habitat score is consistent with other habitat scores from channelized stream reaches.

Figure 12. Currently listed waters by parameters and land use characteristics in the Stony Brook and Rice Creek Watershed Unit



Lower Elk Watershed Unit HUC 07010203040

The Lower Elk Watershed Unit encompasses an area of 130 square miles in the center of the Mississippi River (St. Cloud) watershed in portions of Benton and Sherburne counties. The Lower Elk Watershed Unit is the second largest watershed unit within the Mississippi River (St. Cloud) watershed. The Elk River originates near St. Cloud where it flows south east across several land use types, primarily cropland (36 percent), forest/shrub lands (34 percent), and rangeland (19 percent). In addition, the Elk River flows through several lakes on its course to the Mississippi River near the city of Elk River. These lakes include: Donovan, Elk, and Upper and Lower Orono, respectively. Several other lakes contribute flowage to the Lower Elk River, these include: Big, Briggs, Julia, Mitchell, and Rush. The MPCA monitored eight sites within the Lower Elk Watershed Unit for biology, of these, five occurred on the Elk River proper (Figure 14). The Lower Elk Watershed Unit contains fourteen assessment units (AUIDs).

Table 13. Aquatic life and recreation assessments on stream reaches in the Lower Elk Watershed Unit. Reaches are organized upstream to downstream in the table.

AUID ***Reach Name***, *Reach Description*	Reach Length (miles)	Use Class	Biological Station ID	Location of Biological Station	Aquatic Life Indicators:								Bacteria	Aquatic Life	Aquatic Rec.
					F-IBI	M-IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides			
07010203-507 ***Elk River*** *Mayhwe Cr to Rice Cr*	**15.13**	**2B**	09UM010	Upstream of CR 16, 2.5 mi. N of Clear Lake	MTS	MTS	IF	MTS	--	MTS	--	--	EX	FS	NS
07010203-538 ***Briggs Creek*** *North line to Briggs Lk*	**5.83**	**2B**	00UM043	Upstream of CR 48, 3.5 mi. SW of Santiago	MTS	MTS	--	IF	--	--	--	--	--	FS†	NA
07010203-579 ***Elk River*** *Elk Lk to St. Francis R*	**23.37**	**2B**	10EM084 09UM014 09UM016	Upstream of CR 23, 2.5 mi. N of Becker Downstream of CR 73, 5 mi. SE of Becker Upstream of CR 5, 2 mi. N of Big Lake	EXP	MTS	IF	EXS	--	EXP	--	--	IF	NS	IF
07010203-548 ***Elk River*** *St Francis R to Orono Lk*	**11.75**	**2B**	09UM017	Upstream of CR 15, 2.5 mi. E of Big Lake	MTS	MTS	MTS	MTS	MTS	MTS	MTS	--	EX	FS	NS

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

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

Key for Cell Shading: = previous impairment or deferred impairment prior to 2012 reporting cycle; = new impairment; = full support of designated use.

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

†Reach was assessed based on use class included in table and existing use class as defined in Minn. Rule 7050 is different. MPCA is currently in the process of changing the existing use class for this AUID in rule based on an analysis of the biological community and temperature data.

Table 14. Non-assessed channelized sites in the Lower Elk Watershed Unit

AUID *Reach Name*, *Reach Description*	Reach Length (miles)	Use Class	Biological Station ID	Location of Biological Station	Fish IBI	Invert IBI
07010203-684 ***Unnamed Creek*** *Unnamed Cr to Elk R*	**1.64**	**2B**	09UM006	Upstream of CR 65, 4 mi. E of St. Cloud	Poor	Fair
07010203-689 ***Unnamed Creek*** *Unnamed Cr to Elk R*	**1.59**	**2B**	09UM012	Downstream of CR 67, 2.5 mi. N of Becker	Poor	Good

See Appendix 7 for clarification of the good/fair/poor thresholds and Appendix 8 and Appendix 9 for fish and macroinvertebrate IBI results; respectively. Parentheses indicate the number of visits to a given site and those sites with multiple visits have been averaged to determine the rating depicted in the table. Individual visit ratings for each biological community are reported in Appendix 8 and Appendix 9.

Table 15. Minnesota Stream Habitat Assessment (MSHA) results for the Lower Elk Watershed Unit

			Land Use	Riparian	Substrate	Fish Cover	Channel Morph.	MSHA Score	MSHA
Visits	Site ID	Stream Name	(0-5)	(0-15)	(0-27)	(0-17)	(0-36)	(0-100)	Rating
1	09UM006	Trib. To Elk River	0	10	14.3	13	17	54.3	Fair
2	00UM043	Briggs Creek	2.9	9.25	9.2	12.5	20	53.9	Fair
2	10EM084	Elk River	3	13.25	17.8	12	24	70.1	Good
1	09UM014	Elk River	3.5	14	15.5	15	22	70	Good
1	09UM016	Elk River	3.5	9.5	17.7	16	21	67.7	Good
1	09UM012	Trib. To Elk River	0	11	9	12	11	43	Poor
2	09UM017	Elk River	3.5	11.75	19.8	14	27.5	76.5	Good
Average Habitat Results*: Lower Elk River*			2.3	11.3	14.8	13.5	20.4	62.2	Fair

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

Table 16. Outlet water chemistry results for the Lower Elk Watershed Unit

Station Location:	ELK RIVER CSAH-15, 3.9 MI E OF BIG LAKE, MN												
Equis ID:	S000-278												
Station #:	09UM017												
Parameter	DO	E. coli	NH_3	NO_{2+} NO_3	TKN	pH	TP	TSS	TSVS	Spec. Cond.	Temp	T-tube (100)	T-tube (60)
Units	mg/L		mg/L	mg/L	mg/L	$[H^+]$	mg/L	mg/L	mg/L	uS/cm	°C	cm	cm
# Samples	29	17	17	20	20	29	20	20	16	29	29	38	18
Minimum	6.35	14	< 0.05	0.12	0.48	7.6	0.039	2	1.6	293	11.28	25	33
Maximum	16.35	1400	0.11	0.78	1.97	8.9	0.2	32	17	791	26.25	100	60
Mean[1]	9.58	208.35	0.028	0.42	1.06	8.22	0.09	11.97	7.74	391.28	20.43	82.05	52.89
Median	9.06	67	0	0.38	1.08	8.12	0.09	11	6.8	386	21.13	92	55.5
WQ Standard[2]	5	126/1260	0.04			6.5-9.0		100				20	20
# WQ Exceedances[3]	0	3	1			0		0				0	0
NCHF 75th Percentile[4]			0.2	0.12			0.17	5.6		310	24		

[1]Geometric mean of all samples is provided for *E. coli*

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

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

[4]Based on 1970-1992 summer data; see *Selected Water Quality Characteristics of Minimally Impacted Streams from Minnesota's Seven Ecoregions* (McCollor and Heiskary 1993).

Table 17. Aquatic Recreation Use Assessment (ARUS) for lakes in the Lower Elk Watershed Unit

Name	DOW #	Area	Trophic Status	% Littoral	Max. Depth (ft)	Avg. Depth (ft)	CLMP Trend	Mean TP (ug/L)	Mean Chl-a (ug/L)	Mean Secchi (ft)	ARUS
Donovan	05-0004-02	0	H	0	5	0.9	--	137.12	52.53	1.02	NS
Upper Orono	71-0013-01	300	H	0	17	1.5	↑	132.32	23.08	0.81	NS
Lower Orono	71-0013-02	0	H	0	17	1.5	↑	112.22	31.95	0.79	NS
Mitchell	71-0081-00	156	M	65	33	4.8	NT	18.89	5.51	2.74	FS
Big	71-0082-00	241	M	44	48	5.1	NT	18.37	5.54	2.9	FS
Thompson	71-0096-00	100	M	65.8	22	--	NT	19.55	6.34	2.71	FS
Camp	71-0123-00	83	M	69.8	34	--	↑	17.18	4.82	2.87	FS
Elk	71-0141-00	352	H	100	8	1.6	NT	154.74	66.24	0.55	NS
Julia	71-0145-00	137	E	100	12	2.4	NT	65.17	27.29	0.66	NS
Briggs	71-0146-00	406	H	55.9	20	3.9	NT	97.21	49.39	0.98	NS
Rush	71-0147-00	161	H	100	12	1.7	NT	104.31	58.75	0.54	NS

Abbreviations:

↑-- increasing/Improving Trend
↓--Decreasing/Declining Trend
NT – No Trend

H-Hypereutrophic
E – Eutrophic
M – Mesotrophic
O – Oligotrophic

FS—Full Support
NS – Non-Support
IF – Insufficient Information

Summary

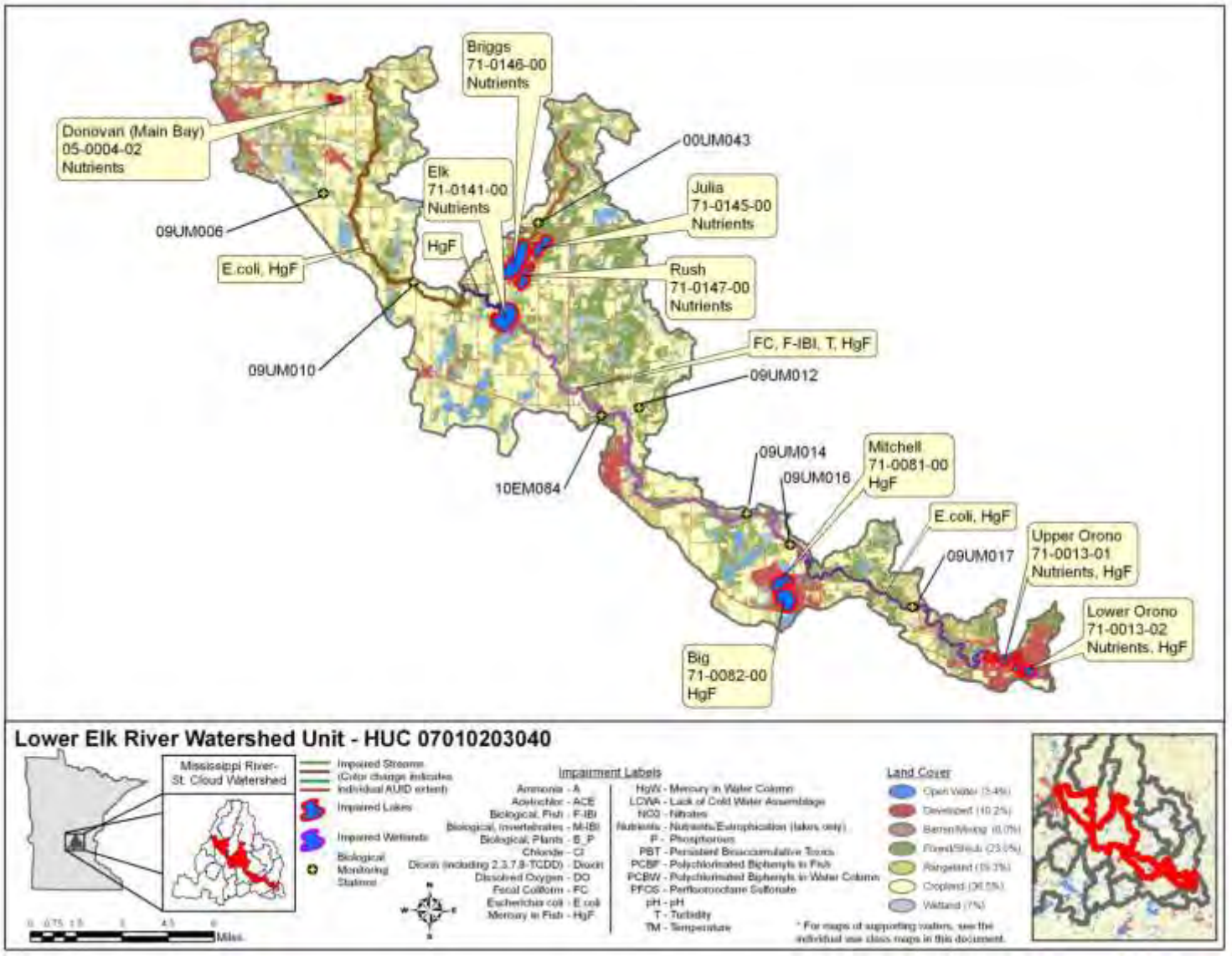
During the 2011 assessment cycle, 6 of the 14 assessment units (AUIDs) were reviewed for aquatic life and aquatic recreational uses (Table 13). Assessment units within the Lower Elk Watershed Unit ranged in length of 0.54 to 23.4 square miles. New impairments within this watershed unit include one aquatic life use impairment based on biological data (fish) for AUID 579 and two aquatic recreational use impairments for AUIDs 507 and 548. In addition, the turbidity impairment, initially listed in 2008 was carried forward for AUID 579. Two AUIDs (684 and 689) were not assessed during this cycle as the biological monitoring stations were channelized (Table 14).

A total of eight biological monitoring stations along six AUIDs were visited in 2009. With the exception of the Elk River between Elk Lake and the St. Francis River (AUID 579), biological communities throughout the Lower Elk River Watershed Unit were favorable (Table 13). The impaired segment between Elk Lake and the St. Francis River (AUID 579) does not meet goals for both F-IBI and turbidity. Previous aquatic macroinvertebrate impairment on this segment was removed based on new aquatic macroinvertebrate community data. The previous impairment, initially listed in 2006 was based upon data collected in 1999. The good biology found throughout most of the Elk River main stem corresponds with generally good habitat conditions. Tributary streams in this watershed were generally worse in terms of habitat and biology. This may be due in part to the extensive channelization that has occurred in headwater streams. Two surveys conducted on channelized tributary streams to the Elk River indicated that fish communities were in poor condition. It is probable that the channelization in the tributaries is having an impact on the fish communities in the main stem Elk River by negatively impacting habitat for spawning of sensitive fish species allowing those fish species with less specific spawning preferences to dominate.

Assessable stream water quality data was available on four reaches of the Elk River and a six mile reach of Briggs Creek (Figure 13). Each of the Elk River reaches were previously listed for mercury concentrations in fish fillets. The lower and upper portions of the Elk River were determined to be non-supporting of aquatic recreation uses due to elevated levels of bacteria (E. coli) on two AUIDs (507 and 548). The only exceedances of a chemical standard for turbidity and pH occurred on the portion of the Elk River that was impaired based on the fish communities (AUID 579). Briggs Creek was determined to be a warm-water stream following discussions with MDNR therefore the creek was assessed using the applicable class 2B (warm water) standards. The six mile reach was assessed as fully support for turbidity.

The Lower Elk River Watershed unit consists of 18 lakes greater than four hectares (~10 acres) of which, 11 were assessed for aquatic recreation use (Table 17). A majority of the lakes in this watershed unit are shallow basins and are evenly distributed throughout the Lower Elk River. Lakes that consisted of small catchment watersheds and received little contribution from the watershed unit (Mitchell, Big, Thompson, and Camp) were fully supporting of aquatic recreation use. Donovan and Julia were exceptions, as each received minimal catchment contribution but both were listed as impaired for aquatic recreation use due to excess nutrients. Additionally, the upper and lower basins of Orono, Elk, Briggs, and Rush were also determined to be impaired for aquatic recreation use due to excess nutrients. Land use north of the Elk River appears to be a greater mixture of forest, rangeland, and cropland. South of the Elk River land use is more dominated by cropland (Figure 13). All of the lakes determined to be impaired were previously listed in the 2008 assessment cycle. These present data further support the initial listings.

Figure 13. Currently listed waters by parameter and land use characteristics in the Lower Elk River Watershed Unit



Snake River Watershed Unit HUC 07010203050

The Snake River Watershed Unit encompasses an area of 43 square miles and is located in the east-central portion of the Mississippi River (St. Cloud) watershed. The Snake River Watershed Unit is contained entirely within Sherburne County. The headwaters of the Snake River arise from wetlands, and as the Snake River flows south, the landscape becomes dominated by forested/shrub lands (39.1 percent) and agriculture (28.9 percent) (Figure 14). The Snake River is a designated trout stream (use class 2A) and was actively managed as a put and take fishery for brown trout from 1972-1979. Since 1979 brown trout have not been stocked in the Snake River. Several lakes are present within the watershed unit, some of these include: Ann, Big Mud, Eagle, and Jim. Aerial imagery indicates that large portions of the Snake River and the contributing tributaries have been channelized. Between 2007 and 2009 the MPCA actively monitored three stations for biology within this watershed unit. However, due to the channelization, assessments were deferred.

Table 18. Aquatic life and recreation assessments on stream reaches in the Snake River Watershed Unit. Reaches are organized upstream to downstream in the table.

AUID ***Reach Name***, *Reach Description*	Reach Length (miles)	Use Class	Biological Station ID	Location of Biological Station	Aquatic Life Indicators:								Bacteria	Aquatic Life	Aquatic Rec.
					F-IBI	M-IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides			
07010203-529 ***Snake River*** *Unnamed Cr to Eagle Lk Outlet*	**2.84**	**2A**	09UM013	Upstream of 185th Ave, 5 mi. E of Becker	NA	NA	IF	MTS	--	MTS	--	--	EX	IF*	NS

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

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

Key for Cell Shading: = previous impairment or deferred impairment prior to 2012 reporting cycle; = new impairment; = full support of designated use.

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

†Reach was assessed based on use class included in table and existing use class as defined in Minn. Rule 7050 is different. MPCA is currently in the process of changing the existing use class for this AUID in rule based on an analysis of the biological community and temperature data.

Table 19. Non-assessed channelized sites in the Snake River Watershed Unit

AUID ***Name***, *Description*	***Reach*** *Reach*	Reach Length (miles)	Use Class	Biological Station ID	Location of Biological Station	Fish IBI	Invert IBI
07010203-558 ***Snake River*** *Headwaters to Unnamed Cr*		**11.41**	**2A**	07UM092 09UM026	Upstream of 112th St, 4 mi. E of Becker Downstream of 87th St SE, 4.5 mi. NE of Becker	Good	Good
07010203-529 ***Snake River*** *Unnamed Cr to Eagle Lk Outlet*		**2.84**	**2A**	09UM013	Upstream of 185th Ave, 5 mi. E of Becker	Good	Good

See Appendix 7 for clarification of the good/fair/poor thresholds and Appendix 8 and Appendix 9 for fish and macroinvertebrate IBI results; respectively. Parentheses indicate the number of visits to a given site and those sites with multiple visits have been averaged to determine the rating depicted in the table. Individual visit ratings for each biological community are reported in Appendix 8 and Appendix 9.

Table 20. Minnesota Stream Habitat Assessment (MSHA) results for the Snake River Watershed Unit

			Land Use	Riparian	Substrate	Fish Cover	Channel Morph.	MSHA Score	MSHA
Visits	**Site ID**	**Stream Name**	**(0-5)**	**(0-15)**	**(0-27)**	**(0-17)**	**(0-36)**	**(0-100)**	**Rating**
1	09UM026	Snake River	3.75	10	12.75	12	10	48.5	Fair
2	07UM092	Snake River	3.75	10.75	16.85	12	20	63.35	Fair
2	09UM013	Snake River	4	11.25	9.25	14.5	11	50	Fair
Average Habitat Results*: Snake River*			3.8	10.7	13.0	12.8	13.7	54.0	Fair

Qualitative habitat ratings

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

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

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

Table 21. Outlet water chemistry results for the Snake River Watershed Unit

Station Location:	SNAKE R AT 185TH AVE, 4 MI NNW OF BIG LAKE, MN												
Equis ID:	S003-006												
Station #:	09UM013												
Parameter	DO	E. coli	NH_3	NO_{2+} NO_3	TKN	pH	TP	TSS	TSVS	Spec. Cond.	Temp	T-tube (100)	T-tube (60)
Units	mg/L		mg/L	mg/L	mg/L	$[H^+]$	mg/L	mg/L	mg/L	uS/cm	°C	cm	cm
# Samples	31	19	13	11	11	31	11	11	1	31	31	9	20
Minimum	3.4	5.3	< 0.05	1.17	0.4	7	0.04	<1	7	282	6.96	67	>60
Maximum	12.14	1413.6	< 0.05	1.73	1.1	8.58	0.9	14	7	448	20.97	100	>60
Mean[1]	9.77	407.58		1.52	0.69	8.11	0.13	5		428.45	15.98	95.22	
Median	9.69	272		1.56	0.6	8.13	0.06	4		432	15.81	100	
WQ Standard[2]	7	126/1260				6.5-9.0		100				20	20
# WQ Exceedances[3]	1	10				0		0				0	0
NCHF 75th Percentile[4]			0.2	0.12			0.17	310			24		

[1]Geometric mean of all samples is provided for *E. coli*

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

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

[4]Based on 1970-1992 summer data; see *Selected Water Quality Characteristics of Minimally Impacted Streams from Minnesota's Seven Ecoregions* (McCollor and Heiskary 1993).

Table 22. Aquatic Recreational Use Assessment (ARUS) for lakes in the Snake River Watershed Unit

Name	DOW #	Area	Trophic Status	% Littoral	Max. Depth (ft)	Avg. Depth (ft)	CLMP Trend	Mean TP (ug/L)	Mean Chl-a (ug/L)	Mean Secchi (ft)	ARUS
Eagle	71-0067-00	426	E	86.8	18	3.2	NT	51.42	21.17	0.85	IF
Ann	71-0069-00	226	M	75	26	2.0	NT	20.67	4.75	2.99	FS

Abbreviations:

↑-- increasing/Improving Trend
↓--Decreasing/Declining Trend
NT – No Trend

H-Hypereutrophic
E – Eutrophic
M – Mesotrophic
O – Oligotrophic

FS—Full Support
NS – Non-Support
IF – Insufficient Information

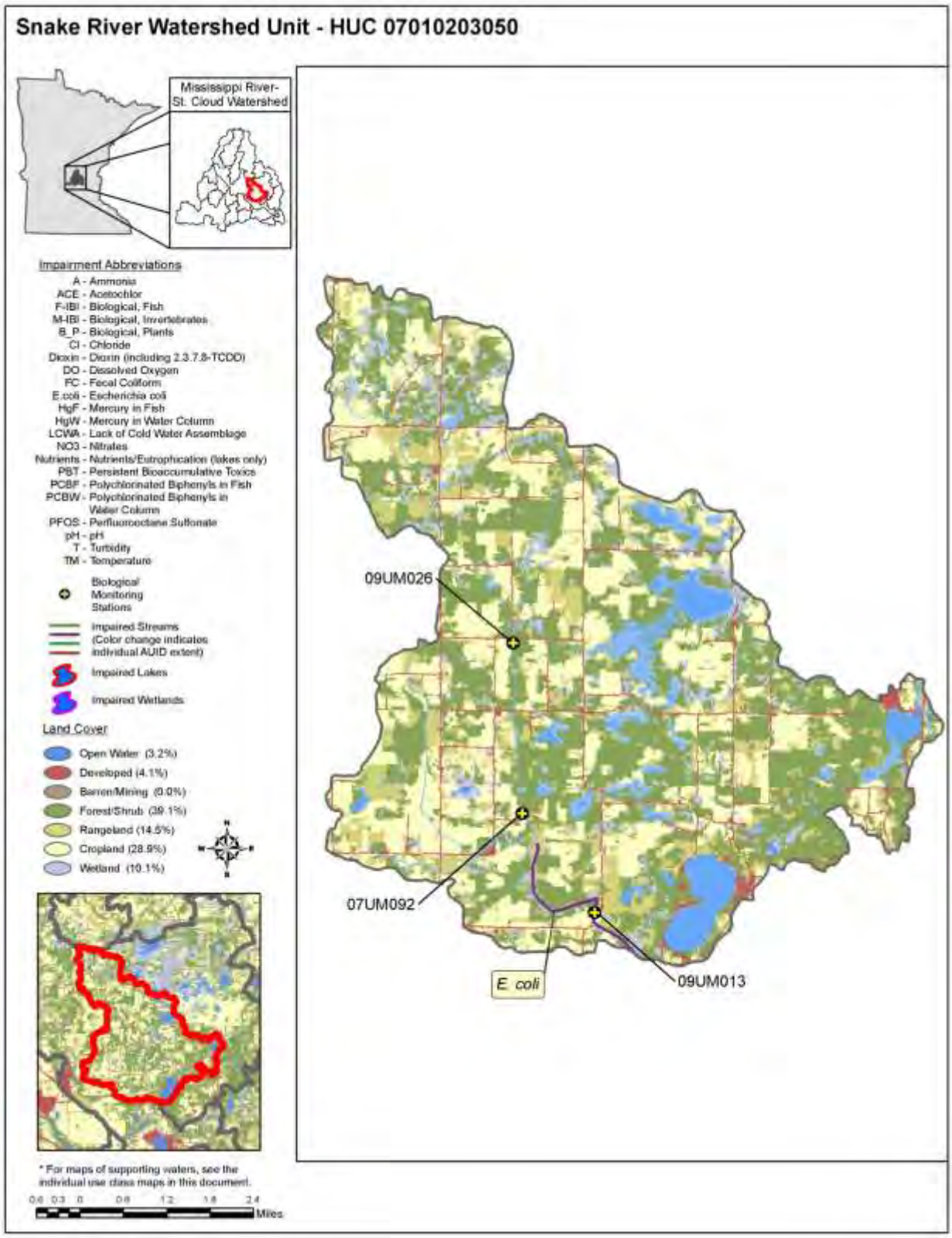
Summary

During the 2011 assessment cycle three assessment units (AUIDs) were reviewed for aquatic life and aquatic recreational use (Table 18). Two of these AUIDs (529 and 558) are channelized and therefore were not assessed for aquatic life use during the present cycle (Table 18). An unnamed creek from the outlet of Eagle Lake to the Snake River (AUID 692) did not have sufficient data for an assessment. Two biological monitoring stations (09UM026 and 09UM013) were visited in 2009 and one station was visited in 2007 (07UM092). It is important to note that all biological monitoring stations from both channelized AUIDs (529 and 558) support favorable biological communities (Table 19). This likely results from the preponderance of sensitive biological communities observed at these stations. Sensitive fish species included blacknose shiner, Iowa dater, longnose dace, and mottled sculpin; while sensitive macroinvertebrate taxa included *Brachycentrus*, *Isoperla*, *Oecetis*, and *Ptilosotmis*. Secondly, habitat conditions observed at all sites are characterized as marginal, which is likely attributed to the associated channelization (Table 20). Substrate types from all stations were composed mainly of sand, silt, and detritus with subtle amounts of gravel (only at 09UM026). Similarly, all sites observed poor channel morphology, resulting from a lack a sinuosity, pool width verse riffle width and depth variability. Therefore the marginal habitat ratings are consistent with the diminished habitats observed. Although habitat conditions are marginal, the biological community is favorable and likely mitigated by the stable flow regime and cold/cool water temperatures observed (09UM013 July average temperature = 18.0ºC). Therefore further restoration and conservation easements should be obtained to maintain this resource.

The Snake River Watershed Unit consists of 14 lakes greater than four hectares (10 acres) of which, two were assessed for aquatic recreation use (Table 22). A majority of the lakes in this watershed unit are small shallow basins and are primarily located in the eastern portion of the Snake River watershed unit. Two of the larger lakes, Eagle and Ann, did have enough data to allow for an assessment to be completed. Eagle Lake, which received contributions from several tributaries and smaller bodies of water, was determined to be impaired for aquatic recreation use (excess nutrients). Additionally, Eagle Lake is likely subject to internal nutrient loading due to intermittent mixing during the summer months. Ann Lake, a smaller deeper lake with a smaller catchment area, was fully supporting of aquatic recreation use. While a majority of the land use within the Snake River watershed unit consisted of undisturbed forest, a reduction in external nutrient loading would still prove beneficial (Figure 14).

A three mile AUID of the Snake River (AUID 529), extending north from the Eagle Lake outlet was determined to be non-supporting for aquatic recreation use due to the number bacterial (*E. coli*) exceedances. The remaining two AUIDs were not assessed due to channelization (558) and insufficient data (592).

Figure 14. Currently listed waters by parameter with associated land use characteristics for the Snake River Watershed Unit



Upper St. Francis River Watershed Unit HUC 07010203060

The Upper St. Francis River Watershed Unit encompasses approximately 96 square miles, making it the third largest watershed unit within the Mississippi River (St. Cloud) watershed. Much of the watershed unit is contained within Benton County, while the southern tip of the watershed unit encompasses portions of Sherburne County. The St. Francis River originates as a series of channelized tributaries in the northern portions of the watershed where the majority of the remaining forested areas are located (Figure 15). Proceeding southerly from its headwaters, the St. Francis River crosses a landscape that is predominately agricultural and range lands. The watershed unit ends at the confluence of the St. Francis River and County Ditch 22 (Figure 15). Disturbed lands (agriculture + rangeland + developed lands) account for 81 percent of the landscape within this watershed unit. There are a few small lakes within the watershed unit, however many are small and did not contain data for assessments.

Table 23. Aquatic Life and Recreation Assessments on Stream Reaches in the Upper St. Francis River Watershed Unit. Reaches are organized upstream to downstream in the table.

AUID ***Reach Name***, *Reach Description*	Reach Length (miles)	Use Class	Biological Station ID	Location of Biological Station	Aquatic Life Indicators: F-IBI	M-IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides	Bacteria	Aquatic Life	Aquatic Rec.
07010203-700 ***St. Francis R*** *Headwaters to Unnamed Lk (71-0371-00)*	**41.12**	**2B**	09UM037 09UM038 09UM035	Upstream of CR 52, 2.5 mi. NE of Foley Downstream of Ronneby Rd, 3 mi. SE of Foley Upstream of 173rd Ave, 1 mi. E of Santiago	EXP	EXP	IF	MTS		MTS	MTS		EX	NS	NS

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

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

Key for Cell Shading: = previous impairment or deferred impairment prior to 2012 reporting cycle; = new impairment; = full support of designated use.

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

†Reach was assessed based on use class included in table and existing use class as defined in Minn. Rule 7050 is different. MPCA is currently in the process of changing the existing use class for this AUID in rule based on an analysis of the biological community and temperature data.

Table 24. Non-assessed channelized sites in the Upper St. Francis River Watershed Unit

AUD *Reach Name*, *Reach Description*	Reach Length (miles)	Use Class	Biological Station ID	Location of Biological Station	Fish IBI	Invert IBI
07010203-693 ***West Branch St. Francis R*** *Unnamed Cr to St. Francis R*	**1.08**	**2B**	09UM036	Upstream of CR 52, 2 mi. NE of Foley	Fair	Poor
07010203-614 ***Unnamed Creek*** *Unnamed Cr to Unnamed Cr*	**0.62**	**2B**	07UM079	Upstream of CR 51, 5 mi. E of Foley	Poor	Fair
07010203-694 ***County Ditch 13*** *Unnamed ditch to St. Francis R*	**0.8**	**2B**	09UM039	Downstream of 7th Ave, 1.5 mi. N of Santiago	Poor	--
07010203-695 ***County Ditch 22*** *Headwaters to St. Francis R*	**3.74**	**2B**	09UM040	Upstream of CR 11, 2mi. S of Santiago	Poor	--

See Appendix 7 for clarification of the good/fair/poor thresholds and Appendix 8 and Appendix 9 for fish and macroinvertebrate IBI results; respectively. Parentheses indicate the number of visits to a given site and those sites with multiple visits have been averaged to determine the rating depicted in the table. Individual visit ratings for each biological community are reported in Appendix 8 and Appendix 9.

Table 25. Minnesota Stream Habitat Assessment (MSHA) results for the Upper St. Francis River Watershed Unit

			Land Use	Riparian	Substrate	Fish Cover	Channel Morph.	MSHA Score	MSHA
Visits	**Site ID**	**Stream Name**	**(0-5)**	**(0-15)**	**(0-27)**	**(0-17)**	**(0-36)**	**(0-100)**	**Rating**
1	09UM036	St. Francis River, West Branch	0	11	20.6	16	20	67.6	Good
1	09UM037	St. Francis River	0	11	18.5	16	24	69.5	Good
1	09UM038	St. Francis River	2.5	10	18.3	12	21	63.8	Good
2	07UM079	County Ditch 14	2.5	11	10.8	12	7.5	43.8	Fair
1	09UM039	County Ditch 13	0	11	10.9	12	22	55.9	Fair
1	09UM035	St. Francis River	1.25	9	21	12	24	67.25	Good
1	09UM040	County Ditch 22	5	12	9	7	5	38	Poor
Average Habitat Results*: Upper St. Francis River*			1.6	10.7	15.6	12.4	17.6	58.0	Fair

Qualitative habitat ratings

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

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

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

Table 26. Outlet water chemistry results for Upper St. Francis Watershed Unit

Station Location:	ST. FRANCIS R AT 173RD AVE, 9.7 MI SE OF FOLEY, MN												
Equis ID:	S005-582												
Station #:	09UM035												
Parameter	DO	E. coli	NH_3	NO_{2+} NO_3	TKN	pH	TP	TSS	TSVS	Spec. Cond.	Temp.	T-tube (100)	T-tube (60)
Units	mg/L		mg/L	mg/L	mg/L	$[H^+]$	mg/L	mg/L	mg/L	uS/cm	°C	cm	cm
# Samples	19	15	10	10	10	19	10	10	10	19	19	19	
Minimum	5.49	48	< 0.05	0.94	0.65	6.7	0.04	1.2	<1	169	14.1	54	
Maximum	10.76	490	< 0.05	4.9	1.66	8.38	0.19	65	32	442	24.04	100	
Mean[1]	7.69	249.47		3.22	0.95	7.53	0.07	8.38	6.47	385.74	19.3	93.95	
Median	7.28	260		3.45	0.9	7.54	0.05	2	1.4	415	19.6	100	
WQ Standard[2]	5	126/1260				6.5-9.0		100				20	20
# WQ Exceedances[3]	0	12				0		0				0	
NCHF 75th Percentile[4]			0.2	0.12			0.17	310			24		

[1]Geometric mean of all samples is provided for *E. coli*

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

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

[4]Based on 1970-1992 summer data; see *Selected Water Quality Characteristics of Minimally Impacted Streams from Minnesota's Seven Ecoregions* (McCollor and Heiskary 1993).

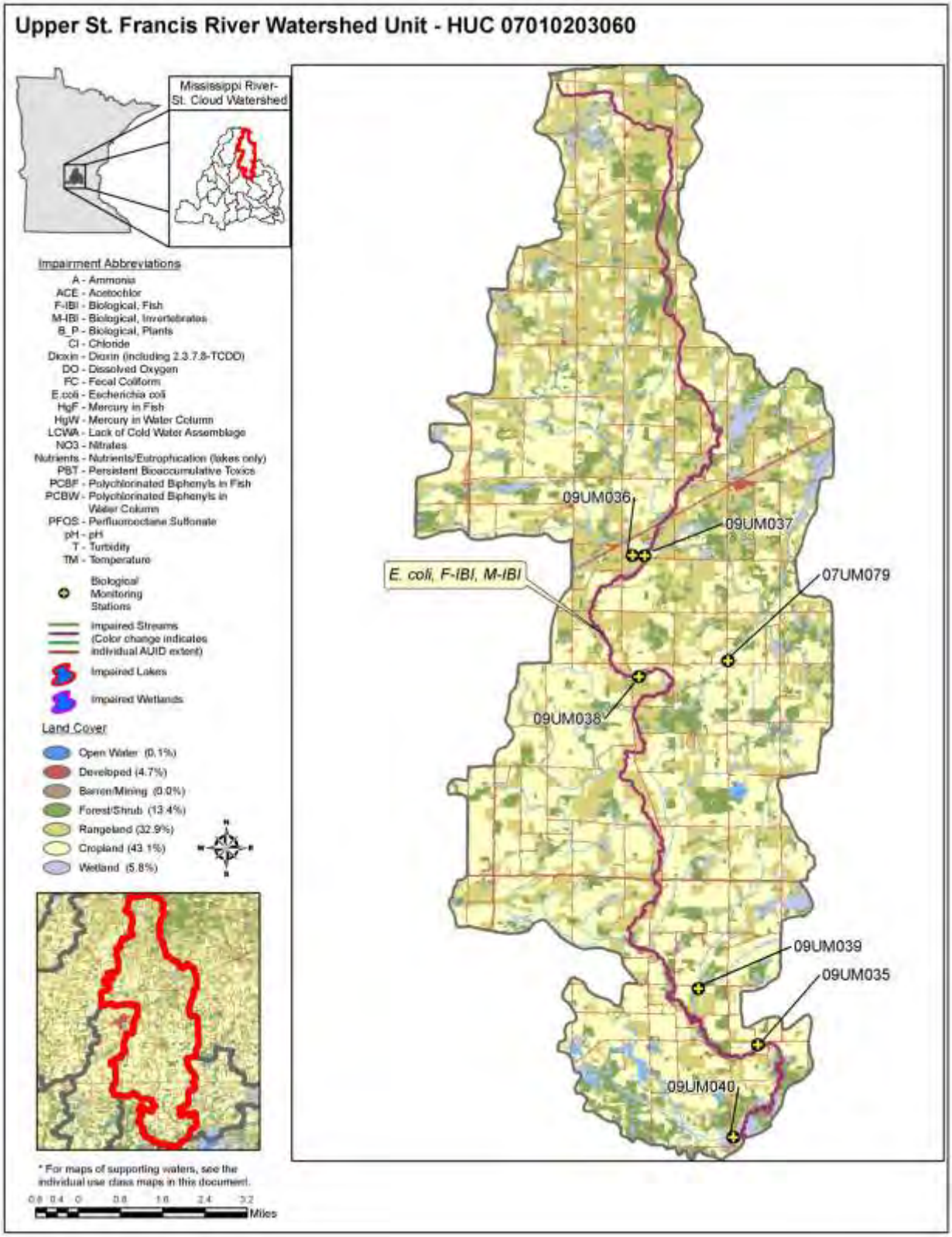
Summary

During the 2011 assessment cycle, five assessment units (AUIDs) were available for aquatic life use and aquatic recreation use review within the Upper St. Francis Watershed Unit. Of the available AUIDs, a 41 mile segment of the St. Francis River AUID (700) was assessed for aquatic life and recreational uses (Table 23). The other four AUIDs (693, 614, 694, and 694) were channelized, thus aquatic life use recommendations were deferred. New impairments for aquatic life use (fish and aquatic macroinvertebrates) and aquatic recreational uses were found in the St. Francis River (Table 23). There were no previous impairments for the AUIDs within this watershed unit.

Biological data was collected from seven stations; all stations were sampled in 2009. Three biological monitoring stations occurred along AUID 700 (09UM037, 09UM038, and 09UM035). In general biological communities were poor across all locations within this watershed unit. However, station 09UM038 along AUID 700 provided the most favorable fish community, likely due to the presence of several sensitive species and the overall taxa richness. The poor biological communities were characterized by low taxa richness and over dominance by tolerant taxa. Average habitat scores across all sites were fair, with several site obtaining good scores. Many of the good habitat scores were from the St. Francis River, where biological communities were most favorable. However, the channelized stream observed poor to fair habitat scores and contained marginal biological communities (Appendix 8 and 9).

Assessable stream water quality data was limited to one 41 mile long portion of the St. Francis River, extending from the headwaters to an unnamed lake (71-0371-00). Insufficient dissolved oxygen measurements did not allow for an assessment of this parameter (Table 26). The turbidity dataset did not indicate impairment. Additionally, this reach was determined to be non-supporting of recreational activities due to bacterial (*E. coli*) exceedances (Figure 15).

Figure 15. Currently listed waters by parameter with associated land use characteristics for the Upper St. Francis River Watershed Unit



Battle Brook Watershed Unit HUC 07010203070

The Battle Brook Watershed Unit is located within the north-eastern portion of the Mississippi River (St. Cloud) watershed. This watershed unit encompasses an area of approximately 53 square miles and spans three counties (Benton, Mille Lacs, and Sherburne). Predominant land uses are agriculture (38.9 percent), forest/shrub land (19.5 percent), rangeland (18.5 percent) and wetland (15.6 percent). Battle Brook originates in the north-western portion of the watershed unit, and is largely channelized. Near the headwaters Battle Brook drains agricultural lands, where it flows east through a large wetland complex prior to flowing past Rice Lake (48-0010-00). From Rice Lake, Battle Brook begins to flow south-east where it empties into Elk Lake (71-0055-00) and ultimately empties into the St. Francis River, approximately 1 mile downstream of Elk Lake.

Table 27. Aquatc Life and Recreation Assessments on Stream Reaches in the Battle Brook Watershed Unit. Reaches are organized upstream to downstream in the table.

AUID ***Reach Name,*** *Reach Description*	Reach Length (miles)	Use Class	Biological Station ID	Location of Biological Station	Aquatic Life Indicators: F-IBI	M-IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides	Bacteria	Aquatic Life	Aquatic Rec.
07010203-535 ***Battle Brook*** *CD 18 to Elk Lk*	**5.23**	**2C**	10EM196 99UM028	Downstream of 136th St., 4 mi. SW of Princeton At CR 9, .1 mi. W of CR 102, 4 mi. N of Zimmerman	EXS	EXS	IF	MTS	--	MTS	MT	--	EX	NS	NS

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

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

Key for Cell Shading: = previous impairment or deferred impairment prior to 2012 reporting cycle; = new impairment; = full support of designated use.

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

†Reach was assessed based on use class included in table and existing use class as defined in Minn. Rule 7050 is different. MPCA is currently in the process of changing the existing use class for this AUID in rule based on an analysis of the biological community and temperature data.

Table 28. Non-assessed channelized sites in the Battle Brook Watershed Unit

AUID *Reach Name*, *Reach Description*	Reach Length (miles)	Use Class	Biological Station ID	Location of Biological Station	Fish IBI	Invert IBI
07010203-696 ***County Ditch 6*** *Unnamed ditch to St. Francis R*	**2.61**	**2B**	09UM024	Downstream of CR 5, 7 mi. SW of Princeton	Good	--
07010203-697 ***County Ditch 5*** *Unnamed ditch to Unnamed ditch*	**1.09**	**2B**	09UM025	Downstream of CR 70, 2.5 mi. E of Santiago	Good	Poor

See Appendix 7 for clarification of the good/fair/poor thresholds and Appendix 8 and Appendix 9 for fish and macroinvertebrate IBI results; respectively. Parentheses indicate the number of visits to a given site and those sites with multiple visits have been averaged to determine the rating depicted in the table. Individual visit ratings for each biological community are reported in Appendix 8 and Appendix 9.

Table 29. Minnesota Stream Habitat Assessment (MSHA) results for Battle Brook Watershed Unit

			Land Use	Riparian	Substrate	Fish Cover	Channel Morph.	MSHA Score	MSHA
Visits	**Site ID**	**Stream Name**	**(0-5)**	**(0-15)**	**(0-27)**	**(0-17)**	**(0-36)**	**(0-100)**	**Rating**
1	09UM024	County Ditch 6	5	11	3	12	5	36	Poor
1	09UM025	County Ditch 5	5	12	20.4	13	18	68.4	Good
1	10EM196	Battle Brook	5	10.5	8.75	11	13	48.25	Fair
1	99UM028	Battle Brook	3.5	9	3	7	9	31.5	Poor
Average Habitat Results*: Battle Brook*			4.6	10.6	8.8	10.8	11.3	46.0	Fair

Qualitative habitat ratings

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

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

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

Table 30. Outlet water chemistry results for Battle Brook Watershed Unit

Station Location:	BATTLE BK AT CSAH-9, 4 MI NW OF ZIMMERMAN, MN												
Equis ID:	S004-704												
Station #:	99UM028												
Parameter	DO	E. coli	NH_3	NO_{2+} NO_3	TKN	pH	TP	TSS	TSVS	Spec. Cond.	Temp	T-tube (100)	T-tube (60)
Units	mg/L		mg/L	mg/L	mg/L	$[H^+]$	mg/L	mg/L	mg/L	uS/cm	°C	cm	cm
# Samples	19	15	10	10	10	34	10	10	10	32	34	57	
Minimum	3.48	61	< 0.05	0.25	0.25	6.65	0.036	<1.0	<1.0	221	12.22	28	
Maximum	10.54	>2400	0.1	1.7	1.3	8.2	0.096	12	6.8	399	24	>100	
Mean[1]	8.22	341.87	0.06	1.17	0.6	7.57	0.07	5.65	3.6	352.44	18.45	91.89	
Median	8.14	99	0.07	1.25	0.54	7.63	0.07	4.4	3.2	360	19.29	100	
WQ Standard[2]	5	126/1260	0.04			6.5-9.0		100				20	20
# WQ Exceedances[3]	1	6	3			0		0				0	
NCHF 75th Percentile[4]			0.2	0.12			0.17	310			24		

[1]Geometric mean of all samples is provided for *E. coli*
[2]Total suspended solids and Transparency tube standards are surrogate standards derived from the turbidity standard of 25
[3]Represents exceedances of individual maximum standard for E. coli (1260/100mL) or fecal coliform
[4]Based on 1970-1992 summer data; see *Selected Water Quality Characteristics of Minimally Impacted Streams from Minnesota's Seven Ecoregions* (McCollor and Heiskary 1993).

Table 31. Aquatic Recreational Use Assessment (ARUS) results for lakes in the Battle Brook Watershed Unit

Name	DOW #	Area	Trophic Status	% Littoral	Max. Depth (ft)	Avg. Depth (ft)	CLMP Trend	Mean TP (ug/L)	Mean Chl-a (ug/L)	Mean Secchi (ft)	ARUS
Cantlin	71-0041-00	133	E	0	--	0.9	↑	25.58	10.28	2.19	FS
Diann	71-0046-00	101	E	100	5	--	--	66.36	31.95	1.1	NS
Elk	71-0055-00	336	E	100	12	2.2	NT	73.11	31.37	0.68	NS

Abbreviations:
↑-- increasing/Improving Trend
↓--Decreasing/Declining Trend
NT – No Trend
H-Hypereutrophic
E – Eutrophic
M – Mesotrophic
O – Oligotrophic
FS—Full Support
NS – Non-Support
IF – Insufficient Information

Summary

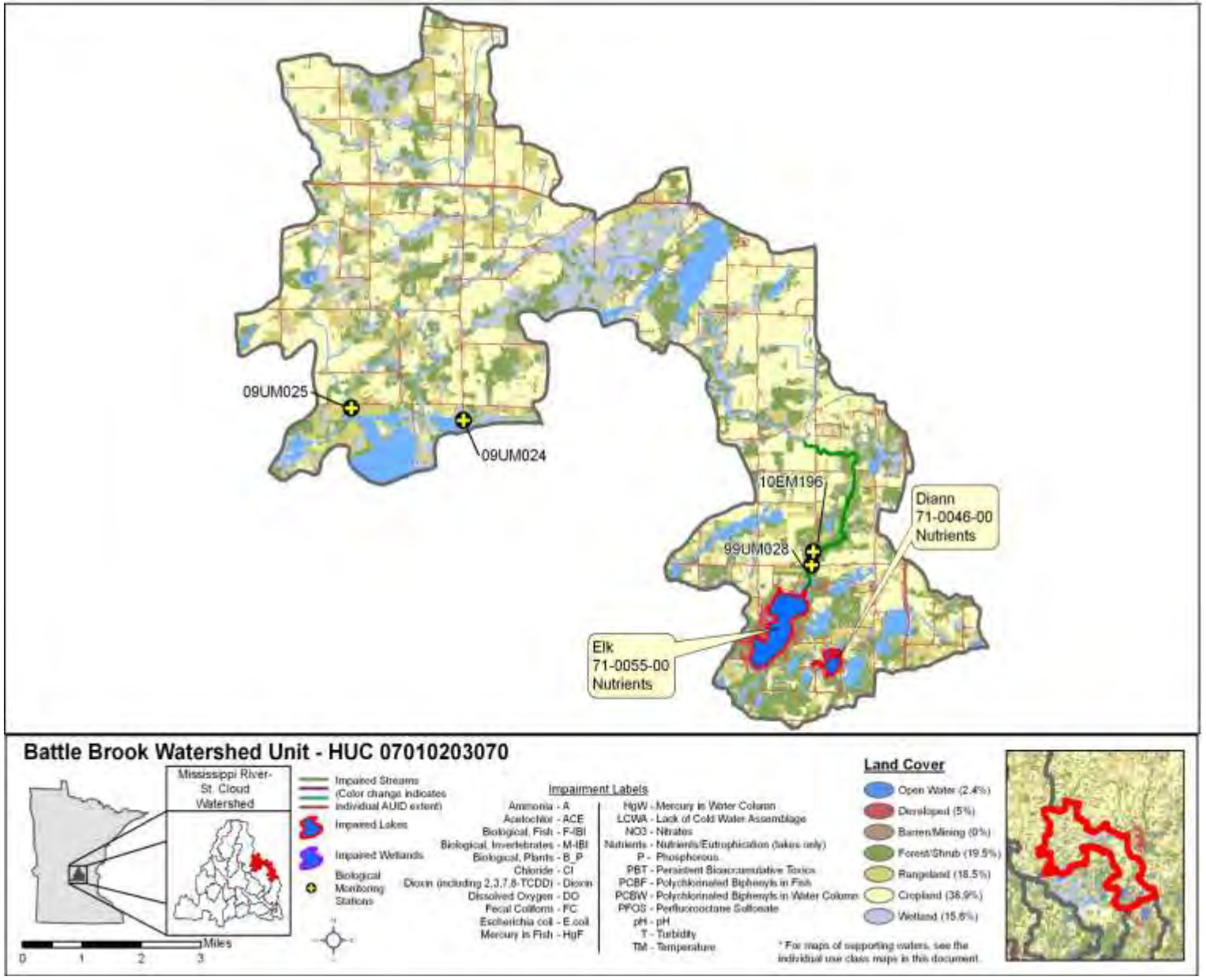
During the 2011 assessment cycle, three assessment units (AUIDs) and three lakes were reviewed for aquatic life use and aquatic recreational use standards. Two tributaries to Battle Brook (AUIDs 696 and 697) were not assessed during this assessment cycle because the streams were channelized. Battle Brook from Elk Lake to the St. Francis River (AUID 537) was not reviewed because it was determined to be too close to Elk Lake and therefore more representative of a lacustrine environment. Two biological monitoring stations (10EM196 and 99UM028) on Battle Brook (AUID 535) had new impairments for fish and bacteria (*E. coli*). During the 2006 assessment cycle this AUID was first listed for aquatic macroinvertebrates, and during the present assessment cycle it was determined that this impairment should be carried forward.

Biological communities along the main-stem of Battle Brook appear to be poor. The downstream segment of Battle Brook where the sites are located is a low gradient system with a wide riparian zone consisting of wetland plant communities. Fish species such as yellow perch, central mudminnow, and bluntnose minnows take advantage of these habitats and dominate the fish community of lower Battle Brook. The habitat is characterized by an abundance of aquatic vegetation, poor substrates (predominately silt and muck), poor channel morphology (unstable banks, no riffle habitats), poor depth variability and general lack of overhead cover. Importantly, one biological monitoring station (10EM196) along this AUID observed a very depauperate fish community, consisting of 3 species comprising 10 total fish; in addition, aquatic macroinvertebrate communities were dominated by tolerant taxa. Secondly, the Chinese mystery snail (*Cipangopaludina chinensis malleata*), an invasive species regulated by the MDNR was observed within the assessed reach. Interestingly, the upstream ditched tributaries to Battle Brook had a more diverse and better balanced fish community, and in the case of County Ditch 6 a more diverse habitat.

The Battle Brook Watershed Unit consists of eight lakes greater than four hectares (10 acres) of which, three were assessed for aquatic recreation use (Table 30). A majority of the lakes in this watershed unit are small shallow basins and are primarily located in the south eastern portion of the watershed unit near the outlet (Figure 16). Cantlin Lake, with the smallest contributing catchment watershed, fully supported aquatic recreation. Diann and Elk Lakes did not support aquatic recreation (excess nutrients). Each lake receives a large amount of external contribution with Elk Lake receiving the highest. Profile data for all three lakes indicate internal loading due to lake mixing may be contributing to nutrient levels in addition to watershed runoff. Despite the high amount of internal nutrient contribution, a reduction in external loading would still prove beneficial.

Assessable stream water quality data was available on one reach of Battle Brook, a five mile reach of Battle Brook from CD-18 to Elk Lake (Figure 16). This reach was determined to be non-supporting of recreational activities due to the number of bacterial (*E. coli*) exceedances (Table 29). Dissolved oxygen data was determined to be insufficient, but the wetland characteristics of the stream combined with fish species tolerant of low DO conditions suggest that further DO monitoring is warranted. As is typical of stream systems with relatively intact riparian zones, the turbidity data did not indicate impairment.

Figure 16. Currently listed impaired waters by parameter with land use characteristics for Battle Brook Watershed Unit



St. Francis River Watershed Unit HUC 07010203080

The St. Francis River Watershed Unit encompasses an area of approximately 60 square miles and is contained within Sherburne County. Approximately 50 percent of the watershed is made up of undisturbed land such as forest/shrub lands and wetlands, which is due in part to the Sherburne National Wildlife Refuge. The other dominant land uses within this watershed include cropland (25 percent) and rangeland (12.5 percent) habitats.

Table 32. Aquatic Life and Recreation Assessments on Stream Reaches in the St. Francis River Watershed Unit. Reaches are organized upstream to downstream in the table.

AUID ***Reach Name,*** *Reach Description*	Reach Length (miles)	Use Class	Biological Station ID	Location of Biological Station	Aquatic Life Indicators: F-IBI	M-IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides	Bacteria	Aquatic Life	Aquatic Rec.
07010203-704 ***St. Francis River*** *Unnamed Lk (71-0731-00) to Rice Lk*	**13.96**	**2B**	09UM023 09UM022	Adjacent to CR 3, 6 mi. SW of Princeton Upstream of CR 9, 6.5 mi. SW of Princeton	EXP	MTS	--	IF	--	--	--	--	--	NS	NA
07010203-702 ***St. Francis River*** *Rice Lk to Elk R*	**22.98**	**2B**	09UM015	Upstream of CR 15, 5 mi. SW of Zimmerman	EXP	MTS	IF	MTS	--	MTS	MTS	--	MTS	NS	FS

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

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

Key for Cell Shading: = previous impairment or deferred impairment prior to 2012 reporting cycle; = new impairment; = full support of designated use.

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

†Reach was assessed based on use class included in table and existing use class as defined in Minn. Rule 7050 is different. MPCA is currently in the process of changing the existing use class for this AUID in rule based on an analysis of the biological community and temperature data.

Table 33. Non-assessed Channelized Sites within the St. Francis River Watershed Unit

AUID ***Reach Name*** *Reach Description*	Reach Length (miles)	Use Class	Biological Station ID	Location of Biological Station	Fish IBI	Invert IBI
07010203-704 ***St. Francis River*** *Unnamed Lk (71-0731-00) to Rice Lk*	**13.96**	**2B**	09UM091	Upstream of CR 5, 5 mi. SE of Santiago	--	Good (2)

See Appendix 7 for clarification of the good/fair/poor thresholds and Appendix 8 and Appendix 9 for fish and macroinvertebrate IBI results; respectively. Parentheses indicate the number of visits to a given site and those sites with multiple visits have been averaged to determine the rating depicted in the table. Individual visit ratings for each biological community are reported in Appendix 8 and Appendix 9.

Table 34. Minnesota Stream Habitat Assessment (MSHA) results for the St. Francis River Watershed Unit

			Land Use	Riparian	Substrate	Fish Cover	Channel Morph.	MSHA Score	MSHA
Visits	**Site ID**	**Stream Name**	**(0-5)**	**(0-15)**	**(0-27)**	**(0-17)**	**(0-36)**	**(0-100)**	**Rating**
1	09UM091	St. Francis River	--	--	--	--	--	--	--
2	09UM023	St. Francis River	5	13.75	21.4	13	30	83.15	Good
1	09UM022	St. Francis River	5	9.5	19.5	13	20	67	Good
1	09UM015	St. Francis River	3.5	13	15.6	12	18	62.1	Fair
Average Habitat Results*: St. Francis River*			4.5	12.1	18.8	12.7	22.7	70.8	Fair

Qualitative habitat ratings

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

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

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

Table 35. Outlet water chemistry results for the St. Francis Watershed Unit

Station Location:	St. Francis River at CR 15, 5 Mi. SW of Zimmerman												
Equis ID:	S002-952												
Station #:	09UM015												
Parameter	DO	*E. coli*	NH_3	NO_{2+} NO_3	TKN	pH	TP	TSS	TSVS	Spec. Cond.	Temp	T-tube (100)	T-tube (60)
Units	mg/L		mg/L	mg/L	mg/L	$[H^+]$	mg/L	mg/L	mg/L	uS/cm	°C	cm	cm
# Samples	18	15		3	9	18	9	9	9	18	18	7	2
Minimum	0.2	11		0.5	0.4	6.7	0.06	2	1.6	218	16	35	35
Maximum	9.6	660		0.7	1.3	8.5	0.15	30	13	375	26	98	58
Mean[1]	6.2	106		0.6	0.8	7.6	0.08	7.4	4	310	22	77	47
Median	7.5	45		0.6	0.8	7.6	0.08	5.4	3	313	22	85	47
WQ Standard[2]	5	126/1260				6.5-9.0		100				20	20
# WQ Exceedances[3]	6	0				0		0				0	0
NCHF 75th Percentile[4]			0.2	0.12			0.17	5.6		310	24		

[1]Geometric mean of all samples is provided for *E. coli*

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

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

[4]Based on 1970-1992 summer data; see *Selected Water Quality Characteristics of Minimally Impacted Streams from Minnesota's Seven Ecoregions* (McCollor and Heiskary 1993).

Summary

An upstream AUID (704) on the St. Francis River above Rice Lake and a downstream AUID (702) on the St. Francis River below Rice Lake were reviewed during the 2011 assessment cycle (Table 31). Biological monitoring was conducted on four stations during 2009, of which three stations were located along AUID 704 and one station along AUID 702 (Table 31). Both AUIDs (704 and 702) were determined to be impaired for aquatic life use standards based on the fish bioassessment results.

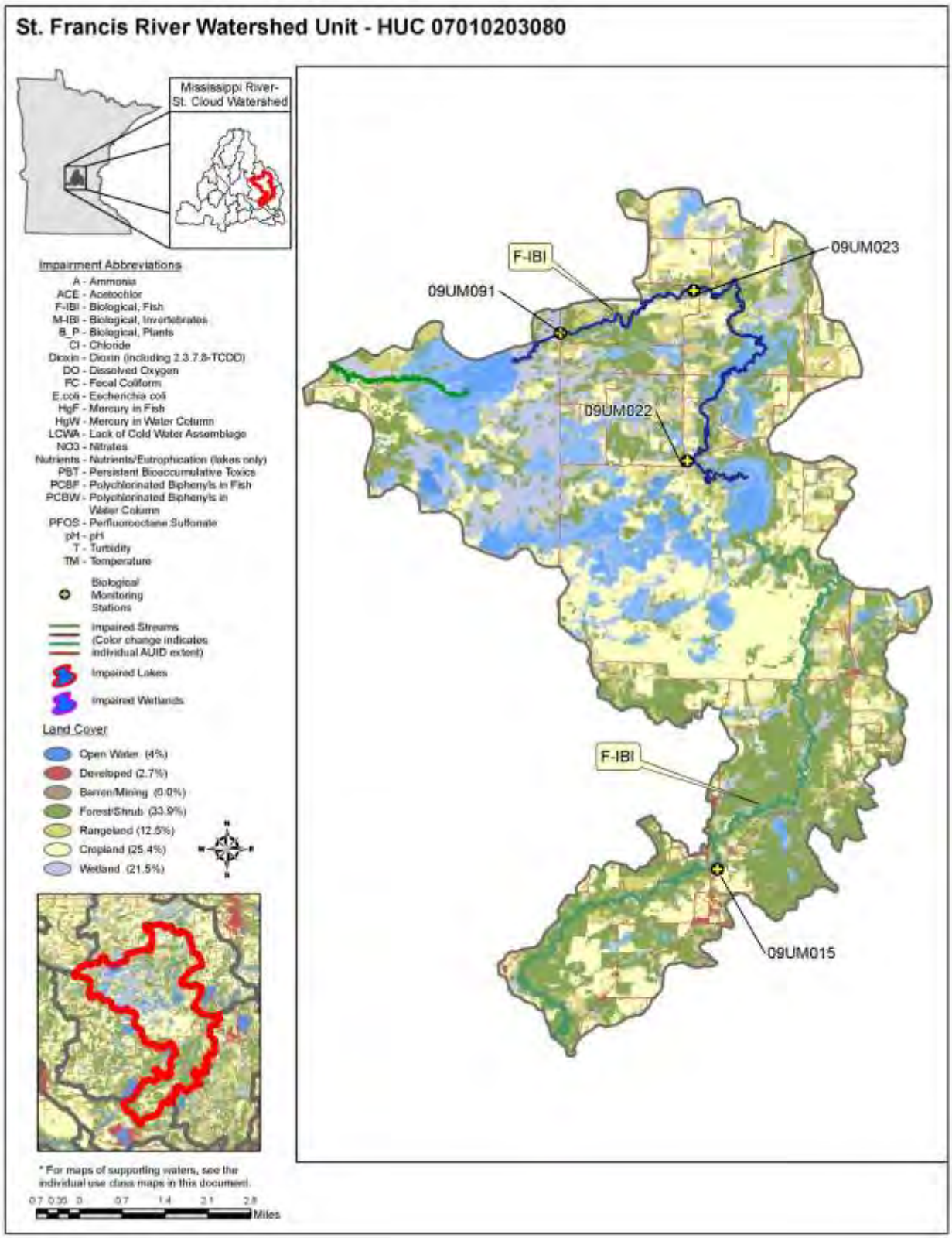
In general, the fish communities contained several tolerant taxa (yellow bullhead, black bullhead, green sunfish and big-mouth shiner). The unfavorable fish communities observed may result from connectivity issues within the St. Francis River, which was previously described (Altena, 2004). The Sherburne National Wildlife Refuge maintains several water control structures on the St. Francis River. These water control structures are used to adjust water levels for wading, shorebirds, and other migratory waterfowl. The 2009 MPCA fish survey suggests that water management may disrupt the natural movement of fish within this stream. This may result from the manmade wetland habitats observed within the watershed, which likely disrupt fish migration patterns and may cause increased water temperatures that can be unfavorable to certain fish species. Temperature data collected over the course of the sampling season indicated an average July temperature of 21°C (69.8°F). In addition, the lack of larger migrating species such as round bodied suckers and smallmouth bass, suggest that these barriers likely disrupt migration.

The fish IBI scores improved in a downstream to upstream trend, whereas the macroinvertebrate IBI scores remained similar throughout the watershed unit (Appendix 8 and 9). The favorable macroinvertebrate IBI scores are likely related to the dispersal and colonization abilities of these organisms, as they are often not hampered by barriers such as water control structures. Habitat conditions followed similar trends, conditions improved in a downstream to upstream trend; however there was no habitat information for the channelized site (09UM091).

Assessable stream water quality data was available on two reaches of the St. Francis River within the St. Francis River Watershed Unit. Data collected from the upstream reach, extending from an unnamed lake (MN DNR ID 71-0731-00) to Rice Lake, was limited to turbidity and the results indicated full support. The downstream reach, extending from Rice Lake to the Elk River, was fully supporting for turbidity as well as aquatic recreation. Dissolved oxygen exceedances occurred within the downstream reach (Table 35); however, the sampling location was determined to be heavily influenced by wetlands. As a result, this reach was not listed for DO (Figure 17).

Many of the small tributaries in the upstream portions of the watershed have been channelized to drain wetland habitats. This often results in diminished habitat scores, which may affect biological communities. The Sherburne National Wildlife Refuge provides an extensive forested riparian buffer and should be maintained to prevent further degradation within this watershed. However, water control structures should be further studied to determine if water control practice may be altered to allow for fish passage during natural fish migration periods (i.e. spawning).

Figure 17. Currently listed impaired waters by parameter with land use characteristics for the St. Francis River Watershed Unit



Tibbits Creek Watershed Unit HUC 07010203090

The Tibbits Creek Watershed Unit is a relatively small watershed (~44 sq. mi.) on the eastern edge of the Mississippi River (St. Cloud) watershed. This watershed unit is solely contained within Sherburne County and similar to the St. Francis Watershed Unit, a small portion of the Sherburne National Wildlife Refuge is in the Tibbits Creek Watershed. Land use within this watershed unit is a mixture of forest/shrub (35.8 percent), rangeland (25.5 percent), cropland (17.1 percent), and wetland (11.4 percent) habitats. The town of Zimmerman, located in the North central portion of the watershed, contributes to the 7.6 percent developed land. Most of the streams within this watershed unit have been channelized or are existing ditch systems and therefore aquatic life use assessments were not made during the 2011 assessment cycle.

Table 36. Aquatic Life and Recreation Assessments on Stream Reaches in the Tibbits Creek Watershed Unit. Reaches are organized upstream to downstream in the table.

AUID ***Reach Name***, *Reach Description*	Reach Length (miles)	Use Class	Biological Station ID	Location of Biological Station	Aquatic Life Indicators: F-IBI	M-IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides	Bacteria	Aquatic Life	Aquatic Rec.
07010203-522 ***Tibbits Brook*** *Rice Lk to Elk R*	**6.62**	**2C**	09UM020 07UM093 09UM021	Upstream of CR 1, 4 mi. S of Zimmerman Downstream of CR 79, 3 mi. NE of Big Lake Upstream of 209th Ave NW, 4.5 mi. E of Big Lake	NA	NA	IF	MTS	--	MTS	MTS	--	EX	IF*	NS

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

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

Key for Cell Shading: = previous impairment or deferred impairment prior to 2012 reporting cycle; = new impairment; = full support of designated use.

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

†Reach was assessed based on use class included in table and existing use class as defined in Minn. Rule 7050 is different. MPCA is currently in the process of changing the existing use class for this AUID in rule based on an analysis of the biological community and temperature data.

Table 37. Non-assessed channelized sites in the Tibbits Creek Watershed Unit

AUID ***Reach Name***, *Reach Description*	Reach Length (miles)	Use Class	Biological Station ID	Location of Biological Station	Fish IBI	Invert IBI
07010203-522 ***Tibbits Brook*** *Rice Lk to Elk R*	**6.62**	**2C**	09UM020 07UM093 09UM021	Upstream of CR 1, 4 mi. S of Zimmerman Downstream of CR 79, 3 mi. NE of Big Lake Upstream of 209th Ave NW, 4.5 mi. E of Big Lake	Good	Fair
07010203-523 ***Unnamed Ditch*** *Headwaters (Lk Fremon 71-0016-00) to Tibbits Bk*	**5.9**	**2B**	09UM019	Upstream of CR 32, 3.5 mi. S of Zimmerman	Good	Poor

See Appendix 7 for clarification of the good/fair/poor thresholds and Appendix 8 and Appendix 9 for fish and macroinvertebrate IBI results; respectively. Parentheses indicate the number of visits to a given site and those sites with multiple visits have been averaged to determine the rating depicted in the table. Individual visit ratings for each biological community are reported in Appendix 8 and Appendix 9.

Table 38. Minnesota Stream Habitat Assessment (MSHA) Result for the Tibbits Creek Watershed Unit

			Land Use	Riparian	Substrate	Fish Cover	Channel Morph.	MSHA Score	MSHA
Visits	**Site ID**	**Stream Name**	**(0-5)**	**(0-15)**	**(0-27)**	**(0-17)**	**(0-36)**	**(0-100)**	**Rating**
2	07UM093	Tibbits Brook	4.3	12.3	14.7	5.5	16	52.8	Fair
1	09UM019	Trib. To Tibbits Brook	3.5	8.5	9	12	10	43	Poor
1	09UM020	Tibbits Brook	3.5	7	9	12	9	40.5	Poor
2	09UM021	Tibbits Brook	2.9	11	10	12	13	48.9	Fair
Average Habitat Results*: St. Francis River*			3.6	9.7	10.7	10.4	12.0	46.3	Fair

Qualitative habitat ratings

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

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

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

Table 39. Outlet water chemistry results for the Tibbits Creek Watershed Unit

Station Location:	TIBBITS BK AT 209TH AVE NW, 4.6 MI ENE OF BIG LAKE, MN												
Equis ID:	S005-538												
Station #:	09UM021												
Parameter	DO	E. coli	NH_3	NO_2^+ NO_3	TKN	pH	TP	TSS	TSVS	Spec. Cond.	Temp	T-tube (100)	T-tube (60)
Units	mg/L		mg/L	mg/L	mg/L	$[H^+]$	mg/L	mg/L	mg/L	uS/cm	°C	cm	cm
# Samples	19	15	10	19	10	19	10	10	10	19	37	36	1
Minimum	4.94	28	< 0.05	<0.05	0.64	7.14	0.07	<1	<1	284	12.78	53	>60
Maximum	13.2	870	0.17	1.1	1.91	8.59	0.211	23	6.8	529	25.6	100	>60
Mean[1]	9.09	203.13	0.11	0.39	1.09	7.85	0.14	6.6	2.74	463.84	20.96	93.94	
Median	8.37	160	0.11	0.29	1.05	7.86	0.13	5.6	2.4	480	21.67	99.5	
WQ Standard[2]	5	126/1260				6.5-9.0		100				20	20
# WQ Exceedances[3]	1	8				0		0				0	0
NCHF 75th Percentile[4]			0.20	0.12			0.17	5.6		310	24		

[1]Geometric mean of all samples is provided for *E. coli*
[2]Total suspended solids and Transparency tube standards are surrogate standards derived from the turbidity standard of 25
[3]Represents exceedances of individual maximum standard for E. coli (1260/100mL) or fecal coliform
[4]Based on 1970-1992 summer data; see *Selected Water Quality Characteristics of Minimally Impacted Streams from Minnesota's Seven Ecoregions* (McCollor and Heiskary 1993).

Table 40. Aquatic Recreational Use Assessment (ARUS) results for lakes in Tibbits Creek Watershed Unit

Name	DOW #	Area	Trophic Status	% Littoral	Max. Depth (ft)	Avg. Depth (ft)	CLMP Trend	Mean TP (ug/L)	Mean Chl-a (ug/L)	Mean Secchi (ft)	ARUS
Fremont	71-0016-00	466	H	100	10	1.6	NT	166.29	93.99	0.63	NS
Birch	71-0057-00	149	E	77.8	18	3.1	NT	48.17	27.92	1.02	NS

Abbreviations:
↑-- increasing/Improving Trend
↓--Decreasing/Declining Trend
NT – No Trend
H-Hypereutrophic
E – Eutrophic
M – Mesotrophic
O - Oligotrophic
FS—Full Support
NS – Non-Support
IF – Insufficient Information

Summary

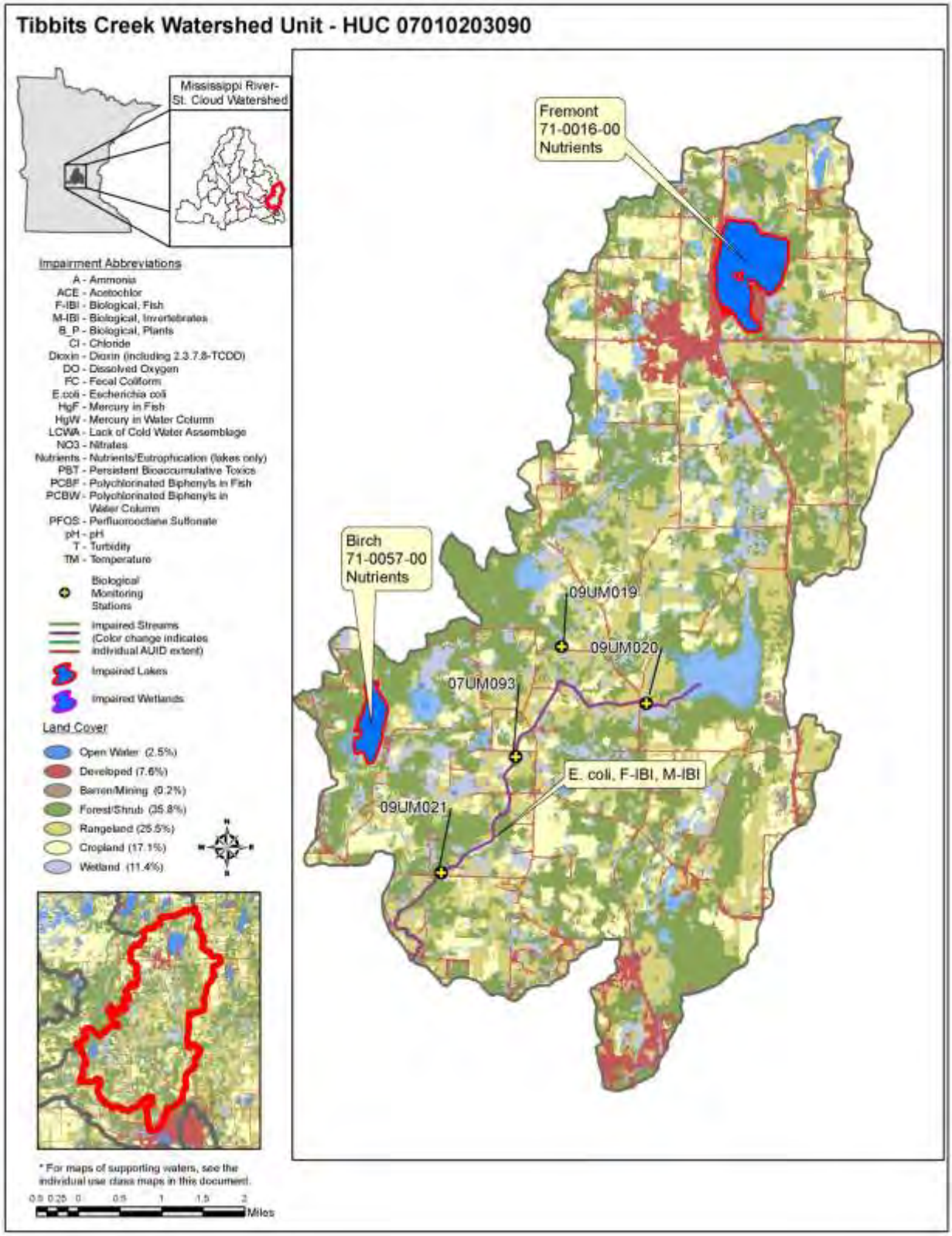
Two assessment units (AUIDs) were reviewed for aquatic life use during the 2011 assessment cycle; these include AUID 522 the portion of Tibbits Creek from Rice Lake to Elk Lake and AUID 523 an unnamed ditch originating as the headwaters to Lake Fremont to Tibbits Creek (Table 35). Both AUIDs were channelized, and therefore assessment decisions were deferred until the MPCA adopts the tiered aquatic life use (TALU) framework. Although these stations were not assessed, some general trends in these data were present. First, fish IBI scores were favorable for most of the downstream locations along Tibbits Creek mainstem; however one upstream ditched tributary to Tibbits Brook (09UM019) scored poorly (Appendix 8). Three biological stations on Tibbits Brook (09UM021, 07UM093 and 09UM020) contain exceptional fish communities, which resulted from a preponderance of sensitive species (e.g., horny head chubs, Iowa darters, pearl dace, and Northern red belly dace).

Macroinvertebrates did not follow the same trend observed with the fish communities. Macroinvertebrate communities were poor throughout the Tibbits Creek watershed and more reflective of the poor stream habitat conditions, with the exception of station 07UM093 (Appendix 9). The components of the habitats scores which performed poorly were channel morphology, fish cover and substrate, which are likely a result of historic and current management of these channelized streams.

The Tibbits Creek watershed unit consists of nine lakes greater than four hectares (ten acres) of which, two were assessed for aquatic recreation use (Table 39). A majority of the lakes in the Tibbits Creek watershed unit are small shallow basins and are located throughout the watershed unit (Figure 18). Fremont and Birch Lakes each have small contributing catchment watersheds and both were determined to be non-supporting of aquatic recreational use due to excess nutrients. Profile data for both lakes indicates internal loading due to lake mixing, which is likely contributing to elevated nutrient levels during periods of watershed runoff. Despite the high amount of internal nutrient contribution, a reduction in external loading would still prove beneficial.

Assessable stream water quality data was available on one reach of Tibbits Brook, a seven mile reach from Rice Lake to the Elk River (Figure 18). This reach was determined to be non-supporting of recreational activities due to bacterial exceedances. Dissolved oxygen (DO) data was determined to be insufficient and turbidity data did not indicate impairment. Although DO data was not assessed, measurements taken during the day ranged above 12 mg/L (Table 38). This may indicate a problem with excess nutrients, which can result in increased algal growth, and consequently wide DO swings. Therefore we recommend continuous DO measurements be taken at this site to determine if the phenomenon is present.

Figure 18. Currently listed impaired waters by parameter with land use characteristics for the Tibbits Creek Watershed Unit



Mississippi Direct Watershed Unit HUC 07010203690

The Mississippi Direct Watershed Unit encompasses approximately 25 square miles in the west-central portion of the Mississippi-St. Cloud watershed and straddles the Sherburne and Stearns county lines. Other than a short segment of the Mississippi River, the watershed has no sampleable tributary streams. Assessment level data for this watershed unit is limited to three lakes (Long, Pickerel and Round), all of which are supporting for aquatic recreational use (Table 40). Land use in the watershed is characterized by row crop agriculture (57 percent), deciduous forests (14.6 percent) and rangelands (10.6 percent) (Figure 19).

Table 41. Aquatic Recreational Use Assessment (ARUS) results for lakes in the Mississippi Direct Watershed Unit

Name	DOW #	Area	Trophic Status	% Littoral	Max. Depth (ft)	Avg. Depth (ft)	CLMP Trend	Mean TP (ug/L)	Mean Chl-a (ug/L)	Mean Secchi (ft)	ARUS
Pickerel	71-0158-00	180	E	87	21	1.8	NT	25.97	10.32	2.43	FS
Long	71-0159-00	180	E	79	26	3.1	NT	29.82	9.54	2.24	FS
Round	71-0167-00	39	E	61.7	43	--	↑	29.12	7.55	3.24	FS

Abbreviations:

↑-- increasing/Improving Trend
↓--Decreasing/Declining Trend
NT – No Trend

H-Hypereutrophic
E – Eutrophic
M – Mesotrophic
O – Oligotrophic

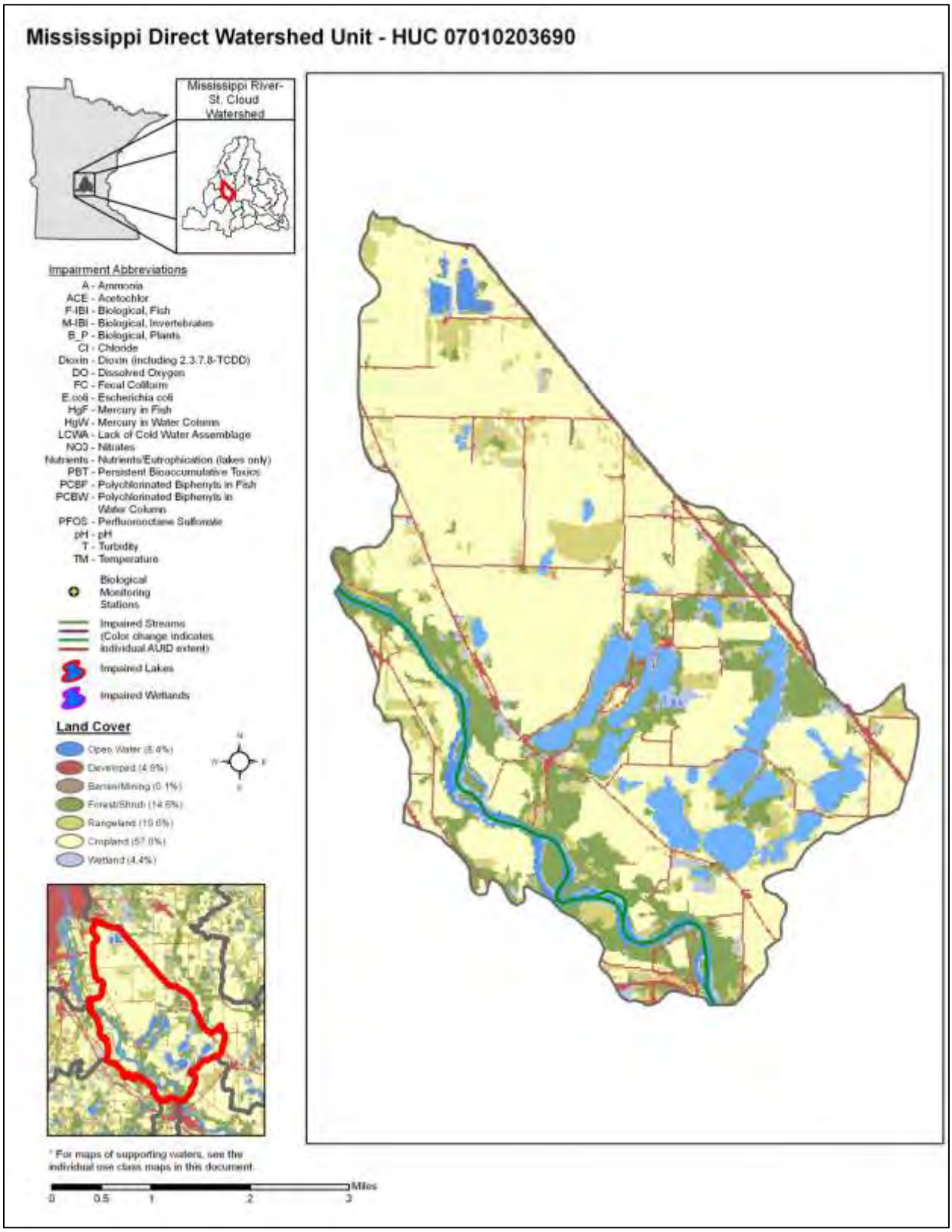
FS—Full Support
NS – Non-Support
IF – Insufficient Information

Summary

The Mississippi Direct Watershed Unit consists of seven lakes greater than four hectares (10 acres), of which three were assessed for aquatic recreation use (Table 40). A majority of the lakes in the Mississippi Direct watershed unit are small deep basins and are primarily located in the southern portion of the watershed unit, north of the Mississippi River (Figure 19). Pickerel, Long, and Round Lakes each have moderately sized contributing catchment watersheds; however due to their depths likely have little internal nutrient loading. All three lakes were determined to be fully supporting of aquatic recreation use (Table 40). Profile data indicates that each lake stratifies, which results in a limited amount of nutrients being released from the bottom sediment.

Assessable stream water quality data was not available for any of the reaches within the Mississippi Direct watershed unit (Figure 19). A separate monitoring strategy and report is being developed that will focus on the full extent of the Upper Mississippi River from the headwaters to the outlet of the Upper Mississippi River Basin.

Figure 19. Currently listed impaired waters by parameter with land use characteristics for the Mississippi Direct Watershed Unit



St. Cloud Watershed Unit HUC 07010203700

The St. Cloud Watershed Unit encompasses an area of approximately 27 square miles in the west-central portion of the Mississippi-St. Cloud watershed. Other than a short segment of the Mississippi River, the watershed has no sampleable tributary streams. Two lakes (George and Melrose Deep Quarry) were monitored to assess their suitability to support aquatic recreation. The St. Cloud Watershed Unit is dominated by developed land use (55.3 percent) with row crop agriculture (13.2 percent), forest (12.3 percent) and range lands (10.3 percent) making up other land uses within the watershed (Figure 20).

Table 42. Aquatic Recreational Use Assessment (ARUS) results for lakes in the St. Cloud Watershed Unit

Name	DOW #	Area	Trophic Status	% Littoral	Max. Depth (ft)	Avg. Depth (ft)	CLMP Trend	Mean TP (ug/L)	Mean Chl-a (ug/L)	Mean Secchi (ft)	ARUS
George	73-0611-00	8	E	43.2	32	--	--	44.82	23.91	1.77	NS
Melrose Deep Quarry	73-0701-00	2	M	0	--	--	NT	--	--	3.72	IF

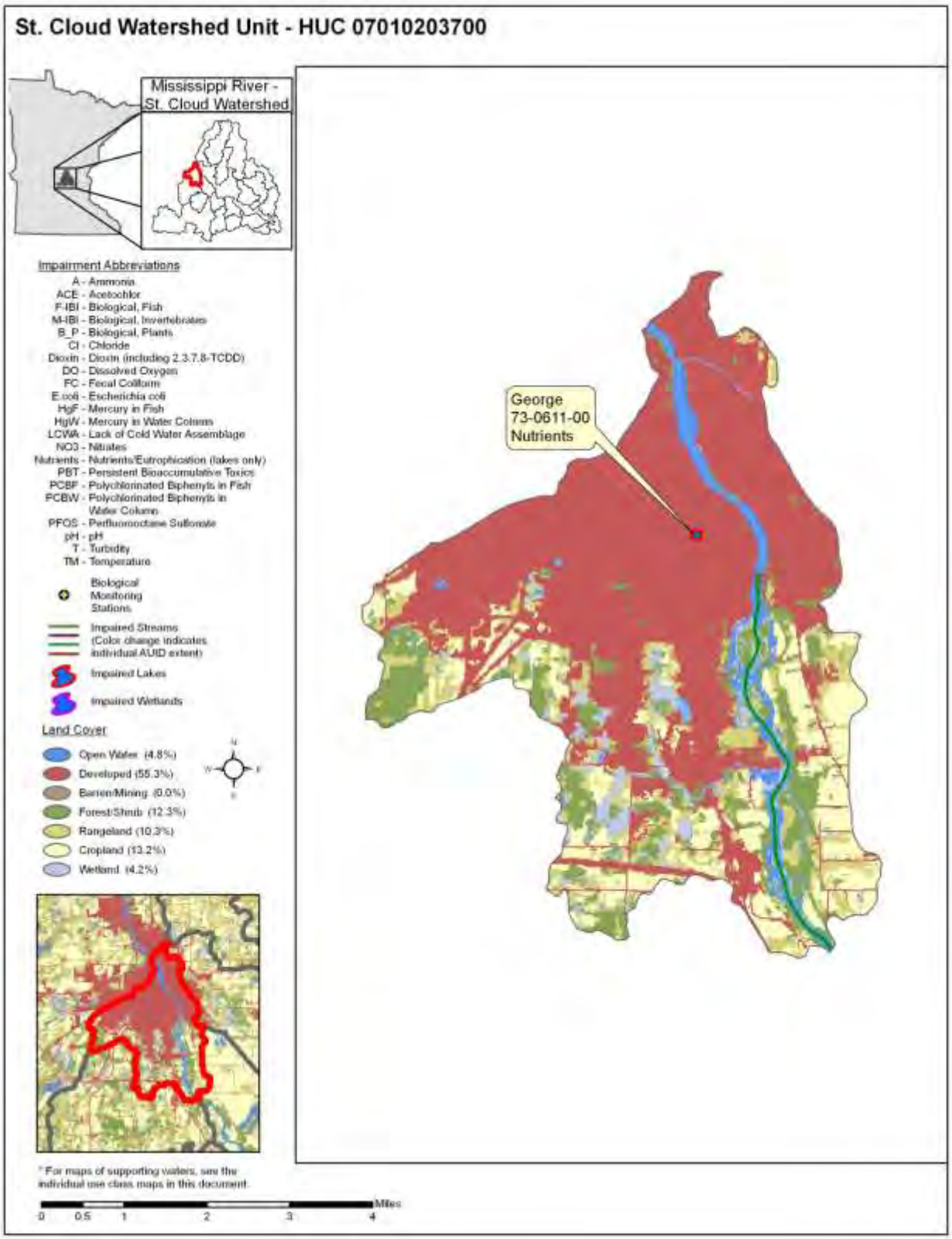
Abbreviations:
↑-- increasing/Improving Trend
↓--Decreasing/Declining Trend
NT – No Trend
H-Hypereutrophic
E – Eutrophic
M – Mesotrophic
O – Oligotrophic
FS—Full Support
NS – Non-Support
IF – Insufficient Information

Summary

One lake within the city of St. Cloud Watershed Unit was assessed for aquatic recreation use (Table 41). Lake George is not classified as a protected water body but assessment level data was collected. Additionally, the Melrose Deep Quarry has had extensive water clarity observations but lacked sufficient information for an assessment. A majority of the water bodies within the city of St. Cloud subwatershed are non-protected, small and deep quarries primarily located in the western portion of the watershed unit (Figure 20). Lake George was determined to be non-supporting of recreational use due to excess levels of nutrients (Table 41). The catchment watershed for Lake George primarily consists of urban development (55 percent) but the lake itself receives no direct input from streams. Runoff from impervious surfaces may play a major role in the nutrient contribution of Lake George. Profile data is not available to determine the lakes mixing status.

A separate monitoring strategy and report is being developed that will focus on the full extent of the Upper Mississippi River from the headwaters to the outlet of the Upper Mississippi River basin.

Figure 20. Currently listed impaired waters by parameter with land use characteristics for the St. Cloud Watershed Unit



Johnson Creek Watershed Unit HUC 07010203710

The Johnson Creek Watershed Unit is located within Stearns County and encompasses an area of approximately 51 square miles in the western portion of the Mississippi River (St. Cloud) watershed. Land use within this watershed unit is predominately characterized by row crop agriculture (42.5 percent), range land (25.4 percent) and forest/shrub lands (15.4 percent) (Figure 21). The headwaters of Johnson Creek drain agricultural landscapes, and as with many of the other watersheds in the Mississippi River (St. Cloud) the headwaters have been channelized to allow for increased drainage. From its headwaters, Johnson Creek flow easterly, ultimately emptying into the Mississippi River south of St. Cloud, east of Interstate 94 (Figure 21).

Table 43. Life and Recreation Assessments on Stream Reaches in the Johnson Creek Watershed Unit. Reaches are organized upstream to downstream in the table.

AUID ***Reach Name,*** *Reach Description*	Reach Length (miles)	Use Class	Biological Station ID	Location of Biological Station	Aquatic Life Indicators: F-IBI	M-IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides	Bacteria	Aquatic Life	Aquatic Rec.
07010203-724 ***Unnamed Creek (Robinson Hill Creek)*** *CD 14 to CSAH 136*	**4.4**	**2B**	09UM042	Upstream of CR 136, 4.5 mi. S of St. Cloud	NA	NA	IF	MTS	--	--	--	--	EX	NA*	NS
07010203-633 ***Johnson Creek (Meyer Creek)*** *Unnamed Cr to Unnamed Cr*	**2.98**	**2A**	09UM043	Upstream of CR 7, 7.5 mi. SE of Rockville	MTS	MTS	--	IF	--	--	--	--	--	FS	NA
07010203-561 ***Unnamed Creek (Luxemburg Ck)*** *T123 R28W S30, South line to Johnson Cr*	**5.5**	**2A**	09UM044	Upstream of 43rd Ave, 7 mi. E of Rockville	MTS	MTS	IF	IF	MTS	MTS	--	--	EX	FS	NS

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

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

Key for Cell Shading: = previous impairment or deferred impairment prior to 2012 reporting cycle; = new impairment; = full support of designated use.

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

†Reach was assessed based on use class included in table and existing use class as defined in Minn. R. 7050 is different. MPCA is currently in the process of changing the existing use class for this AUID in rule based on an analysis of the biological community and temperature data.

AUID ***Reach Name,*** *Reach Description*	Reach Length (miles)	Use Class	Biological Station ID	Location of Biological Station	Aquatic Life Indicators:								Bacteria	Aquatic Life	Aquatic Rec.
					F-IBI	M-IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides			
07010203-635 ***Johnson Creek (Meyer Creek)*** *Unnamed Cr to Unnamed Cr*	**0.99**	**2A**	--	--	--	--	IF	MTS	MT	MTS	--	--	EX	IF	NS
07010203-639 ***Johnson Creek (Meyer Creek)*** *T123 R28W S14, West line to Mississippi R*	**6.37**	**2B**	09UM041	Upstream of CR 136, 4.5 mi. S of St. Cloud	EXS	MTS	IF	MTS	MT	MTS	--	--	EX	NS	NS

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

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

Key for Cell Shading: = previous impairment or deferred impairment prior to 2012 reporting cycle; = new impairment; = full support of designated use.

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

†Reach was assessed based on use class included in table and existing use class as defined in Minn. Rule 7050 is different. MPCA is currently in the process of changing the existing use class for this AUID in rule based on an analysis of the biological community and temperature data.

Table 44. Non-assessed channelized sites in the Johnson Creek Watershed Unit

AUID ***Reach Name,*** *Reach Description*	Reach Length (miles)	Use Class	Biological Station ID	Location of Biological Station	Fish IBI	Invert IBI
07010203-724 ***Unnamed Creek (Robinson Hill Creek)*** *CD 14 to CSAH 136*	**4.4**	**2A**	09UM042	Upstream of CR 136, 4.5 mi. S of St. Cloud	Good	Good

See Appendix 7 for clarification of the good/fair/poor thresholds and Appendix 8 and Appendix 9 for fish and macroinvertebrate IBI results; respectively. Parentheses indicate the number of visits to a given site and those sites with multiple visits have been averaged to determine the rating depicted in the table. Individual visit ratings for each biological community are reported in Appendix 8 and Appendix 9.

Table 45. Minnesota Stream Habitat Assessment (MSHA) Result for the Johnson Creek Watershed Unit

Visits	Site ID	Stream 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	09UM042	Neenah Creek	0	11.5	12.5	12	19	55	Fair
1	09UM043	Johnson Creek	0	11	18	11	29	69	Good
1	09UM044	Trib. to Johnson Creek	2.5	14	12.9	11	25	65.4	Fair
1	09UM041	Johnson Creek	2.5	10.5	16.15	8	22	59.15	Fair
Average Habitat Results*: Johnson Creek Watershed Unit*			1.3	11.8	14.9	10.5	23.8	62.1	Fair

Qualitative habitat ratings

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

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

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

Table 46. Outlet water chemistry results for the Johnson Creek Watershed Unit

Station Location:	JOHNSON CK BTWN CR-75 AND I-94, 5 MI S OF ST CLOUD, MN												
Equis ID:	S003-370												
Station #:	09UM041												
Parameter	DO	E. coli	NH_3	$NO_2 + NO_3$	TKN	pH	TP	TSS	TSVS	Spec. Cond.	Temp	T-tube (100)	T-tube (60)
Units	mg/L		mg/L	mg/L	mg/L	[H+]	mg/L	mg/L	mg/L	uS/cm	°C	cm	cm
# Samples	23	20	10	10	10	23	10	10	9	23	23	14	5
Minimum	7.43	840	< 0.05	0.62	0.45	7.51	0.03	2	1.2	508	8.34	56	27
Maximum	10.42	7700	< 0.05	2.7	1.07	8.55	0.13	16	4.8	661	21.21	100	57
Mean[1]	8.59	3222		1.96	0.65	7.99	0.05	8.7	2.6	591.22	16.11	85.86	41.8
Median	8.45	2400		2.1	0.61	7.98	0.04	8.7	2.2	603	16.07	94	40
WQ Standard[2]	5	126/1260				6.5-9.0		100				20	20
# WQ Exceedances[3]	0	20				0		0				0	0
NCHF 75th Percentile[4]			0.2	0.12			0.17	310			24		

[1]Geometric mean of all samples is provided for *E. coli*
[2]Total suspended solids and Transparency tube standards are surrogate standards derived from the turbidity standard of 25
[3]Represents exceedances of individual maximum standard for E. coli (1260/100mL) or fecal coliform
[4]Based on 1970-1992 summer data; see *Selected Water Quality Characteristics of Minimally Impacted Streams from Minnesota's Seven Ecoregions* (McCollor and Heiskary 1993).

Table 47. Lake Aquatic Recreational Use Assessment (ARUS) results for the Johnson Creek Watershed Unit

Name	DOW #	Area	Trophic Status	% Littoral	Max. Depth (ft)	Avg. Depth (ft)	CLMP Trend	Mean TP (ug/L)	Mean Chl-a (ug/L)	Mean Secchi (ft)	ARUS
Beaver	73-0023-00	158	M	32	27	4.0	--	17.33	5.42	3.92	FS

Abbreviations:
↑-- increasing/Improving Trend
↓--Decreasing/Declining Trend
NT – No Trend
H-Hypereutrophic
E – Eutrophic
M – Mesotrophic
O – Oligotrophic
FS—Full Support
NS – Non-Support
IF – Insufficient Information

Summary

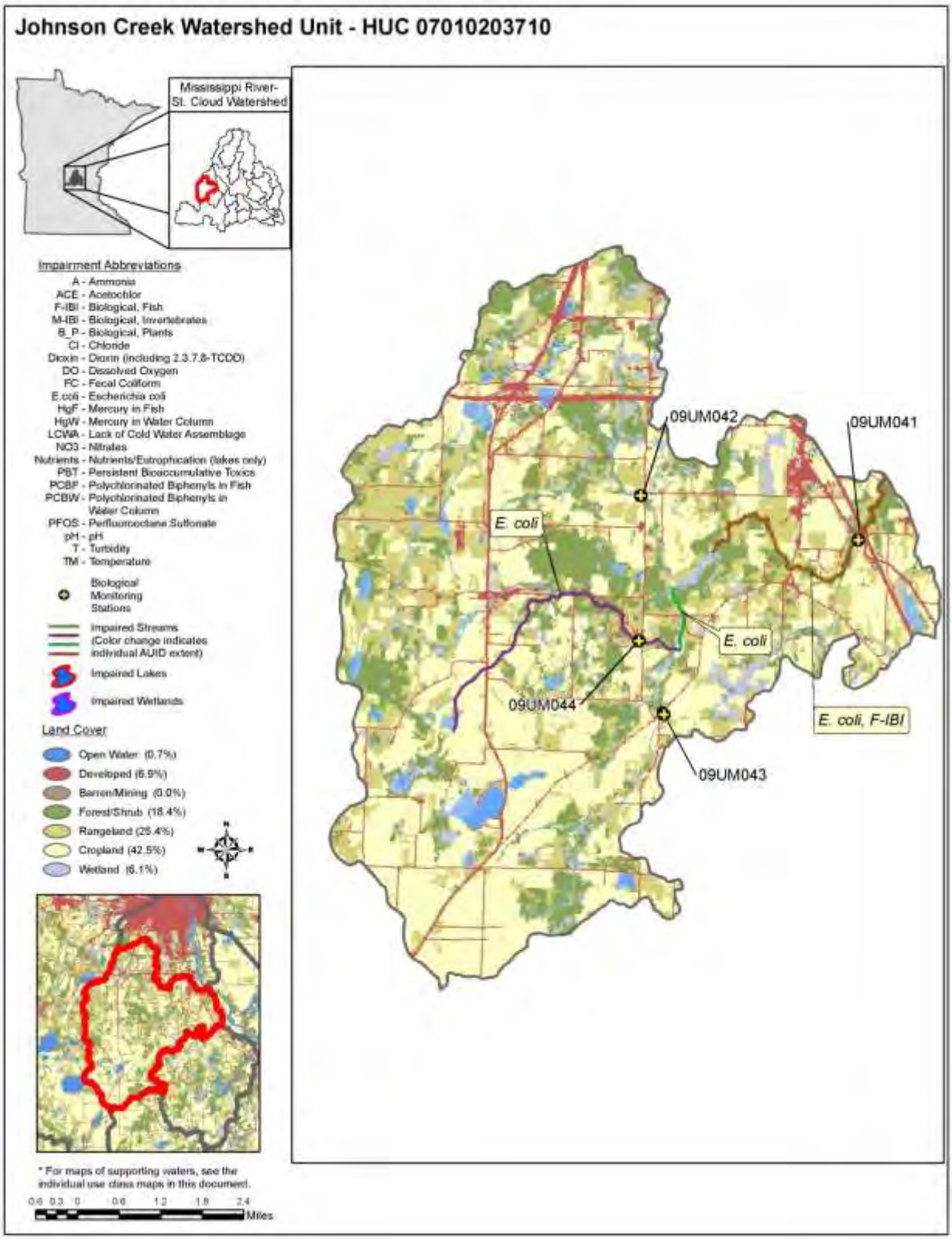
A total of five assessment units (AUIDs) were reviewed during the 2011 assessment cycle. Of these, three AUIDs were assessed for aquatic life use, four AUIDs were assessed for aquatic recreational use. The Robinson Hill AUID (724) stretching from County road 14 to County highway 136 was not assessed due to channelization (Table 42). Of the three AUIDs assessed for aquatic life use, the lower segment of Johnson Creek was determined to be impaired based upon the fish bioassessment results. The site (09UM041) is located upstream of the Mississippi River and is downstream of several feedlots with direct access to the stream (Figure 21). Although the riparian corridor along this site is extensive forest, aerial imagery and MPCA permit information indicate a large feedlot immediately (~1 mi) upstream of the monitoring station. This feedlot is currently working with the Stearns County SWCD to implement manure containment and runoff capture mechanisms. All 20 bacteria (*E. coli)* samples collected in 2009 were in violation of the current standard (Table 45). This may provide some explanation for the poor fish community observed at this station; however, a housing development is also encroaching on the northern portion of the riparian corridor.

In general, the upstream (headwater) AUIDs have favorable biological communities, of which two stations (09UM044 and 09UM043) have exceptional macroinvertebrate communities; characterized by several sensitive and coldwater taxa. These two stations are on designated trout streams (use class 2A). Station 09UM044 (AUID 561) supports brown trout populations, while station 09UM043 did not contain trout during the MPCA survey; however mottled sculpin and other coldwater species were present. Habitat across the watershed unit was fair to good (Table 44) but was notably better at 09UM043 where the channel morphology was more diverse and unembedded gravel and cobble was common.

The Johnson Creek Watershed Unit consists of one lake greater than four hectares (10 acres). Beaver Lake was assessed and determined to be fully supporting of aquatic recreation use (Table 46). Beaver Lake is located in the southern portion of the watershed unit and all other waterbodies within Johnson Creek are classified as wetlands (Figure 21). Beaver Lake is a small lake with a small contributing catchment watershed consisting primarily of rangeland.

Assessable stream water quality data was available along three coldwater reaches of Johnson Creek, extending from the headwaters to the Mississippi River outlet, near St. Augusta, MN (Figure 21). All measured water chemistry parameters were within acceptable ranges with the exception of bacteria. E. coli exceedances occurred on three segments including AUID 561 (Luxemburg Creek from South Line Road to Johnson Creek), AUID 635 (a section of Johnson Creek split by 228th street, east of the town of Luxemberg) and AUID 639 (Johnson Creek from County road 7 to the Mississippi River).

Figure 21. Currently listed impaired waters by parameter with land use characteristics for the Johnson Creek Watershed Unit



Plum Creek Watershed Unit HUC 07010203720

The Plum Creek Watershed Unit is located within Stearns County and encompasses an area of approximately 32 square miles. Land use within this watershed unit is primarily made up of row crop agriculture (37.7 percent), range lands (22.9 percent) and forest/shrub lands (22.5 percent). Many of the headwater streams and tributaries within this watershed have been channelized. This watershed unit arises on the western boundary of the Mississippi River (St. Cloud) watershed and flows north-easterly through a series of small lakes, eventually emptying into the Mississippi River approximately 2.5 miles upstream of Clearwater, Minnesota.

Table 48. Aquatic Life and Recreation Assessments on Stream Reaches in the Plum Creek Watershed Unit. Reaches are organized upstream to downstream in the table.

AUID ***Reach Name,*** *Reach Description*	Reach Length (miles)	Use Class	Biological Station ID	Location of Biological Station	Aquatic Life Indicators:								Bacteria	Aquatic Life	Aquatic Rec.
					F-IBI	M-IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides			
07010203-572 ***Plum Creek*** *Warner Lk to Mississippi R*	**2.5**	**2B**	09UM027	Upstream of CR 75, 1.5 mi. NW of Clearwater	NA	NA	IF	IF	MTS	MTS	--	--	EX	IF*	NS

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

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

Key for Cell Shading: = previous impairment or deferred impairment prior to 2012 reporting cycle; = new impairment; = full support of designated use.

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

Table 49. Non-assessed channelized sites in the Plum Creek Watershed Unit.

AUID ***Reach Name,*** *Reach Description*	Reach Length (miles)	Use Class	Biological Station ID	Location of Biological Station	Fish IBI	Invert IBI
07010203-676 ***Plum Creek*** *Unnamed Cr to Maria Lk*	**3.56**	**2B**	09UM028	Downstream of CR 45, 3.5 mi. W of Clearwater	Poor	--
07010203-572 ***Plum Creek*** *Warner Lk to Mississippi R*	**2.5**	**2B**	09UM027	Upstream of CR 75, 1.5 mi. NW of Clearwater	Good	Poor

See Appendix 7 for clarification of the good/fair/poor thresholds and Appendix 8 and Appendix 9 for fish and macroinvertebrate IBI results; respectively. Parentheses indicate the number of visits to a given site and those sites with multiple visits have been averaged to determine the rating depicted in the table. Individual visit ratings for each biological community are reported in Appendix 8 and Appendix 9.

Table 50. Minnesota Stream Habitat Assessment (MSHA) Result for the Plum Creek Watershed Unit

			Land Use	Riparian	Substrate	Fish Cover	Channel Morph.	MSHA Score	MSHA
Visits	**Site ID**	**Stream Name**	**(0-5)**	**(0-15)**	**(0-27)**	**(0-17)**	**(0-36)**	**(0-100)**	**Rating**
1	09UM028	Plum Creek	0	7	14	7	6	34	Poor
1	09UM027	Plum Creek	2.5	8.5	9	15	15	50	Fair
Average Habitat Results*: Plum Creek Watershed Unit*			1.3	7.8	11.5	11.0	10.5	42.0	Fair

Qualitative habitat ratings

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

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

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

Table 51. Aquatic Recreational Use Assessment (ARUS) results for lakes in the Plum Creek Watershed Unit

Name	DOW #	Area	Trophic Status	% Littoral	Max. Depth (ft)	Avg. Depth (ft)	CLMP Trend	Mean TP (ug/L)	Mean Chl-a (ug/L)	Mean Secchi (ft)	ARUS
Dallas	73-0001-00	23	E	78.4	22	--	--	25	6.5	3.27	FS
Feldges	73-0002-00	32	E	90.6	17	--	--	30	10.08	2.5	FS
Maria	73-0003-00	96	E	97.3	18	2.3	--	32.42	13.17	2.25	FS
Long	73-0004-00	62	M	53.1	38	3.9	NT	23.83	7.34	3.93	FS
Crooked	73-0006-00	112	M	55.1	35	4.1	NT	20.55	4.12	3.94	FS
Quinn	73-0007-00	21	M	0		0.9	--	23.92	6.5	4.07	FS
Bunt	73-0010-00	100	E	0	6	0.9	--	51.83	12.75	1.23	FS
Warner	73-0011-00	31	M	0	38	3.7	--	20.92	15.75	1.79	FS

Abbreviations:

↑-- increasing/Improving Trend
↓--Decreasing/Declining Trend
NT – No Trend

H-Hypereutrophic
E – Eutrophic
M – Mesotrophic
O – Oligotrophic

FS—Full Support
NS – Non-Support
IF – Insufficient Information

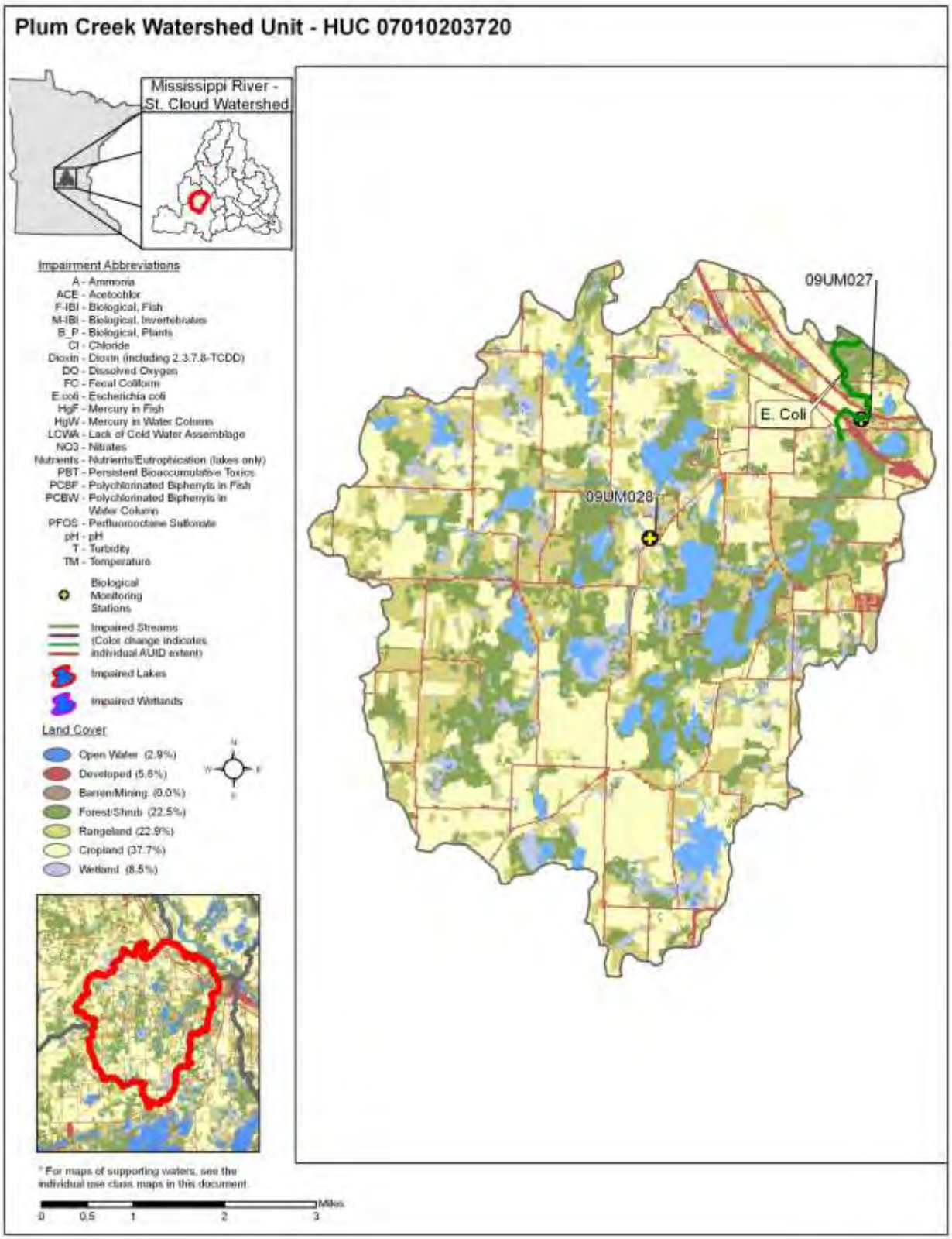
Summary

Biological monitoring data were collected from two sampling locations along two unique assessment units (AUIDs), however all streams were channelized and a formal assessment was not made. In general, habitat conditions within the watershed unit were fair to poor, with the worst habitat (MSHA = 34) at the headwater site (09UM028). Fish and macroinvertebrate community measures were contradictory at the lower Plum Creek site (09UM027). Macroinvertebrates communities were in poor condition while F-IBI scores were marginally better and, in general, more aligned with the MSHA habitat results. An abundance of tolerant fish species occurred at both sites with central mudminnow and bluntnose minnow dominating the fish communities and the very tolerant green sunfish and common carp present in significant numbers.

Within the Plum Creek watershed, there were six lakes greater than four hectares (10 acres) of which, five were assessed for aquatic recreation use (Table 50). Three additional lakes (Dallas, Feldges, and Quinn) are classified as wetlands by the MDNR Department of Waters but have basin characteristics more representative of a lake and were assessed as such. Most lakes in the Plum Creek Watershed Unit are small, shallow to moderately deep basins and are located throughout the watershed unit (Figure 22). All eight lakes were determined to be fully supporting of aquatic recreational use. All of the lakes, with the exception of Bunt, are classified as deep lakes and all had small to moderately sized contributing catchment watersheds. Profile data was limited to only Crooked and Long Lakes. The results for each lake indicated that they were stratified during the summer months. Despite the fully supporting assessment for Bunt, Maria, Feldges, and Dallas Lakes, each of these water bodies was determined to be eutrophic and a reduction in external loading would still prove beneficial.

Assessable stream water quality data was available on one reach of Plum Creek, a three mile reach from Warner Lake to the Mississippi River (Figure 22). This reach was determined to be non supporting of recreational activities due to bacterial exceedances. Dissolved oxygen data was determined to be insufficient and turbidity data did not indicate impairment. The outlet water chemistry station was not established within the Plum Creek watershed. This is due to the small size of the watershed (32 sq. mi.); the MPCA usually monitors water chemistry at pour point locations when the watershed is > 40 sq. mi.

Figure 22. Currently listed impaired waters by parameter with land use characteristics for the Plum Creek Watershed Unit



Clearwater River Watershed Unit HUC 07010203730

The Clearwater River Watershed Unit encompasses an area of approximately 180 square miles, making this watershed unit the largest within the Mississippi River (St. Cloud) watershed. The watershed is located in southwestern corner of the Mississippi River (St. Cloud) watershed and straddles three counties: Stearns, Meeker and Wright. The Clearwater River system originates as a series of channelized tributaries near the town of Watkins, and much of the Clearwater River has been altered upstream of Betty Lake (47-0042-00). From there the Clearwater River flows southeasterly through Meeker County where it turns to the north and flows through Wright County and through a series of lakes ultimately emptying into the Mississippi River. Along its course, the Clearwater River drains landscapes predominately comprised of row crop agriculture (45.1 percent) and rangeland (19.1 percent). Much of the forested riparian areas (16.5 percent) of this watershed occur upstream of Clearwater Lake. Within the Clearwater River watershed there are 46 lakes greater than four hectares of which 25 were assessed for aquatic recreation use (Table 54). In addition, there are six biological monitoring stations within the watershed unit, of which five were sampled in 2009 and one sampled in 2007; three sites were assessed for aquatic life use (Tables 51; 52). Stream water chemistry was monitored at the outlet of the watershed (Table 53) near a biological monitoring station (09UM033) (Figure 23).

Table 52. Aquatic Life and Recreation Assessments on Stream Reaches in the Clearwater River Watershed Unit. Reaches are organized upstream to downstream in the table.

AUID ***Reach Name***, *Reach Description*	Reach Length (miles)	Use Class	Biological Station ID	Location of Biological Station	Aquatic Life Indicators:								Bacteria	Aquatic Life	Aquatic Rec.
					F-IBI	M-IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides			
07010203-533 ***County Ditch 20*** *Unnamed Cr to Unnamed*	**2.33**	**2B**	09UM030	Upstream of 380th St., 1.5 mi. SE of Watkins	NA	NA	--	--	MTS	--	MTS	--	--	IF*	NA
07010203-550 ***County Ditch 44*** *Clear Lk to Clearwater R*	**2.05**	**2B**	09UM029	Upstream of 675th St., 2 mi. S of Watkins	NA	NA	--	--	MTS	--	MTS	--	--	IF*	NA
07010203-549 ***Clearwater River*** *CD 44 to Lk Betsy*	**8.4**	**2B**	07UM087	Downstream of 356th St., 3 mi. SW of Kimball	NA	NA	NA	--	MTS	--	MTS	--	--	NA*	NA

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

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

Key for Cell Shading: = previous impairment or deferred impairment prior to 2012 reporting cycle; = new impairment; = full support of designated use.

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

AUID ***Reach Name,*** *Reach Description*	Reach Length (miles)	Use Class	Biological Station ID	Location of Biological Station	Aquatic Life Indicators:								Bacteria	Aquatic Life	Aquatic Rec.
					F-IBI	M-IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides			
07010203-717 ***Clearwater River*** *Scott Lk to Lk Louisa*	**3.87**	**2B**	09UM031	Upstream of Rockwood Ave NW, 2 mi. W of South Haven	EXS	EXS	--	MTS	MTS	--	--	--	--	NS	NA
07010203-565 ***Unnamed Creek (Fairhaven Creek)*** *Headwaters to Lk Louisa*	**2.33**	**2A**	--	--	--	--	IF	IF	MTS	MTS	--	MTS	EX	NA	NS
07010203-545 ***Threemile Creek*** *Unnamed stream outlet of Lk Lur to T122 R28W S36*	**3.4**	**2A**	09UM032	Downstream of CR 45, 3 mi. NE of Fairhaven	EXS	MTS	--	--	--	--	--	--	--	NS	NA
07010203-544 ***Threemile Creek*** *T122 R28W S35, east line to Otter Lk*	**0.28**	**2B**	--		--	--	IF	MTS	MTS	MTS	--	--	IF	IF	IF
07010203-611 ***Unnamed Creek*** *Nixon Lk to Clearwater R*	**2.22**	**2B**	--	--	--	--	--	--	MTS	--	MTS	--	--	NA	NA
07010203-511 ***Clearwater River*** *Clearwater Lk to Mississippi R*	**11.79**	**2B**	09UM033	Upstream of CR 145, 0.5 mi. SE of Clearwater	EXP	MTS	EXP	MTS	MTS	MTS	MTS	--	MTS	NS	FS

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

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

Key for Cell Shading: = previous impairment or deferred impairment prior to 2012 reporting cycle; = new impairment; = full support of designated use.

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

Table 53. Non-assessed channelized sites in the Clearwater River Watershed Unit

AUID ***Reach Name,*** *Reach Description*	Reach Length (miles)	Use Class	Biological Station ID	Location of Biological Station	Fish IBI	Invert IBI
07010203-533 ***County Ditch 20*** *Unnamed Cr to Unnamed*	**2.33**	**2B**	09UM030	Upstream of 380th St., 1.5 mi. SE of Watkins	Poor	Poor
07010203-550 ***County Ditch 44*** *Clear Lk to Clearwater R*	**2.05**	**2B**	09UM029	Upstream of 675th St., 2 mi. S of Watkins	Poor	Good
07010203-549 ***Clearwater River*** *CD 44 to Lk Betsy*	**8.4**	**2B**	07UM087	Downstream of 356th St., 3 mi. SW of Kimball	Fair	Good

See Appendix 7 for clarification of the good/fair/poor thresholds and Appendix 8 and Appendix 9 for fish and macroinvertebrate IBI results; respectively. Parentheses indicate the number of visits to a given site and those sites with multiple visits have been averaged to determine the rating depicted in the table. Individual visit ratings for each biological community are reported in Appendix 8 and Appendix 9.

Table 54. Minnesota Stream Habitat Assessment (MSHA) Result for the Clearwater River Watershed Unit

			Land Use	Riparian	Substrate	Fish Cover	Channel Morph.	MSHA Score	MSHA
Visits	**Site ID**	**Stream Name**	**(0-5)**	**(0-15)**	**(0-27)**	**(0-17)**	**(0-36)**	**(0-100)**	**Rating**
1	09UM030	County Ditch 20	0	11	12	14	14	51	Fair
2	09UM029	County Ditch 44	0	10	17.7	12	15	54.7	Fair
2	07UM087	Clearwater River	0	12.5	12.8	8.5	23	56.8	Fair
1	09UM031	Clearwater River	2.5	14	20.45	11	21	68.9	Good
2	09UM032	Three Mile Creek	1.5	11	20	13.5	20.5	66.5	Good
1	09UM033	Clearwater River	2.5	14	20.7	14	30	81.2	Good
Average Habitat Results*: Clearwater River Watershed Unit*			1.1	12.1	17.3	12.2	20.6	63.2	Fair

Qualitative habitat ratings

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

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

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

Table 55. Outlet water chemistry results for the Clearwater River Watershed Unit

Station Location:	CLEARWATER R AT CR-145, 0.8 MI SW OF CLEARWATER, MN												
Equis ID:	S004-508												
Station #:	09UM033												
Parameter	DO	E. coli	NH_3	NO_2^+ NO_3	TKN	pH	TP	TSS	TSVS	Spec. Cond.	Temp	T-tube (100)	T-tube (60)
Units	mg/L		mg/L	mg/L	mg/L	$[H^+]$	mg/L	mg/L	mg/L	uS/cm	°C	cm	cm
# Samples	38	35	< 0.05	16	24	38	24	23	9	38	38	39	-
Minimum	5.42	17.3	0.1	<0.05	0.53	7.29	0.009	<1	<1	359	13	49	-
Maximum	11.6	650	0.03	0.27	1.02	8.89	0.056	12	4.8	447	27.6	100	-
Mean[1]	8.57	69.46	0	0.07	0.8	8.06	0.025	3.53	2.32	396.45	21.62	97.92	-
Median	8.23	42		0.07	0.85	8.03	0.02	2	1.6	395	22.47	100	-
WQ Standard[2]	5	126/1260				6.5-9.0		100				20	20
# WQ Exceedances[3]	0	1				0		0				0	0
NCHF 75th Percentile[4]			0.2	0.12			0.17	5.6		310	24		

[1]Geometric mean of all samples is provided for *E. coli*

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

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

[4]Based on 1970-1992 summer data; see *Selected Water Quality Characteristics of Minimally Impacted Streams from Minnesota's Seven Ecoregions* (McCollor and Heiskary 1993).

Table 56. Aquatic Recreational Use Assessment (ARUS) results for lakes in the Clearwater River Watershed Unit

Name	DOW #	Area	Trophic Status	% Littoral	Max. Depth ft)	Avg. Depth (ft)	CLMP Trend	Mean TP (ug/L)	Mean Chl-a (ug/L)	Mean Secchi (ft)	ARUS
Betty	47-0042-00	182	H	60.9	29	3.6	NT	172.19	56.73	0.85	NS
Clear	47-0095-00	703	H	88.6	17	2.5	NT	185.33	62.33	0.52	NS
Little Mud	47-0096-00	43	E	68.2	42	3.6	--	49	21.43	2.11	IF
Marie	73-0014-00	145	H	84.4	36	2.2	NT	108.17	47.94	1.46	NS
Otter	73-0015-00	125	M	33.3	51	7.2	↑	22.43	8.86	2.8	FS
Laura	73-0020-00	147	M	0	--	0.9	--	20.17	4.25	1.5	FS
Island	73-0042-00	94	E	0	--	0.9	--	28.5	3.17	2.98	FS
Swartout	86-0208-00	344	H	100	11	1.5	--	421.8	444.25	1.02	NS
Albion	86-0212-00	330	H	0	--	0.9	--	199	117.33	1.37	NS
Henshaw	86-0213-00	277	H	0	--	0.9	--	207.5	102.75	0.69	NS
Indian	86-0223-00	135	E	44.8	31	5.1	NT	46.86	28	1.29	NS
Cedar	86-0227-00	837	E	37.6	108	29.5	NT	31.21	14.73	2.08	FS
Sugar	86-0233-00	1145	M	35.2	69	7.6	↓	19.63	6.72	2.92	FS
Bass	86-0234-00	234	M	45.3	34	5.1	NT	18	3.49	4.29	FS
Nixon	86-0238-00	103	M	59.2	67	4.1	NT	18.5	4.97	3.34	IF
Wiegand	86-0242-00	85	E	83.3	24		--	36.5	5.3	2.96	IF
Grass	86-0243-00	123	M	68.1	35	3.0	NT	23.5	1.6	3.07	IF
Pleasant	86-0251-00	639	E	51.1	74	4.9	NT	28.73	11.52	2.35	FS
Clearwater East	86-0252-01	0	E	0	73	6.8	NT	32.88	10.16	1.94	FS
Clearwater West	86-0252-02	0	E	0	70	4.9	↑	37	12.4	2.45	IF
Caroline	86-0281-00	138	E	50	44.5	4.6	NT	82.25	39.11	1.66	NS
Louisa	86-0282-00	183	E	63	44	3.2	NT	66.25	51.65	1.16	NS
Augusta	86-0284-00	186	E	27	82	7.6	↑	68.14	18.71	2.43	NS
Scott	86-0297-00	101	H	65	23	2.9	NT	185.38	84.28	0.81	NS
Union	86-0298-00	91	E	30.9	35	5.6	NT	72.5	31.59	1.65	NS

Abbreviations:

↑-- increasing/Improving Trend
↓--Decreasing/Declining Trend
NT – No Trend

H – Hypereutrophic
E – Eutrophic
M – Mesotrophic
O – Oligotrophic

FS — Full Support
NS – Non-Support
IF – Insufficient Information

Summary

During the 2011 assessment cycle MPCA staff reviewed a total of 11 assessment units (AUIDs) (Table 51). Aquatic life use assessment decisions were made for three of these AUIDs, while assessment decisions for three AUIDS (533, 550 and 549) were deferred due to channelization. Aquatic recreational use assessments were made for two AUIDs (565 and 511) (Table 51). Of the three AUIDs assessed, all were determined to be impaired for aquatic life use for a number of reasons including F-IBI, M-IBI, and DO. The DO impairment on the lower reaches of the Clearwater River AUID (511) is an existing aquatic life use impairment first listed during the 2006 assessment cycle (Table 51).

In general, the Clearwater River and its assessed tributaries (AUIDs 533, 550 and 549) had uniformly poor fish communities (Appendix 8). The aquatic macroinvertebrate communities were notably better, particularly near the headwaters (07UM087) and the lower reaches (09UM033) (Appendix 9). The fish communities were comprised of several tolerant species, overall low diversity and low numbers of longer lived, migrating fish species.

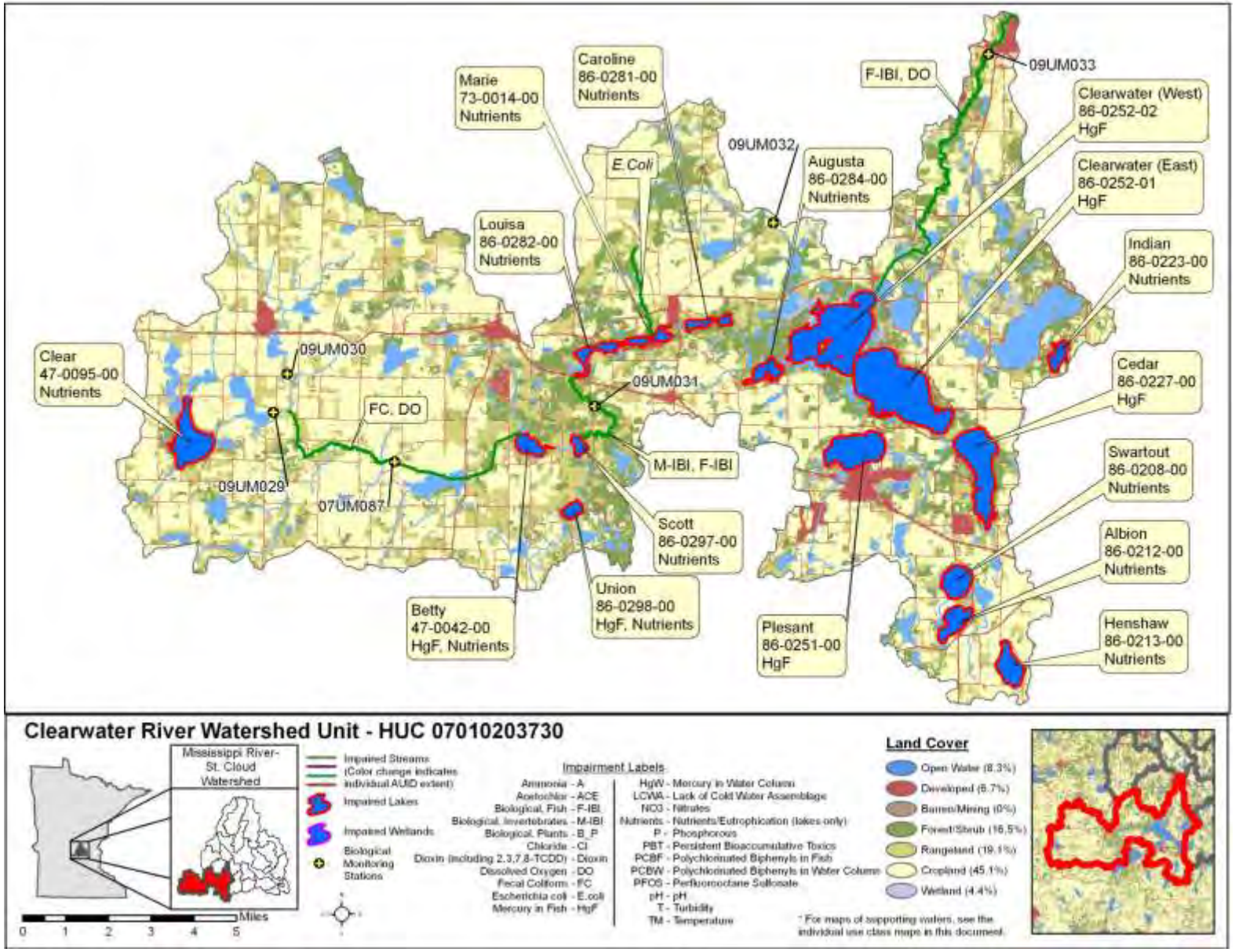
Stream habitat conditions throughout this watershed ranged from fair to good (Table 53). Some trends in habitat data were apparent. The spatial distribution of habitat scores correspond with prevailing land use conditions. Streams in the northeastern portion of the watershed had more forested stream riparian corridors and relatively good habitat while smaller streams (drainage area less than 44 square miles) in the more open and agricultural areas in the southwest had habitat that was generally only fair.

The Clearwater River watershed consists of 46 lakes greater than four hectares (ten acres) of which, 25 were assessed for aquatic recreation use (Table 55). Lakes in the Clearwater River watershed vary in size from small basins to large chains of lakes and are located throughout the watershed unit (Figure 23). Of the 25 lakes that were assessed, 12 were determined to be non-supporting of aquatic recreational use (excess nutrients). In the case of Betty, Marie, Caroline, Louisa, Augusta, and Scott, large contributing catchment watersheds are potentially increasing nutrient levels due to a high level of external loading. Profile data for Clear, Swartout, Albion, Henshaw, and Scott indicate periods of mixing which likely causes internal nutrient release from the lake sediment into the water. Further investigation will be required to fully determine the source of nutrient contributions but an overall reduction in external loading would prove beneficial for all impaired waters.

Water chemistry data for streams within the Clearwater River watershed often met water quality standards. The exception was dissolved oxygen where a lack of data often prevented a formal assessment. The interconnected nature of the lakes and streams in this watershed and the fact that many of the lakes in the chain are impaired for nutrients is a strong indication that further water chemistry monitoring, particularly for DO. New aquatic recreation impairment for Fairhaven Creek (headwaters to Lake Louisa) was identified during the current assessment.

Assessable stream water quality data was available only from a lower reach of the Clearwater River, a 12 mile section from Clearwater Lake to the Mississippi River. This reach of the Clearwater River was previously listed for dissolved oxygen however; additional DO monitoring was recommended for a more complete data set. Also, this reach was determined to be supporting for recreational activities. *E. coli,* turbidity, and chloride data were also collected from other reaches of the Clearwater River however, several of these data sets were insufficient to complete a formal assessment. Due to the interconnections within the watershed between the Clearwater River and several impaired lakes, additional water chemistry monitoring is recommended.

Figure 23. Currently listed impaired waters by parameter with land use characteristics for the Clearwater River Watershed Unit



Fish Creek Watershed Unit HUC 07010203740

The Fish Creek Watershed Unit is a small watershed (approximately 24 sq. mi.) containing a short segment of the main-stem Mississippi River and a small tributary stream (Fish Creek). The upstream end of the Mississippi River originates at the confluence with the Clearwater River near the city of Clearwater. The Mississippi flows southeasterly approximately three miles where Fish Creek empties into the Mississippi River. From here the Mississippi continues approximately four miles on its southeasterly path, with the watershed boundary terminating at the confluence of Silver Creek (Figure 24). Land use throughout the watershed unit is predominately row crop agriculture (41 percent), rangeland (23 percent) and forest/shrub (17.9 percent). Monitoring data is limited to aquatic recreational data from one lake, Fish (86-0183-00) (Table 56).

Table 57. Aquatic Recreational Use Assessment (ARUS) results for the Fish Creek Watershed Unit

Name	DOW #	Area	Trophic Status	% Littoral	Max. Depth (ft)	Avg. Depth (ft)	CLMP Trend	Mean TP (ug/L)	Mean Chl-a (ug/L)	Mean Secchi (ft)	ARUS
Fish	86-0183-00	104	E	59.4	38	4.0	NT	48.14	23.56	1.34	NS

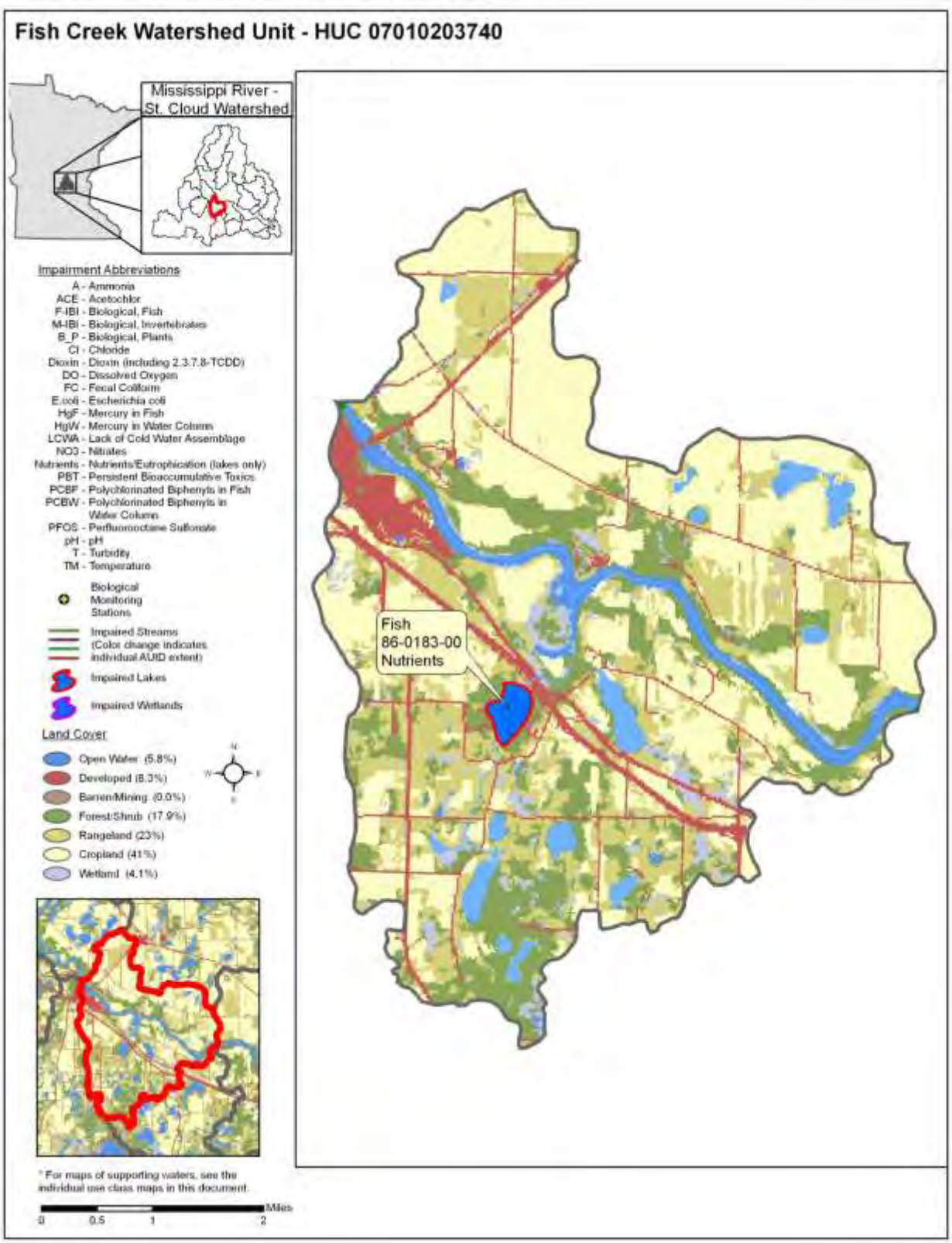
Abbreviations:
↑-- increasing/Improving Trend
↓--Decreasing/Declining Trend
NT – No Trend
H-Hypereutrophic
E – Eutrophic
M – Mesotrophic
O – Oligotrophic
FS—Full Support
NS – Non-Support
IF – Insufficient Information

Summary

The Fish Creek Watershed Unit consists of three lakes greater than four hectares (10 acres). Of these three lakes, Fish Lake was assessed and determined to be non-supporting of aquatic recreation use (Table 56). Rangeland use is dominating within the contributing watershed (Figure 23). Fish Lake is a small, deep lake that intermittently stratifies which likely causes the internal release of nutrients from the lake sediment into the water. Further investigation will be required to fully determine the source of nutrient contributions but an overall reduction in external loading would still prove beneficial.

Assessable stream water quality data was not available for any of the stream reaches within the Fish Creek watershed unit (Figure 24). Turbidity data was collected from Fish Creek from Sheldon Lake to Fish Lake with no exceedances. This data alone was insufficient to complete an assessment. A separate monitoring strategy and report is being developed that will focus on the full extent of the Upper Mississippi River from the headwaters to the outlet of this major basin. It is important to note that a pour point water chemistry station was not established within the Fish Creek watershed. This is due to the small size of the watershed (24 sq. mi.); the MPCA usually monitors water chemistry at pour point locations when the watershed is > 40 sq. mi.

Figure 24. Currently listed impaired waters by parameter with land use characteristics for the Fish Creek Watershed Unit



Silver Creek Watershed Unit HUC 07010203750

Located within the south central portion of the Mississippi River (St. Cloud) watershed, the Silver Creek watershed encompasses an area of roughly 40 square miles and is contained within Wright County (Figure 25). Silver Creek originates as a series of channelized headwater tributaries, near Somers and Mink lakes, in the southwestern portion of the watershed. From here Silver Creek flows northeasterly through several small lakes, ultimately emptying into the Mississippi River near Becker, Minnesota (Figure 25). Land use within this watershed unit is predominately characterized by row crop agriculture (43.7 percent), rangeland (19 percent) and forest/shrub lands (17.8 percent). Most of the forest/shrub land areas occur in the northern portion of the watershed unit, where nearly three-quarters of Lake Maria State park is located.

Table 58. Aquatic Life and Recreation Assessments on Stream Reaches in the Silver Creek Watershed Unit. Reaches are organized upstream to downstream in the table.

AUID ***Reach Name***, *Reach Description*	Reach Length (miles)	Use Class	Biological Station ID	Location of Biological Station	Aquatic Life Indicators: F-IBI	M-IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides	Bacteria	Aquatic Life	Aquatic Rec.
07010203-662 ***Silver Creek*** *Unnamed Cr to Silver Lk*	**1.49**	**2B**	09UM046	Upstream of CR 39, 1.5 mi. SE of Silver Creek	EXS	EXP	--	--	--	--	--	--	--	NS	NA
07010203-555 ***Silver Creek*** *Little Mary Lk to Locke Lk*	**3.1**	**2B**	07UM091	Upstream 134th st NW, 3 mi. NE of Silver Creek	NA	NA	--	MTS	--	--	--	--	--	IF*	NA
07010203-557 ***Silver Creek*** *Locke Lk to Mississippi R*	**1.98**	**2B**	09UM045 09UM081	Upstream of 155th St. NW, 1 mi. E of Hasty Upstream of 155th St. NW, 1.5 mi. E of Hasty	EXS	EXS	EXS	MTS	--	MTS	MTS	--	EX	NS	NS

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

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

Key for Cell Shading: = previous impairment or deferred impairment prior to 2012 reporting cycle; = new impairment; = full support of designated use.

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

Table 59. Non-assessed channelized sites in the Silver Creek Watershed Unit

AUID ***Reach Name,*** *Reach Description*	Reach Length (miles)	Use Class	Biological Station ID	Location of Biological Station	Fish IBI	Invert IBI
07010203-555 ***Silver Creek*** *Little Mary Lk to Locke Lk*	**3.1**	**2B**	07UM091	Upstream 134th St NW, 3 mi. NE of Silver Creek	Poor	Poor

See Appendix 7 for clarification of the good/fair/poor thresholds and Appendix 8 and Appendix 9 for fish and macroinvertebrate IBI results; respectively. Parentheses indicate the number of visits to a given site and those sites with multiple visits have been averaged to determine the rating depicted in the table. Individual visit ratings for each biological community are reported in Appendix 8 and Appendix 9.

Table 60. Minnesota Stream Habitat Assessment (MSHA) Result for the Silver Creek Watershed Unit

Visits	Site ID	Stream 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	09UM046	Silver Creek	1.25	10	7.25	12	15	45.5	Fair
1	07UM091	Silver Creek	5	9.5	14	14	19	61.5	Fair
1	09UM045	Silver Creek	0	12	18.1	6	13	49.1	Fair
1	09UM081	Silver Creek	1.25	13.5	21.9	7	29	72.65	Good
Average Habitat Results*: Sliver Creek Watershed Unit*			1.9	11.3	15.3	9.8	19.0	57.2	Fair

Qualitative habitat ratings

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

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

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

Table 61. Outlet water chemistry results for the Silver Creek Watershed Unit

Station Location:	SILVER CK AT CURTIS AVE NW, 3.5 MI SW OF BECKER, MN												
Equis ID:	S005-540												
Station #:	09UM045												
Parameter	DO	E. coli	NH_3	NO_2 + NO_3	TKN	pH	TP	TSS	TSVS	Spec. Cond.	Temp	T-tube (100)	T-tube (60)
Units	mg/L		mg/L	mg/L	mg/L	[H+]	mg/L	mg/L	mg/L	uS/cm	°C	cm	cm
# Samples	21	19	9	9	9	21	9	9	9	21	21	17	1
Minimum	1.5	35	< 0.05	< 0.05	0.93	6.89	0.04	1.2	<1.0	378	15.64	33	56
Maximum	13	370	0.25	0.36	1.43	9.01	0.09	12	6.8	441	26.3	100	56
Mean[1]	5.58	136.58	0.09	0.19	1.12	7.87	0.05	4.44	2.7	414.9	20.78	90.47	
Median	5.29	74	0.06	0.14	1.1	7.9	0.04	2.8	2.6	420	20.77	100	
WQ Standard[2]	5	126/1260	0.04			6.5-9.0		100				20	20
# WQ Exceedances[3]	10	8	5			1		0				0	0
NCHF 75th Percentile[4]			0.2	0.12			0.17	5.6		310	24		

[1]Geometric mean of all samples is provided for *E. coli*

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

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

[4]Based on 1970-1992 summer data; see *Selected Water Quality Characteristics of Minimally Impacted Streams from Minnesota's Seven Ecoregions* (McCollor and Heiskary 1993).

Table 62. Aquatic Recreational Use Assessment (ARUS) results for lakes in the Silver Creek Watershed Unit

Name	DOW #	Area	Trophic Status	% Littoral	Max. Depth (ft)	Avg. Depth (ft)	CLMP Trend	Mean TP (ug/L)	Mean Chl-a (ug/L)	Mean Secchi (ft)	ARUS
Little Mary South	86-0139-01	-	H	0	--	0.9	--	106.5	55.88	0.76	NS
Little Mary North	86-0139-02	-	H	0	--	0.9	--	163.25	80.25	0.49	NS
Silver	86-0140-00	89	H	39	42	5.1	--	104.65	45.3	1.24	NS
Millstone	86-0152-00	221	H	0	6	1.3	--	357	118.75	1.28	NS
Mary	86-0156-00	232	E	39.2	102	10.7	↑	34.82	13.14	2.26	FS
Limestone	86-0163-00	373	M	54.1	34	3.7	--	23.56	9.78	2.41	FS
Locke	86-0168-00	152	E	43	49	5.5	NT	65.79	34.05	0.91	NS
Ember	86-0171-00	66	M	42.4	41	--	NT	23.5	5.18	3.68	FS
Mink	86-0229-00	304	H	90.6	32	1.9	NT	133.59	81.03	0.82	NS
Somers	86-0230-00	156	E	79.3	18	2.9	NT	83.8	48.76	1.01	NS

Abbreviations:

↑-- increasing/Improving Trend
↓--Decreasing/Declining Trend
NT – No Trend

H-Hypereutrophic
E – Eutrophic
M – Mesotrophic
O – Oligotrophic

FS—Full Support
NS – Non-Support
IF – Insufficient Information

Summary

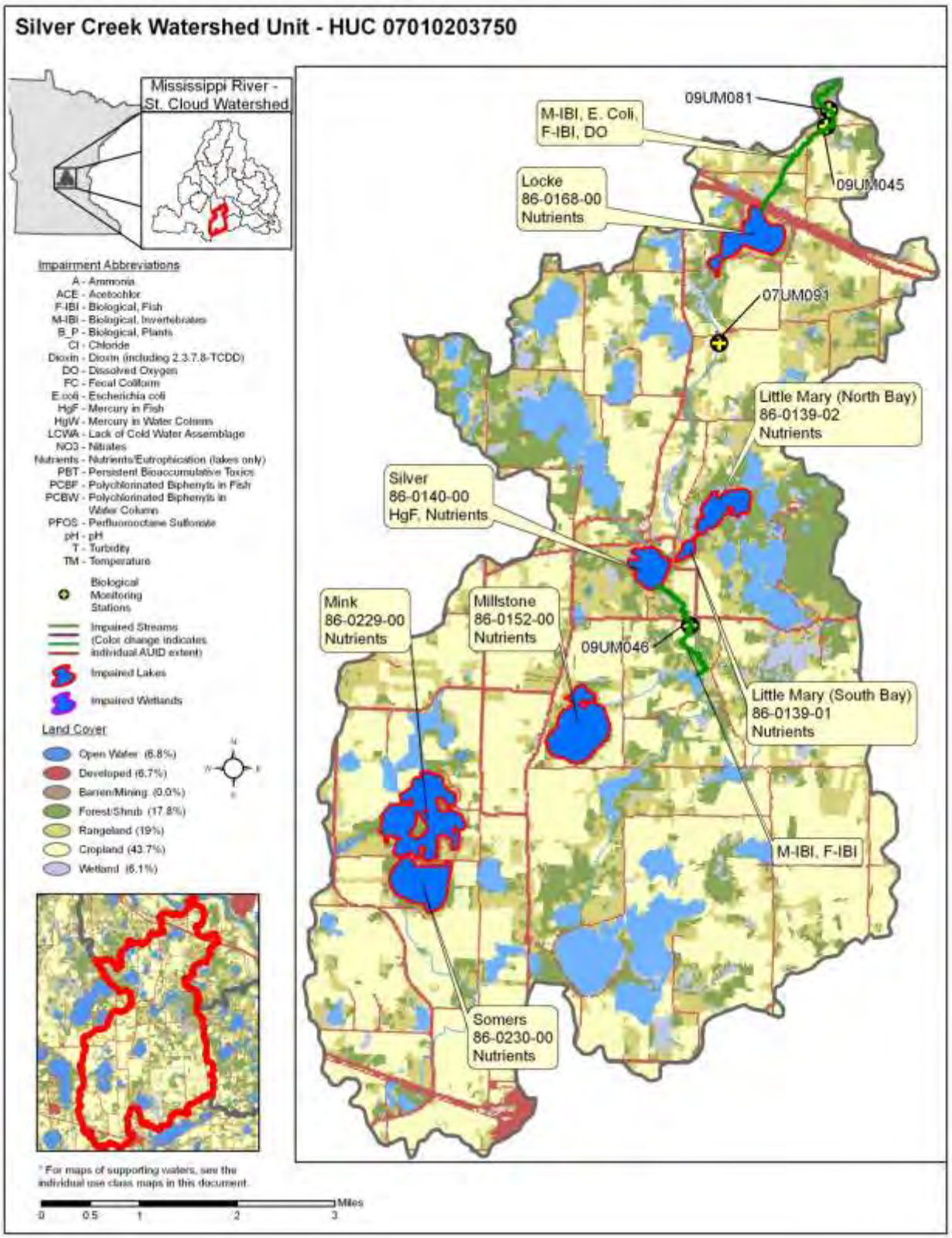
During the 2011 assessment cycle, MPCA staff reviewed three assessment units (AUIDs) for aquatic life use and aquatic recreation use within the Silver Creek watershed (Table 57). Silver Creek between Mary and Locke Lakes (AUID 555) was not assessed because this segment of stream was channelized. The upper and lower segments of Silver Creek (AUID 662 and 557) were assessed and determined to be impaired for aquatic life use based on poor biological communities (AUIDs 662 and 557), DO and bacteria (AUID 557).

As stated above, biological communities through the Silver Creek watershed unit were generally poor (Appendix 8 and 9). These results largely stem from the overall lack of fish species (richness) captured and the lack of sensitive aquatic macroinvertebrate and fish species. The uniformly poor biology is somewhat surprising because habitat scores ranged from fair to good, with the best habitat found near the mouth of Silver Creek (MSHA of 72 at 09UM081).

The poor biological results may be more related to water chemistry than habitat. Assessable stream water quality data from the downstream segment of Silver Creek indicated that this segment does not meet the DO standard (Table 60). Increased algal production stemming from nutrient enriched Locke Lake immediately upstream of this stream segment may negatively influence DO concentrations in the lower stretches of Silver Creek (Table 60). Also, this reach was determined to be non-supporting for recreational activities due to bacterial (*E. coli*) exceedances. All reviewed turbidity data did not indicate impairment (Table 60).

The Silver Creek Watershed Unit consists of 21 lakes greater than four hectares (10 acres), of which 10 were assessed for aquatic recreation use (Table 61). Lakes in the Silver Creek Watershed Unit vary in size from small to moderately sized basins and are located throughout the watershed unit (Figure 25). Of the 10 lakes that were assessed, 7 were determined to be non-supporting of aquatic recreational use due to elevated nutrient concentrations (Table 61). In the case of Little Mary South, Silver, and Locke Lakes, large contributing catchment watersheds are potentially increasing nutrient levels due to a high level of external loading. Profile data was not available to determine internal contribution; however, a disturbance of the sediment due to lake mixing is another potential nutrient source for the shallow lakes (Little Mary North and South, and Millstone). The deeper impaired lakes (Silver, Locke, Mink, and Somers) are also likely receiving high levels of external nutrient contribution and further investigation will be required to fully determine the source of nutrient contributions. An overall reduction in external loading would prove beneficial for all impaired waters.

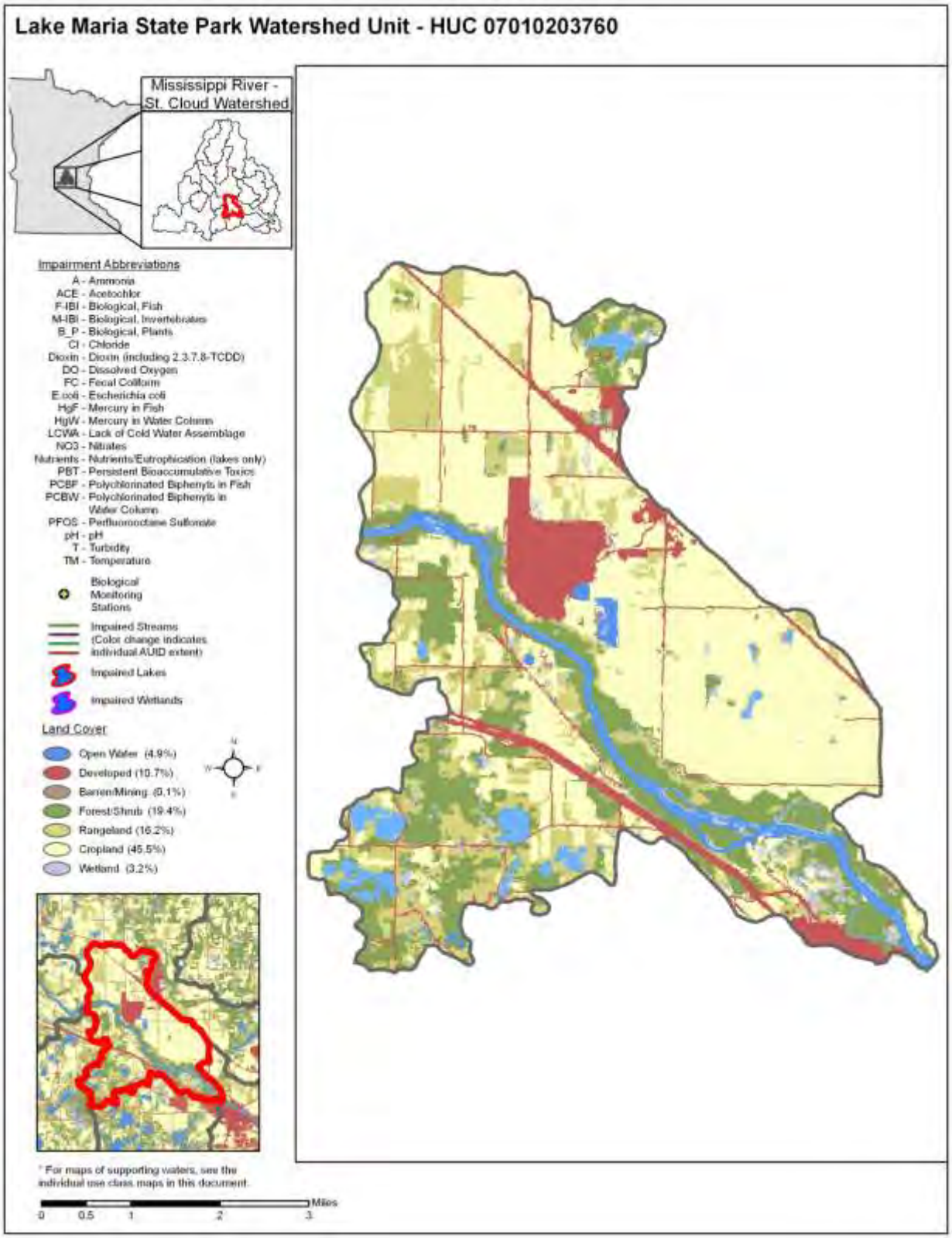
Figure 25. Currently listed impaired waters by parameter with land use characteristics for the Silver Creek Watershed Unit



Lake Maria State Park Watershed Unit HUC 07010203760

The Lake Maria State Park Watershed is located in the south central portion of the Mississippi River (St. Cloud) watershed and gets its name from the state park located in the southwest corner of the watershed unit. The park is known for its "Big Woods," a reference to the historic large stands of maple, basswood, white and red elm, red oak, tamarack, and red cedar forest that once dominated a large portion of south-central Minnesota. Today the predominant land use within the watershed is row crop agricultural lands (45.5 percent). The Lake Maria State Park watershed contains a short segment of the main-stem Mississippi River and a number of small lakes and wetlands. The segment begins at the confluence of Silver Creek and extends to the confluence with Otter Creek. There are no major streams or tributaries within this watershed unit. During the IWM effort, the MPCA did not monitor this portion of the main stem (Mississippi River) for biology. A separate monitoring strategy and report is being developed that will focus on the full extent of the Upper Mississippi River from the headwaters to the outlet of the Upper Mississippi River basin. In addition, lakes were not assessed for aquatic recreational because many of the lakes within this watershed were not large enough for water quality monitoring. Therefore, no monitoring information will be presented for this watershed unit.

Figure 26. Currently listed impaired waters by parameter with land use characteristics for the Lake Maria State Park Watershed Unit



Otter Creek Watershed Unit HUC 07010203770

The Otter Creek Watershed Unit encompasses an area of 26 square miles in the south central portion of the Mississippi River (St. Cloud) watershed. Land use in this watershed unit is a mixture of forest (24.2 percent), row crop agriculture (27.8 percent), and range (24 percent) lands. Several lakes are present within the watershed unit and contribute to the 9.5 percent of the watershed unit that is open water. Several small channelized streams and tributaries are located in the southwestern portion of the watershed; however there is limited connectivity with these waterbodies and Otter Creek. Otter Creek originates in two sources, one as drainage of First Lake (86-0067-00) and the other as a series of small channelized tributaries draining from an unnamed lake and agricultural lands (Figure 27). Otter Creek flows westerly, emptying into the Mississippi River approximately one mile upstream of the city of Monticello. Six of the eight lakes monitored contained sufficient information to make an aquatic recreational use assessment. In addition, the MPCA's biological monitoring staff visited one channelized monitoring station during the 2009 sampling season.

Table 63. Non--assessed channelized sites in the Otter Creek Watershed Unit

AUID ***Reach Name***, *Reach Description*	Reach Length (miles)	Use Class	Biological Station ID	Location of Biological Station	Fish IBI	Invert IBI
07010203-690 ***Otter Creek*** *First Lk to Unnamed Cr*	**1.14**	**2B**	09UM047	Downstream of CR 39, 1 mi. W of Monticello	Good	Fair

See Appendix 7 for clarification of the good/fair/poor thresholds and Appendix 8 and Appendix 9 for fish and macroinvertebrate IBI results; respectively. Parentheses indicate the number of visits to a given site and those sites with multiple visits have been averaged to determine the rating depicted in the table. Individual visit ratings for each biological community are reported in Appendix 8 and Appendix 9.

Table 64. Minnesota Stream Habitat Assessment (MSHA) Result for the Otter Creek Watershed Unit

			Land Use	Riparian	Substrate	Fish Cover	Channel Morph.	MSHA Score	MSHA
Visits	Site ID	Stream Name	(0-5)	(0-15)	(0-27)	(0-17)	(0-36)	(0-100)	Rating
1	09UM047	Otter Creek	1	8	9	12	16	46	Fair

Qualitative habitat ratings

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

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

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

Table 65. Aquatic Recreational Use Assessment (ARUS) results for the Otter Creek Watershed Unit

Name	DOW #	Area	Trophic Status	% Littoral	Max. Depth (ft)	Avg. Depth (ft)	CLMP Trend	Mean TP (ug/L)	Mean Chl-a (ug/L)	Mean Secchi (ft)	ARUS
Birch	86-0066-00	103	M	48.7	52	--	NT	18.57	5.15	4.17	FS
First	86-0067-00	14	E	59.7	35	--	--	--	--	1.8	IF
Mud	86-0068-00	29	E	66.5	37	--	--	--	--	1.65	IF
Long	86-0069-00	160	M	67.2	33	--	--	22	5.23	1.79	FS
Bertram	86-0070-00	137	E	23	42	5.9	--	31.88	12.5	1.54	FS
Cedar	86-0073-00	271	M	89.1	47	1.8	--	17.36	3.97	5.09	FS
Ida	86-0146-00	260	M	47.2	60	5.6	NT	14	4.83	4.02	FS
Eagle	86-0148-00	199	E	69.3	38	4.4	↑	32.33	13.93	2.03	FS

Abbreviations:
↑-- increasing/Improving Trend
↓--Decreasing/Declining Trend
NT – No Trend
H-Hypereutrophic
E – Eutrophic
M – Mesotrophic
O – Oligotrophic
FS—Full Support
NS – Non-Support
IF – Insufficient Information

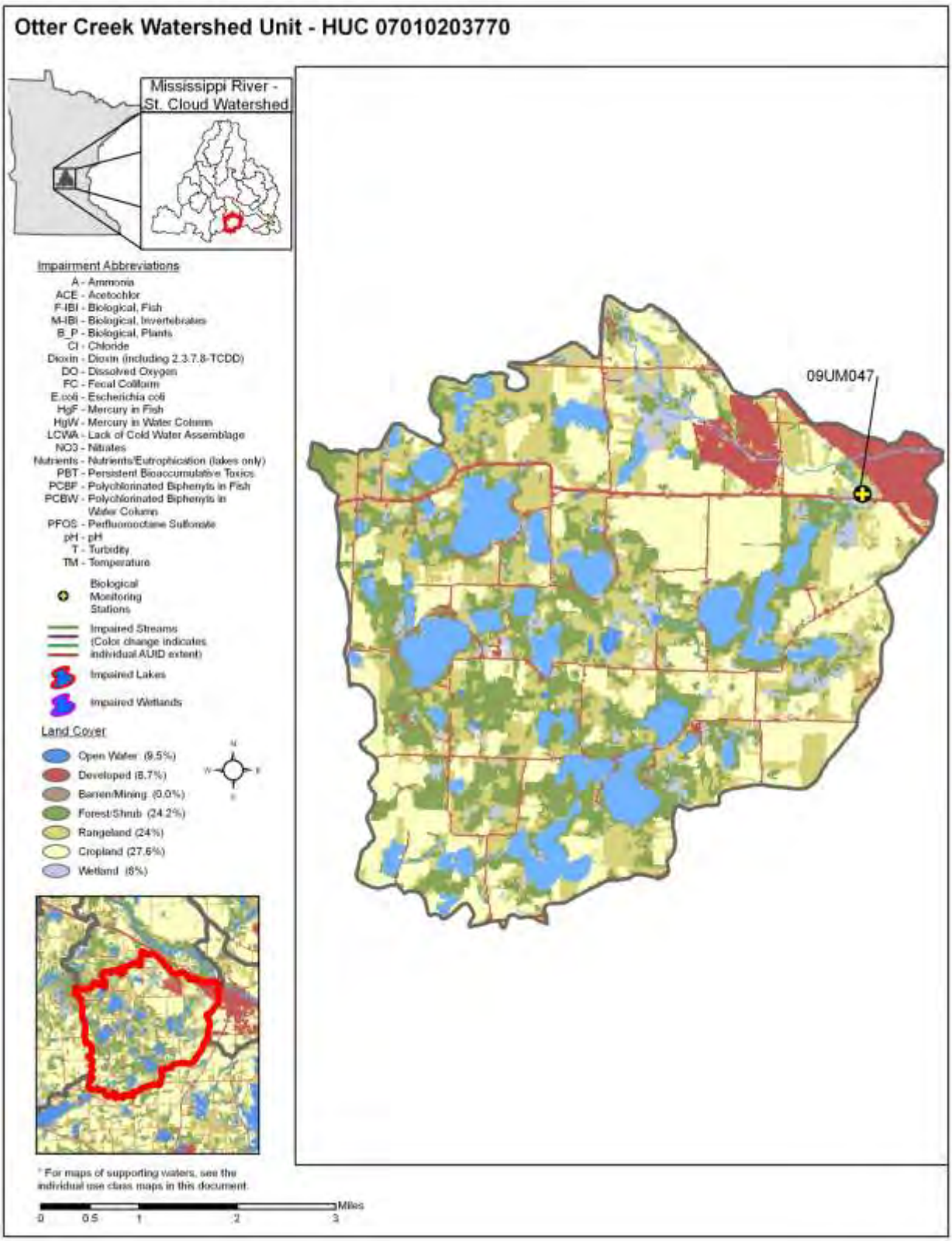
Summary

During the 2011 assessment cycle, two assessment units (AUIDs) were reviewed for aquatic life and aquatic recreational use within the Otter Creek watershed unit (Appendix 3). Limited data are available for AUID 901 (a stream connecting unnamed lake to birch lake) and Otter Creek (AUID 690) is channelized, therefore an assessment decision was not made for either of these stream segments during the 2011 assessment cycle.

Although a formal assessment was not made, biological communities on Otter Creek (AUID 690) were generally good. Several sensitive fish and aquatic macroinvertebrate species were present in the biological samples. Although habitat conditions were only fair, the healthy biological communities suggest that the channelized portion of Otter Creek may be recovering to a state where the habitat and water quality can support favorable biological communities.

The Otter Creek watershed unit consists of 13 lakes greater than four hectares (10 acres), of which five were assessed for aquatic recreation use. Three additional lakes were assessed; however the existing data were determined to be insufficient (Table 64). Lakes in the Otter Creek watershed unit vary in size from small to moderately sized basins and are located throughout the watershed (Figure 27). All five of the lakes that were assessed were determined to be supporting of aquatic recreational use. All of the lakes are classified as deep lakes and all of the lakes had small to moderately sized contributing catchments dominated by forest. Profile data from Cedar and Ida Lakes indicated stratification during the summer months. Despite the fully supporting assessment for Bertram and Eagle Lakes, both of these water bodies were determined to be eutrophic. A reduction in external loading would still prove beneficial for them.

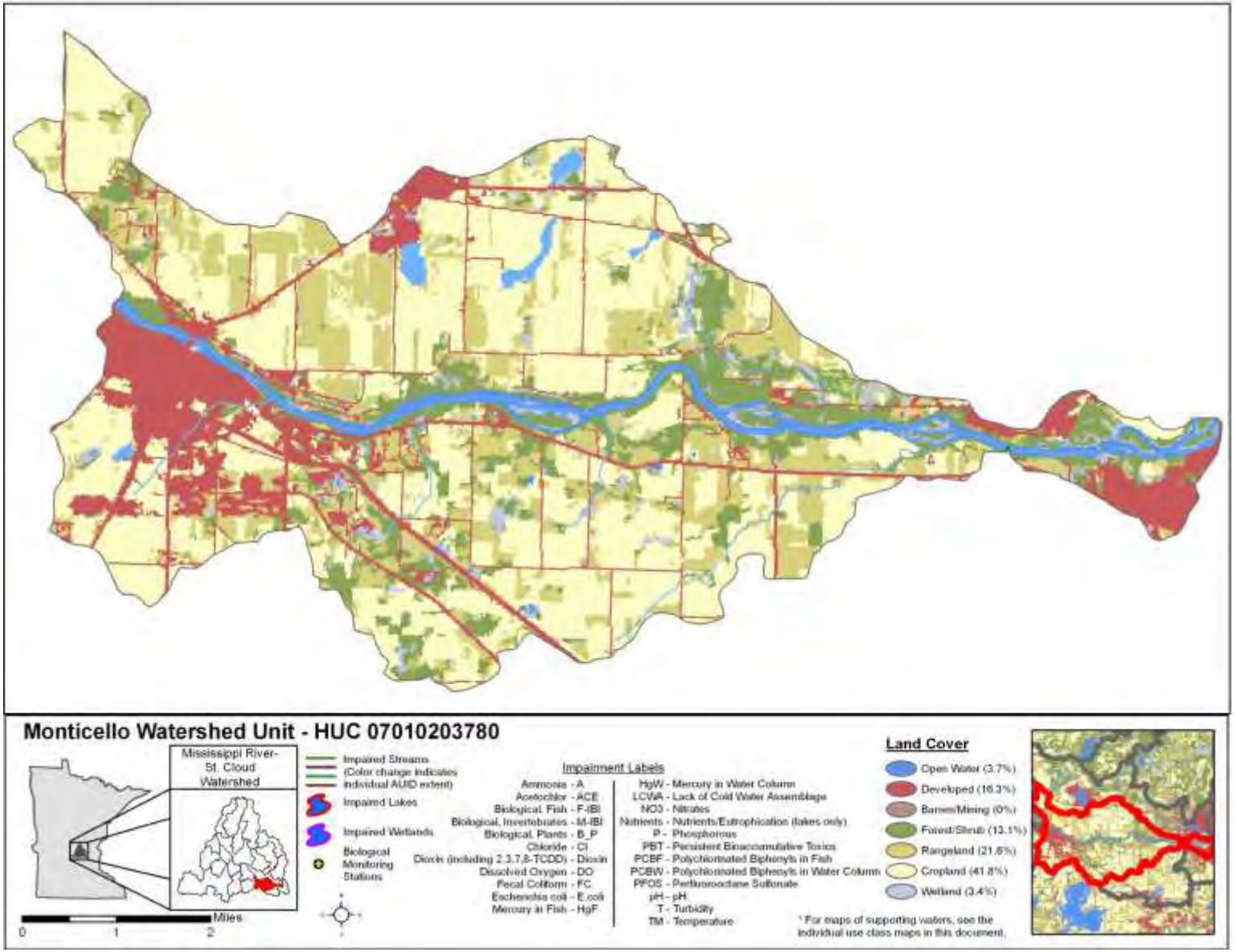
Figure 27. Currently listed impaired waters by parameter with land use characteristics for the Otter Creek Watershed Unit



Monticello Watershed Unit HUC 07010203780

The Monticello Watershed Unit encompasses an area of approximately 39 square miles in the southeastern portion of the Mississippi River (St. Cloud) watershed. This watershed is split between Sherburne and Wright counties. Land use within this watershed unit is predominately row crop agriculture (41.8 percent), while rangeland (21.6 percent), developed (16.3 percent) and forest/shrub (13.1 percent) makeup the other land uses (Figure 28). Many of the forest/shrub land riparian areas coincide with the Mississippi River Island Scientific and Natural Areas located in the east-central portion of this watershed unit. The Mississippi River flows through the central portion of this watershed unit, which extends from the confluence with Otter Creek (western boundary) to the confluence with the Elk River (eastern boundary). A few unnamed streams and tributaries, primarily located downstream of the city of Monticello occur throughout the watershed unit; however during the IWM effort the MPCA did not monitor this portion of the Mississippi River for biology. A separate monitoring strategy and report is being developed that will focus on the full extent of the Upper Mississippi River from the headwaters to the outlet of the Upper Mississippi River basin. In addition, lakes were not assessed for aquatic recreational use because many of the lakes within this watershed were not large enough for water quality monitoring. Therefore, no monitoring information will be presented for this watershed unit.

Figure 28. Currently listed impaired waters by parameter with land use characteristics for the Monticello Watershed Unit



Otsego Watershed Unit HUC 07010203790

At just over 14 square miles, the Otsego Watershed Unit is the smallest watershed unit within the Mississippi River (St. Cloud) watershed. This small watershed unit contains several channelized unnamed streams and tributaries between the cities of Albertville (south) and Otsego (north) (Figure 29). Over the last 20 years the Otsego Watershed Unit has seen a dramatic increase in development, particularly with the development of the Albertville outlet mall and increased expansion of housing development. Approximately 89 percent of the watershed unit is characterized by disturbed land use practices (cropland + rangeland + developed). Forest/shrub land habitats (3.9 percent) are limited to portions near the confluence with the Mississippi River and the east-central portion of the watershed unit (Figure 29).

Table 66. Life and Recreation Assessments on Stream Reaches in the Otsego Watershed Unit. Reaches are organized upstream to downstream in the table.

AUID ***Reach Name,*** *Reach Description*	Reach Length (miles)	Use Class	Biological Station ID	Location of Biological Station	Aquatic Life Indicators:								Bacteria	Aquatic Life	Aquatic Rec.
					F-IBI	M-IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides			
07010203-528 ***Unnamed Creek*** *T121 R23W S19, south line* *Mississippi R*	**3.02**	**2B**	09UM048	Upstream of 90th St., 1 mi. SW of Otsego	EXS	EXS	--	--	--	--	--	--	IF	NS	IF

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

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

Key for Cell Shading: = previous impairment or deferred impairment prior to 2012 reporting cycle; = new impairment; = full support of designated use.

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

Table 67. Non-assessed channelized sites in the Otsego Watershed Unit

AUID ***Reach Name,*** *Reach Description*	Reach Length (miles)	Use Class	Biological Station ID	Location of Biological Station	Fish IBI	Invert IBI
07010203-527 ***Unnamed Creek*** *Headwaters to T121 R23W S 30*	**2.61**	**7**	09UM052	Upstream of Mciver Ave., 1.5 mi. N of Albertville	Poor	--

See Appendix 7 for clarification of the good/fair/poor thresholds and Appendix 8 and Appendix 9 for fish and macroinvertebrate IBI results; respectively. Parentheses indicate the number of visits to a given site and those sites with multiple visits have been averaged to determine the rating depicted in the table. Individual visit ratings for each biological community are reported in Appendix 8 and Appendix 9.

Table 68. Minnesota Stream Habitat Assessment (MSHA) Result for the Otsego Watershed Unit

Visits	Site ID	Stream 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	09UM052	Trib. to Mississippi River	0	8.5	10	6	13	37.5	Poor
1	09UM048	Trib. to Mississippi River	2.75	14	13.3	6	23	59.05	Fair
Average Habitat Results*: Otsego Watershed Unit*			1.4	11.3	11.7	6.0	18.0	48.3	Fair

Qualitative habitat ratings

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

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

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

Table 69. Aquatic Recreational Use Assessment (ARUS) results for the Otsego Watershed Unit

Name	DOW #	Area	Trophic Status	% Littoral	Max. Depth (ft)	Avg. Depth (ft)	CLMP Trend	Mean TP (ug/L)	Mean Chl-a (ug/L)	Mean Secchi (ft)	ARUS
School	86-0025-00	76	H	100	5	4.0	-	261	105	-	NS
Hunters (Mud)	86-0026-00	128	H	100	4	3.0	-	521	150	-	NS

Abbreviations:

↑-- increasing/Improving Trend
↓--Decreasing/Declining Trend
NT – No Trend

H-Hypereutrophic
E – Eutrophic
M – Mesotrophic
O – Oligotrophic

FS—Full Support
NS – Non-Support
IF – Insufficient Information

Summary

During the 2011 assessment cycle, two assessment units (AUIDs) were reviewed for aquatic life and aquatic recreation use support within the Otsego Watershed Unit (Table 66). Site 09UM052 was located on a small channelized stream emanating from Mud Lake (AUID 527) downstream of the Albertville wastewater treatment plant. The stream segment (AUID 527) was not assessed because it is a limited resource value water (class 7) and currently is not protected for aquatic life. The lower stream segment nearest the Mississippi River (AUID 528) was impaired due to poor aquatic macroinvertebrate and fish bioassessment results (Table 66).

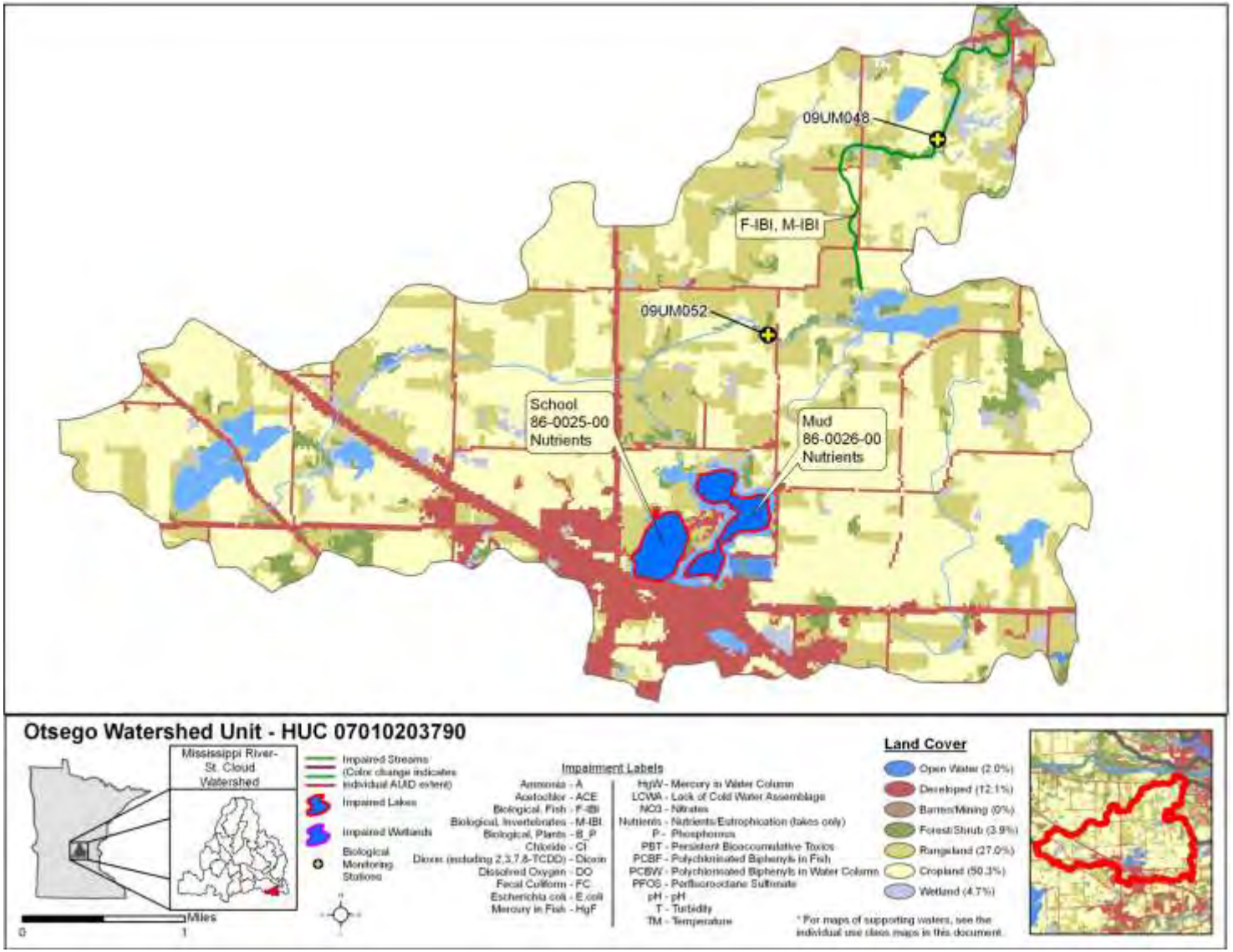
Biological communities within this watershed unit were very poor (Appendix 8 and 9). During the 2009 fish visit to 09UM048 (AUID 528) no fish were found. Similarly, the observed aquatic macroinvertebrate community from this location was among the worst in the Upper Mississippi River (St. Cloud) watershed and was characterized by only 18 unique species, all of which are adapted to tolerate periods of low DO concentrations.

Habitat conditions ranged from poor to fair, with the downstream station (09UM028) receiving a fair score, likely a result of a forested riparian corridor and better channel morphology. The marginally better habitat scores combined with the very poor biological results in the downstream reaches of this tributary stream suggest that habitat is not the sole limiting factor for fish and macroinvertebrate communities. Water chemistry issues should be investigated as a contributing factor to the poor aquatic assemblages found in this watershed.

The Otsego watershed consists of three lakes greater than four hectares (10 acres), of which two were assessed for aquatic recreation use. Water quality data for School Lake and Hunters Lake (Mud) was obtained through a discharge permit from the city of Albertville. The morphometric characteristics of both lake basins were analyzed and they were each determined to be shallow lakes. Both lakes were assessed and determined to be non-supporting of aquatic recreation use (Table 68). Residential development is the dominating land use within the watershed for both lakes (Figure 29). Profile data is not available for either lake to determine the mixing characteristics. However, based on their depth, internal nutrient contribution due to lake mixing is likely. Further investigation will be required to fully determine the source of nutrient contributions but an overall reduction in external loading will still prove beneficial.

Assessable stream water quality data was limited to a three mile unnamed creek which pours into the Mississippi River just west of the city of Otsego. E. Coli data was determined to be insufficient to make a complete assessment for aquatic recreation. However, the samples collected indicate the potential for an impairment as three of the data points were exceeding (Figure 29).

Figure 29. Currently listed impaired waters by parameter with land use characteristics for the Otsego Watershed Unit



VII. Watershed-Wide Results and Discussion

Assessment results and data summaries are included below for the entire Mississippi River (St. Cloud) HUC-8 watershed, grouped by sampling type. Summaries are provided for aquatic life and recreation uses in streams and lakes throughout the watershed and for aquatic consumption results at selected river and lake locations within the watershed.

A series of maps provide an overall summary of assessment results by designated use, impaired waters and fully supporting waters within the entire Mississippi River (St. Cloud) watershed.

Stream water quality

During the 2011 water quality assessment cycle, a total of 62 assessment units were reviewed for aquatic life use and aquatic recreation use (Appendix 3). Of those, 21 contained adequate data to assess aquatic life, 16 contained insufficient information and 25 assessments (nearly 40 percent) were deferred because greater than 50 percent of the assessment unit (AUID) was channelized or the biological monitoring station was located on a channelized stream reach on the AUID (Table 69). As noted in the watershed unit summaries, many of the deferred AUIDs within the Mississippi River (St. Cloud) watershed are meeting water quality standards for DO, turbidity, pH, and may meet standards for biological communities (Appendix 3 and 4).

Of the 21 AUIDs that were assessed for aquatic life, 6 were determined to be fully supporting and 15 were determined to be non-supporting of aquatic life (Table 69). Of these 15 AUIDs, 5 were existing impairment that were carried forward from a previous assessment cycle. However in most cases, additional water quality parameters were added to the original impairment (Appendix 3). Eighteen of the 20 AUIDs assessed for aquatic recreation are currently in violation of the bacteria standard..

Table 70. Assessment summary for stream water chemistry in the Mississippi River (St. Cloud) Watershed

			Supporting		*Non-Support*			
Watershed Unit	**Area (acres)**	**# Assessed AUIDs**	**# Aquatic Life**	**# Aquatic Recreation**	**# Aquatic Life**	**# Aquatic Recreation**	**Insufficient Data**	**Deferred**
Mississippi River HUC 8		**21**	**6**	**2**	**15**	**18**	**16**	**25**
Upper Elk River	52,843	1	0	0	1	1	0	0
Mayhew Creek	32,878	2	0	0	1	1	0	1
Stony Brook and Rice Creek	29,170	4	1	0	1	1	1	1
Lower Elk River	82,899	14	3	0	1	2	8	2
Snake River	28,124	3	0	0	0	1	1	2
Upper St. Francis River	61,442	5	0	0	1	1	0	4
Battle Brook	33,880	4	0	0	1	1	1	2
St. Francis River	38,669	2	0	1	2	1	0	0
Tibbits Creek	28,302	2	0	0	0	2	0	2
Johnson Creek	33,132	5	2	0	1	4	1	1
Plum Creek	20,967	2	0	0	0	1	0	2
Clearwater River	115,811	11	0	1	3	1	3	5
Silver Creek	25,921	3	0	0	2	1	0	1
Otter Creek	16,712	2	0	0	0	0	1	1
Otsego	9,037	2	0	0	1	0	0	1

Biological monitoring

Fish

The Upper Mississippi River Basin contains 16 HUC 8 watersheds and encompasses an area of 22,268 square miles. Historically, this basin contained 76 fish species (Siems *et al.* 2001). The Mississippi River (St. Cloud) watershed accounts for approximately five percent of the entire Upper Mississippi River basin (1,121 square miles). During the IWM effort, MPCA biological monitoring crews sampled 58 fish species, totaling 37,413 individuals (Appendix 10). Of these, the dominant species in terms of number of individuals observed were white sucker (6,227), common shiner (4,494), central mudminnow (4,118), johnny darter (2,971) and hornyhead chub (2,703). Likewise, these fish also represent the taxa encountered at the most monitoring sites within the watershed. For example, central mudminnows were observed at all but eight stations within the watershed. Several species were sampled only from one station such as bigmouth buffalo, brown bullhead, brown trout, burbot, finescale dace, hybrid Phoxinus, smallmouth buffalo and trout-perch (Appendix 10). There were no species of special concern or rare taxa observed.

Macroinvertebrates

Invertebrates were collected from several habitat types throughout the Mississippi River (St. Cloud) watershed, however the most frequently sampled habitats included undercut banks/overhanging vegetation, and aquatic macrophytes. Other habitat types included riffle/rock and woody debris. The most common macroinvertebrate taxa encountered were *Polypedilum* (diptera), *Hyalella* (Amphipoda), Pisidiidae (Bivalvia), *Cricotopus* (Diptera), *Physa* (Gastropoda) and *Caenis* (Ephemeroptera). Many of these taxa were also the most numerous macroinvertebrates captured, *Hyalella* (4,293), *Physa* (865), *Caenis* (844), Oligochaeta (830), and *Simulium* (819). It is important to note that all of these macroinvertebrate taxa are tolerant or very tolerant of environmental disturbance. Many of the intolerant/sensitive taxa were observed throughout the watershed and were often encountered in single digit numbers.

Watershed wide

The dominance of tolerant and/or very tolerant fish and macroinvertebrate species, along with a relatively high rate of aquatic life impairments (71 percent), suggests that more should be done to restore and protect the biological integrity of many of the streams within the watershed. Land use practices that encroach upon streams should be mitigated through the targeted use of best management practices and voluntary efforts to conserve and preserve riparian habitats throughout the watershed.

On streams that were assessed for macroinvertebrates, 12 stream segments (AUIDs) met their respective thresholds for M-IBI, while 9 AUIDs scoring below their respective M-IBI thresholds (Appendix 3). For those AUIDs that were not assessed for macroinvertebrates due to channelization, 8 sites received poor, 8 had fair, and 8 had good M-IBI ratings, respectively (Appendix 9). Fifteen AUIDs scored below their respective F-IBI threshold and seven AUIDs met or exceeded their respective F-IBI thresholds (Appendix 3). Of the AUIDs not assessed for fish due to channelization, 16 received good, 5 had fair, and 14 had poor F-IBI ratings.

Fish contaminant results

The Elk River is divided into six segments (AUIDs), not including Elk Lake (71-0141) and Orono Lake (71-0013). All six AUIDs are listed as impaired for aquatic consumption because of elevated levels of mercury in fish tissue. Orono Lake –Upper and Lower—is also listed as impaired for mercury in fish tissue. Elk Lake has not been tested for fish tissue contamination. A summary of descriptive statistics for mercury and PCBs (Table 70) indicates mercury exceeded the threshold of 0.2 mg/Kg in the 90^{th} percentiles of northern pike, smallmouth bass, shorthead redhorse and walleye from Elk River.

In 1999, four common carp were collected from Elk River and composited into one sample for PCB analysis; also, one northern pike and one walleye were analyzed for PCBs. Smallmouth bass and shorthead redhorse were collected from Elk River in 2009 and the two largest fish in each species were analyzed for PCBs. All PCB results, except for the carp collected in 1999, were below the detection limit for PCBs; the carp sample from 1999 was only slightly above the detection limit. Therefore, none of the fish species were impaired for PCBs.

The Minnesota Department of Health has fish consumption advice for Elk River. Consumption advice can be based on the data from one fish. Advice for sensitive populations (women who are or may become pregnant and children under age 15) is one meal per week for carp and walleye, and one meal per month for northern pike. These advisories are based on the fish collected in 1999 and have not been updated with the 2009 fish collections.

Nine of the 15 lakes with fish contaminant data are listed as impaired because of the level of mercury in fish tissue (Table 70). The impaired lakes are Betsy (Betty), Big, Cedar, Clearwater (East and West), Mayhew, Orono, Pleasant, Silver, and Union. The 90^{th} percentile values for mercury that exceed the threshold of 0.2 mg/kg correspond to those impaired waters. Silver Lake (86-0140) is an exceptional case, however, because the only species exceeding the threshold was snapping turtle collected in 1981. Fish collected in 2002 did not have mercury levels that exceeded the impairment threshold. Therefore, this latest evaluation of the fish contaminant information indicates Silver Lake could be removed from the impaired waters inventory.

Pleasant Lake (86-0251) has a one meal per week fish consumption advisory for bluegill sunfish and one meal per month advisories for largemouth bass, northern pike, and walleye. Results compiled in Table 70 for Pleasant Lake indicate the mercury levels in the three top predator species were indeed high. The last fish collection for contaminants in Pleasant Lake was in 1997; therefore, it would be beneficial to test the fish again to see if the mercury levels have remained high. A recommendation for another fish collection will be made to the MDNR.

Table 71. Descriptive statistics of mercury and PCB concentrations in fish species from Elk River and lakes within the Mississippi River (St. Cloud) watershed

						Total Length (in)				Mercury (mg/Kg)						PCBs (mg/Kg)			
Waterway	AUID	Species	Year	N Fish	N	Mean	Median	Min	Max	Mean	Median	Min	Max	90th Pctl	90th Pctl-post 1998	N	Mean	Min	Max
ELK River	07010203-507, 507, 581, 579, 548, 525	Common Carp	1999	4	1	23	23			0.18	0.18					1	0.029		
		Northern pike	1999	7	7	20.7	20.6	18.2	23.8	0.229	0.22	0.17	0.28	0.278	0.278	1	< 0.01		
		Smallmouth bass	2009	6	6	14.6	14.5	12.8	16.6	0.221	0.177	0.132	0.407	0.394	0.394		< 0.025	< 0.025	< 0.025
		Shorthead redhorse	2009	5	5	17.5	18.6	13.5	19	0.113	0.079	0.055	0.204	0.204	0.204		< 0.025	< 0.025	< 0.025
		Walleye	1999	8	8	13.6	13.3	11.8	16	0.17	0.175	0.06	0.23	0.224	0.224	1	< 0.01		
BASS	86023400	Bluegill sunfish	2001	10	1	6.3	6.3			0.06	0.06								
		Yellow bullhead	2001	5	1	9.1	9.1			0.137	0.137					1	< 0.01		
BETTY	47004200	Black bullhead	2007	8	1	9.8	9.8			0.114	0.114								
		Black crappie	2007	10	1	8.5	8.5			0.07	0.07								
		Northern pike	2007	6	6	23	22.4	18.8	27.4	0.241	0.202	0.118	0.506	0.481	0.481				
BIG	71008200	Bluegill sunfish	2004	7	1	6.3	6.3			0.065	0.065								
		Black crappie	2004	12	1	7.6	7.6			0.062	0.062								
		Common Carp	2004	3	1	25.6	25.6			0.073	0.073					1	0.08		
		Largemouth bass	2004	5	5	13.3	13.4	12	15.2	0.225	0.25	0.143	0.268	0.268	0.268				
		Northern pike	2004	6	6	22.8	21.9	17.4	30.5	0.282	0.264	0.219	0.381	0.374	0.374				
		Walleye	2004	5	5	24.1	24	21.2	27.4	0.67	0.628	0.402	0.909	0.909	0.909				
BRIGGS	71014600	Northern pike	1993	15	3	22.6	22.4	19.3	26	0.048	0.042	0.036	0.065	0.065		1	< 0.01		
		White sucker	1993	8	1	16	16			0.023	0.023								
CEDAR	86022700	Black crappie	1991	10	1	9.2	9.2			0.2	0.2								
		Northern pike	1991	16	3	22.9	22.9	18.5	27.3	0.36	0.35	0.27	0.46	0.46		2	< 0.01		
		White sucker	1991	2	1	18.6	18.6			0.057	0.057					1	< 0.01		
CLEAR	47009500	Bluegill sunfish	1993	10	1	6.2	6.2			0.044	0.044								
		Walleye	1993	13	2	14.5	14.5	11.2	17.8	0.112	0.112	0.073	0.15	0.15		1	< 0.01		
		White sucker	1993	6	1	15.4	15.4			0.015	0.015								

CLEARWATER	86025200	Bluegill sunfish	1997	11	1	7	7			0.13	0.13								
			2005	7	1	7.1	7.1			0.085	0.085								
		Common Carp	2005	2	1	23.1	23.1			0.066	0.066					1	0.02		
		Largemouth bass	2005	5	5	14.1	12.8	12	18.3	0.528	0.554	0.207	1.007	1.007	0.769				
			2006	6	6	11.3	11.3	10.2	12.6	0.269	0.227	0.191	0.449	0.437					
		Northern pike	1987	5	3	25.2	24.7	22.5	28.4	0.417	0.28	0.27	0.7	0.7		1	0.05		
			1997	10	10	22.8	22.7	17.9	27	0.313	0.285	0.17	0.57	0.51		2	< 0.01		
			2005	6	6	25.3	25	22	28.8	0.418	0.374	0.316	0.631	0.613	0.613				
		Walleye	1979	5	1	17.6	17.6			0.22	0.22								
			1987	5	3	22.1	21.5	17.9	26.8	0.567	0.7	0.28	0.72	0.72		1	0.05		
			1997	11	11	20.5	19.6	18.5	27.1	0.608	0.63	0.38	0.82	0.748		2	< 0.01		
			2005	5	5	21.4	21.3	18.9	25	0.495	0.517	0.371	0.635	0.635	0.635				
		White sucker	1979	10	2	21.2	21.2	20.7	21.7	0.085	0.085	0.07	0.1	0.1					
			1997	8	1	18	18			0.09	0.09					1	< 0.01		
		Yellow bullhead	1987	5	1	10.4	10.4			0.09	0.09					1	0.05		
EAGLE	71006700	Black crappie	2002	8	1	8.8	8.8			0.062	0.062								
		Common Carp	2002	3	1	25.6	25.6			0.033	0.033								
		Northern pike	2002	5	5	19.8	19.7	18.2	21.5	0.047	0.047	0.041	0.053	0.053	0.053				
MAYHEW	5000700	Black crappie	1996	9	1	8.6	8.6			0.12	0.12								
		Northern pike	1996	2	1	22.8	22.8			0.23	0.23					1	< 0.01		
ORONO	71001300	Common Carp	1987	18	6	20.1	20.2	19.4	20.5	0.26	0.23	0.19	0.44	0.421		6	< 0.01	< 0.01	< 0.01
		Northern pike	2007	2	2	17.5	17.5	17.4	17.5	0.191	0.191	0.145	0.237	0.237					
		Smallmouth bass	1987	6	2	11.2	11.2	11.2	11.2	0.13	0.13	0.12	0.14	0.14		2	< 0.01	< 0.01	< 0.01
			2007	24	24	11.2	11.4	7.9	14.4	0.11	0.099	0.017	0.23	0.222	0.222				
		Yellow perch	2007	2	1	4.5	4.5			0.063	0.063	0.063	0.063						

Figure 30. Aquatic life use support in the Mississippi River (St. Cloud) Watershed

Figure 31. Aquatic recreation use support in the Mississippi River (St. Cloud) Watershed

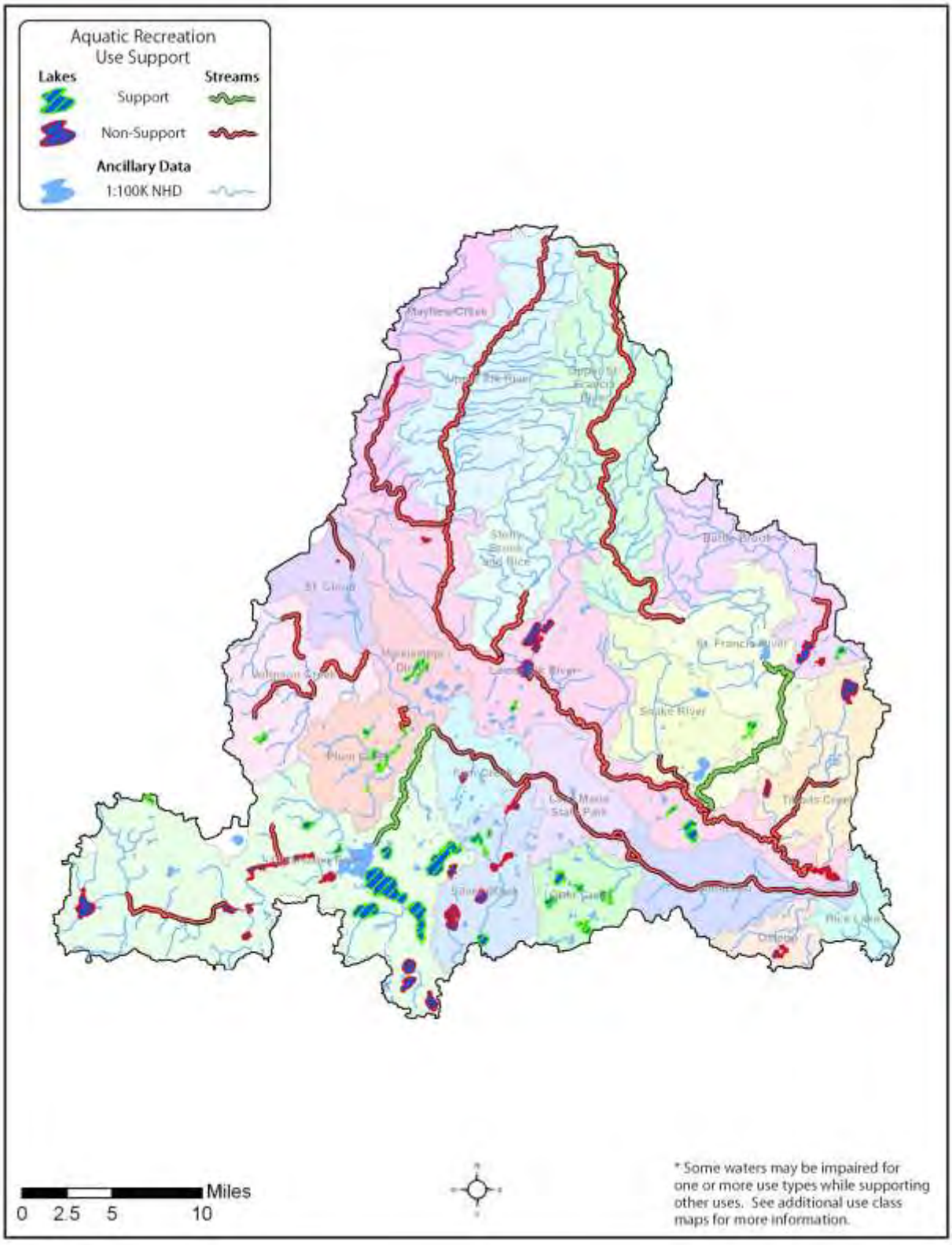


Figure 32. Aquatic consumption use support in the Mississippi River (St. Cloud) Watershed

Figure 33. Impaired waters by designated use in the Mississippi River (St. Cloud) Watershed

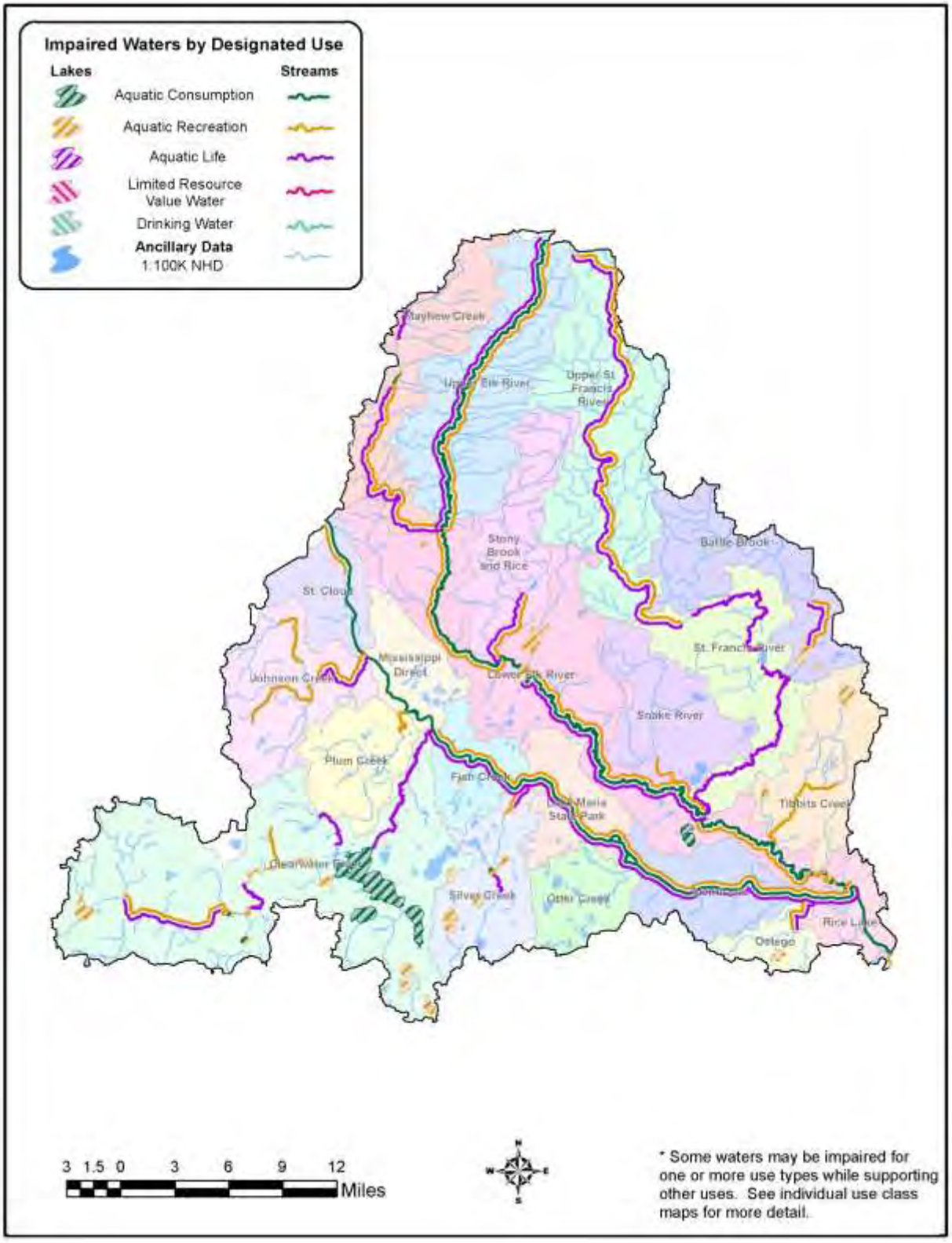


Figure 34. Fully supporting waters by designated use in the Mississippi River (St. Cloud) Watershed

VIII. Summaries and Recommendations

The Mississippi River (St. Cloud) watershed is a diverse landscape; however the predominant land uses within the watershed are that of row crop agriculture and rangeland habitats, accounting for approximately 62 percent of the watershed as a whole. Of concern are the many areas where the riparian zones have been removed or reduced to allow for, in some cases, increases in agricultural and/or urban development. Importantly, several areas have wide and extensive forest riparian corridors (i.e. Lake Maria State Park, Mississippi River SNA and the Sherburne National Wildlife Area), which may ameliorate the negative influence of land use disturbances. Based on the results of the 2011 water quality assessment cycle, these areas should be conserved and management practices should be focused on areas near sensitive waterbodies.

Likely best management practice (BMP) projects for the watershed may include but are not limited to: improving conditions in feedlots along riparian corridors, protection of remaining forested areas and natural landscapes, improve riparian buffer (i.e. grassland corridors) strips along waterbodies, and reducing levels of total phosphorous in order to reduce the occurrence of algal blooms for lakes. Measures should be taken to work with landowners in the watershed to target BMPs and these areas should be monitored to determine the effectiveness of these efforts.

In conjunction with the IWM cycle, which began in 2009, a Watershed Restoration and Protection Project (WRAP) began in 2012. Through the integral assistance of local partners and citizen input, the WRAP process will provide the overall water quality framework for strategies and methods for achieving water quality standards for the waters within the Mississippi River (St. Cloud) watershed. The WRAP will integrate TMDLs for the restoration of impaired waters and protection needs for unimpaired waters into a watershed plan. To help achieve the overall water quality goals within the watershed, the watershed plan will identify target areas for the implementation of BMPs. Upon the completion of the WRAP process in 2013/2014, through the cooperation of local partners, an implementation phase will commence based on the watershed plan recommendations. The Mississippi River (St. Cloud) watershed will be subsequently re-evaluated in 2019 during the next IWM cycle for progress made through a reassessment of the surface water resources.

Throughout the Mississippi River (St. Cloud) watershed, a number of TMDL projects aimed at restoring water quality for impaired waters or protecting high-quality waters have already been completed or are in progress. For a specific list of these TMDL plans and their specific targets within this watershed, please visit the MPCA website: (http://www.pca.state.mn.us/index.php/water/water-types-and-programs/watersheds/mississippi-river-st.-cloud.html#restoration-and-protection). In addition to the TMDL study, stressor identification (SID) will be used to identify the probable causes of impaired fish and aquatic macroinvertebrate communities. The SID process looks at the chemical, physical, and habitat availability to determine the likely causes of low biological IBI scores. Linkages are made to biology through the most likely causal pathways of common pollutants and land use characteristics to determine what may be inhibiting the biological communities.

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Appendix 1. Water Chemistry Parameter 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.

Dissolved Orthophosphate - Dissolved Orthophosphate (DOP) is a water soluble form of phosphorus that is readily available to algae (bio-available) (MPCA and MSUM 2009). 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.

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

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

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

Total Phosphorus (TP) - Nitrogen (N), phosphorus (P), and potassium (K) are essential macronutrients and are required for growth by all animals and plants. Lack of sufficient nutrient levels in surface water often restricts the growth of aquatic plant species (University of Missouri Extension 1999). In freshwaters such as lakes and streams, phosphorus is typically the nutrient limiting growth; increasing the amount of phosphorus entering a stream or lake will increase the growth of aquatic plants and other organisms. Although phosphorus is a necessary nutrient, excessive levels over-stimulate aquatic growth in lakes and streams resulting in reduced water quality. The progressive deterioration of water quality from overstimulation of nutrients is called eutrophication where, as nutrient concentrations increase, the surface water quality is degraded (University of Missouri Extension 1999). Elevated levels of phosphorus in rivers and streams can result in: increased algae

growth, reduced water clarity, reduced oxygen in the water, fish kills, altered fisheries, and toxins from cyanobacteria (blue green algae) which can affect human and animal health (University of Missouri Extension 1999). In “non-point” source dominated watersheds, total phosphorus (TP) concentrations are strongly correlated with stream flow. During years of above average precipitation, TP loads are generally highest.

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

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

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

Unnionized Ammonia (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. Intensive Water Chemistry Monitoring Stations in the Mississippi River (St. Cloud) Watershed

Biological Station ID	EQUIS ID	Waterbody Name	Location	11-digit HUC
09UM005	S005-539	Elk River	Upstream of 35th St, 6 mi. NE of St Cloud	07010203010
09UM003	S002-946	Mayhew Creek	Upstream of CR 8, 4.5 mi. E of St Cloud	07010203020
09UM009	S001-523	Rice Creek	Downstream of 57th St SE, 3 mi. NE of Clear Lake	07010203030
09UM017	S000-278	Elk River	Upstream of CR 15, 2.5 mi. E of Big Lake	07010203040
09UM013	S003-006	Snake River	Upstream of 185th Ave, 5 mi. E of Becker	07010203050
99UM028	S004-704	Battle Brook	@ C.R. 9, ~ .1 mi. W. of C.R. 102, ~4.0 mi. No. of Zimmerman	07010203070
09UM015	S005-582	St. Francis River	Upstream of CR 15, 5 mi. SW of Zimmerman	07010203080
09UM021	S005-538	Tibbits Brook	Upstream of 209th Ave NW, 4.5 mi. E of Big Lake	07010203090
09UM041	S003-370	Johnson Creek	Upstream of CR 75, 5 mi. S of St Cloud	07010203710
09UM033	S004-508	Clearwater River	Upstream of CR 145, 0.5 mi. SE of Clearwater	07010203730
09UM045	S005-540	Silver Creek	Upstream of 155th St NW, 1 mi. E of Hasty	07010203750

Appendix 3. AUID Table of Results by Parameter and Beneficial Use

				Uses					Biological Criteria		Water Quality Standards											Ecoregion Expectations			
National Hydrography Dataset (NHD) Assessment Segment AUID	Stream Segment Name	Segment Description	NHD Length (Miles)	Use Class	Aquatic Life	Aquatic Recreation	Aquatic Consumption		Fish	Macroinvertebrates	Acetochlor	Alachlor	Atrazine	Chloride	Bacteria (Aquatic Recreation)	Metolachlor	Dissolved Oxygen	pH	Turbidity	Un-ionized ammonia		Oxygen Demand (BOD)	Nitrate/Nitrite	Total Phosphorous	Suspended Solids
HUC-11: 07010203010 (Upper Elk River)																									
07010203-508	Elk River	Headwaters to Mayhew Cr.	27.14	2B	NS	NS	NS		-	-					-			+	+	+					
HUC-11: 07010203020 (Mayhew Creek)																									
07010203-675	Mayhew Creek	Unnamed Creek to CD 7	2.1	2B	NS	NA	NA		-	-															
07010203-509	Mayhew Creek	Mayhew Lake to Elk River	15.42	2B	NA	NS	NA		NA	NA					-		-	+	+	+		+	-	-	
HUC-11: 07010203030 (Stony Brook and Rice Creek)																									
07010203-520	Stony Brook	T37 R29W S35	5.9	7	NA	NA	NA		NA	NA															
07010203-546	Stony Brook	T36 R29W S17	10.96	2B	FS	NA	NA		+	+									+						
07010203-685	Unnamed Creek	Unnamed Creek to Rice Creek	2.14	2B	NA	NA	NA		NA	NA															
07010203-512	Rice Creek	Rice Lake to Elk River	7.22	2C	NS	NS	NA		+	+					-		-	+	-	+					

HUC-11: 07010203040 (Lower Elk River)																											
07010203-507	Elk River	Mayhew Cr to Rice Cr	15.13	2B	FS	NS	NS		+	+					-		IF	+	+				-	-		
07010203-684	Unnamed Creek	Unnamed Cr to Elk R	1.64	2B	NA	NA	NS		NA	NA																
07010203-581	Elk River	Rice Cr to Elk Lk	2.04	2B	IF	NA	NS												+						+	
07010203-902	Unnamed Creek	Briggs Lk to Elk R	0.9	2b	NA	NA	NA												IF							
07010203-538	Briggs Creek	North line to Briggs Lk	5.83	2A	FS	NA	NA		+	+									IF						+	
07010203-585	Unnamed Creek	Headwaters to Julia Lk	0.81	2B	IF	NA	NA												+						+	
07010203-541	Lilly Creek	Rush Lk to Elk Lk	0.58	2B	NA	NA	NA												-						+	
07010203-568	Unnamed Creek	Unnamed Lk (71-0120-00) to Elk Lk	1.43	2B	IF	NA	NA												+						+	
07010203-579	Elk River	Elk Lk to St. Francis R	23.37	2B	NS	IF	NS		-	+					IF		IF	-	-				-	-		
07010203-687	Unnamed Creek	Headwaters to Unnamed Cr	0.54	2B	NA	IF	NA								IF											
07010203-688	Unnamed Creek	Headwaters to Unnamed Cr	2.68	2B	IF	IF	NA								IF		IF	+					-	-		
07010203-689	Unnamed Creek	Unnamed Cr to Elk R	1.59	2B	IF	IF	NA		NA	NA					IF		IF	+					-	-		
07010203-548	Elk River	St. Francis R to Orono Lk	11.75	2B	FS	NS	NS		+	+				+	-		+	+	+	+			-	-	-	
07010203-525	Elk River	Orono Lk to Mississippi R	1.53	2B	IF	NA	NS												+							
HUC-11: 07010203050 (Snake River)																										
07010203-529	Snake River	Unnamed Cr to Eagle Lk Outlet	2.84	2A	IF	NS	NA		NA	NA					-		IF	+	+				-	+		
07010203-558	Snake River	Headwaters to Unnamed Cr	11.41	2A	NA	NA	NA		NA	NA																

07010203-692	Unnamed Creek (Eagle Lk Outlet)	Eagle Lk to Snake R	1.25	2B	IF	NA	NA										IF	+					-	+	
HUC-11: 07010203060 (Upper St. Francis River)																										
07010203-693	West Branch St. Francis R	Unnamed Cr to St. Francis R	1.08	2B	NA	NA	NA		NA	NA																
07010203-700	St. Francis R	Headwaters to Unnamed Lk (71-0371-00)	41.12	2B	NS	NS	NA		-	-							IF	+	+	+			-	-	
07010203-614	Unnamed Creek	Unnamed Cr to Unnamed Cr	0.62	2B	NA	NA	NA		NA	NA																
07010203-694	County Ditch 13	Unnamed ditch to St. Francis R	0.8	2B	NA	NA	NA		NA																	
07010203-695	County Ditch 22	Headwaters to St. Francis R	3.74	2B	NA	NA	NA		NA																	
HUC-11: 07010203070 (Battle Brook)																										
07010203-696	County Ditch 6	Unnamed ditch to St. Francis R	2.61	2B	NA	NA	NA																			
07010203-697	County Ditch 5	Unnamed ditch to Unnamed ditch	1.09	2B	NA	NA	NA																			
07010203-535	Battle Brook	CD 18 to Elk Lk	5.23	2C	NS	NS	NA		-	-					-		IF	+	+	+			-	+	
07010203-537	Battle Brook	Elk Lk to St. Francis R	1.15	2B	NA	NA	NA																			
HUC-11: 07010203080 (St. Francis River)																										
07010203-704	St. Francis River	Unnamed Lk (71-0731-00) to Rice Lk	13.96	2B	NS	NA	NA		-	+									IF							
07010203-702	St. Francis River	Rice Lk to Elk R	22.98	2B	NS	FS			-	+					+		IF	+	+	+		-	+	+	

HUC-11: 07010203090 (Tibbits Creek)																											
07010203-522	Tibbits Brook	Rice Lk to Elk R	6.62	2C	IF	NS	NA		NA	NA					-		IF	+	+	+			-	-	
07010203-523	Unnamed Ditch	Headwaters (Lk Fremon 71-0016-00) to Tibbits Bk	5.9	2B	NA	NA	NA		NA																
HUC-11: 07010203710 (Johnson Creek)																											
07010203-724	Unnamed Creek (Robinson Hill Creek)	CD 14 to CSAH 136	4.4	2B	NA	NS	NA		NA	NA					-		IF		+				-		
07010203-633	Johnson Creek (Meyer Creek)	Unnamed Cr to Unnamed Cr	2.98	2A	FS	NA	NA		+	+									IF						
07010203-561	Unnamed Creek (Luxemburg Ck)	T123 R28W S30, South line to Johnson Cr	5.5	2A	FS	NS	NA		+	+				+	-		IF	+	IF				-		
07010203-635	Johnson Creek (Meyer Creek)	Unnamed Cr to Unnamed Cr	0.99	2A	IF	NS	NA							+	-		IF	+	+				-		
07010203-639	Johnson Creek (Meyer Creek)	T123 R28W S14, West line to Mississippi R	6.37	2B	NS	NS	NA		-	+				+	-		IF	+	+				-	+	
HUC-11: 07010203720 (Plum Creek)																											
07010203-572	Plum Creek	Warner Lk to Mississippi R	2.5	2B	IF	NS	NA		NA	NA				+	-		IF	+	IF				+		
07010203-676	Plum Creek	Unnamed Cr to Maria Lk	3.56	2B	NA	NA	NA		NA																

HUC-11: 07010203730 (Clearwater River)																												
07010203-533	County Ditch 20	Unnamed Cr to Unnamed Cr	2.33	2B	IF	NA	NA		NA	NA				+						+			-		
07010203-550	County Ditch 40	Clear Lk to Clearwater R	2.05	2B	IF	NA	NA		NA	NA				+						-			-	-	
07010203-549	Clearwater River	CD 44 to Lk Betsy	8.4	2B	NA	NA	NA		NA	NA				+			NA			+			-	-	
07010203-515	Willow Creek	Headwaters to Lk Betsy	4.48	2A	NA	NA	NA												IF						
07010203-717	Clearwater River	Scott Lk to Lk Louisa	3.87	2B	NS	NA	NA		-	-				+					+						
07010203-566	Unnamed Creek (Thief Creek)	Headwaters to Lk Louisa	0.92	2A	NA	NA	NA							IF											
07010203-565	Unnamed Creek (Fairhaven Creek)	Headwaters to Lk Louisa	2.33	2A	NA	NS	NA							+	-		IF	+	IF				-		
07010203-545	Threemile Creek	Unnamed stream outlet of Lk Lur to T122 R28W S36	3.4	2A	NS	NA	NA		-	+															
07010203-544	Threemile Creek	T122 R28W S35, East line to Otter Lk	0.28	2B	IF	IF	NA							+	IF		IF	+	+				-		
07010203-611	Unnamed Creek	Nixon Lk to Clearwater R	2.22	2B	NA	NA	NA							+						+					
07010203-511	Clearwater River	Clear Lk to Mississippi R	11.79	2B	NS	FS	NA		-	+				+	+		+	+	+	+		+	-	+	
HUC-11: 07010203750 (Silver Creek)																												
07010203-555	Silver Creek	Little Mary Lk to Locke Lk	3.1	2B	IF	NA	NA		NA	NA									+						
07010203-557	Silver Creek	Locke Lk to Mississippi R	1.98	2B	NS	NS	NA		-	-					-		-	+	+	+			-	+	
07010203-662	Silver Creek	Unnamed Cr to Silver Lk	1.49	2B	NS	NA	NA		-	-															

HUC-11: 07010203770 (Otter Creek)																										
07010203-690	Otter Creek	First Lk to Unnamed Cr	1.14	2B	NA	NA	NA		NA	NA																
07010203-901	Unnamed Creek	Unnamed Lk (86-0092-00) to Birch Lk	0.08	2B	NA	NA	NA													NA						
HUC-11: 07010203790 (Ostego)																										
07010203-527	Unnamed Creek	Headwaters to T121 R23W S30	2.61	7	NA	NA	NA		NA	NA																
07010203-528	Unnamed Creek	T121 R23W S19, South line to Mississippi R	3.02	2B	NS	NA	NA		-	-					IF											

Full Support (FS); Not Supporting (NS); Insufficient Data (IF); Not Assessed (NA); Meets Standards of Ecoregion Norms (+); Exceeds Standards or Ecoregion Norms (-); Channelized streams and class 7 (Limited value resource waters) were not assessed for aquatic life.

Appendix 4. Minnesota Statewide Index of Biological Integrity (IBI) Thresholds and Confidence Limits

Class	Class Name	Use Class	Threshold	Confidence Limit	Upper	Lower
Fish						
1	Southern Rivers	2B	39	±11	57	35
2	Southern Streams	2B	45	±9	54	36
3	Southern Headwaters	2B	51	±7	58	44
4	Northern Rivers	2B	35	±9	44	26
5	Northern Streams	2B	50	±9	59	41
6	Northern Headwaters	2B	40	±16	56	24
7	Low Gradient	2B	40	±10	50	30
8	Southern Coldwater	2A	45	±13	58	32
9	Northern Coldwater	2A	37	±10	47	27
Invertebrates						
1	Northern Forest Rivers	2B	51.3	±10.8	53.8	32.2
2	Prairie Forest Rivers	2B	30.7	±10.8	41.5	19.9
3	Northern Forest Streams RR	2B	50.3	±12.6	62.9	37.7
4	Northern Forest Streams GP	2B	52.4	±13.6	66	38.8
5	Southern Streams RR	2B	35.9	±12.6	48.5	23.3
6	Southern Forest Streams GP	2B	46.8	±13.6	60.4	33.2
7	Prairie Streams GP	2B	38.3	±13.6	51.9	24.7
8	Northern Coldwater	2A	26	±12.4	38.4	13.6
9	Southern Coldwater	2A	46.1	±13.8	59.9	32.3

Appendix 5. Biological Monitoring Results - Fish Index of Biological Integrity (IBI) Scores

National Hydrography Dataset (NHD) Assessment Segment AUID	Biological Station ID	Stream Segment Name	Drainage Area Mi^2	Fish Class	Threshold	F-IBI	Visit Date
HUC-11: 07010203010 (Upper Elk River)							
07010203-508	09UM001	Elk River	17.98	6	40	30	16-Jun-09
07010203-508	09UM004	Elk River	62.55	5	50	25	24-Jun-09
07010203-508	09UM004	Elk River	62.55	5	50	46	22-Sep-11
07010203-508	09UM005	Elk River	77.84	5	50	41	25-Jun-09
07010203-508	09UM005	Elk River	77.84	5	50	54	26-Sep-11
07010203-508	10EM138	Elk River	33.19	6	40	62	22-Jun-10
HUC-11: 07010203020 (Mayhew Creek)							
07010203-509	00UM042	Mayhew Creek	44.69	6	40	18	07-Jul-00
07010203-509	00UM042	Mayhew Creek	44.69	6	40	38	02-Aug-00
07010203-675	09UM002	Mayhew Creek	17.01	6	40	24	05-Jun-09
07010203-509	09UM003	Mayhew Creek	49.42	6	40	38	07-Jul-09
HUC-11: 07010203030 (Stony Brook and Rice Creek)							
07010203-546	09UM007	Stony Brook	23.22	6	40	39	17-Jun-09
07010203-685	09UM008	Trib. to Rice Creek	6.23	6	40	13	17-Jun-09
07010203-512	09UM009	Rice Creek	45.82	7	40	66	18-Jun-09
07010203-512	09UM049	Rice Creek	37.71	7	40	47	23-Jun-09
07010203-520	09UM050	Stony Brook	6.25	6	40	9	07-Jul-09
07010203-546	09UM051	Stony Brook	14.13	6	40	42	05-Jun-09
HUC-11: 07010203040 (Lower Elk River)							
07010203-538	00UM043	Briggs Creek	8.66	6	40	34	07-Jul-00
07010203-538	00UM043	Briggs Creek	8.66	6	40	69	08-Jul-09
07010203-684	09UM006	Trib. to Elk River	15.13	6	40	24	15-Jun-09
07010203-507	09UM010	Elk River	169.80	5	50	60	24-Jun-09
07010203-689	09UM012	Trib. to Elk River	10.63	6	40	19	10-Jun-09
07010203-579	09UM014	Elk River	285.25	5	50	57	01-Jul-09
07010203-579	09UM014	Elk River	285.25	5	50	47	21-Sep-11
07010203-579	09UM016	Elk River	333.53	5	50	42	16-Jun-09
07010203-548	09UM017	Elk River	554.64	4	35	57	16-Jun-09
07010203-548	09UM017	Elk River	554.64	4	35	38	11-Aug-09
07010203-579	10EM084	Elk River	261.01	5	50	36	02-Jul-09
07010203-579	10EM084	Elk River	261.01	5	50	38	22-Jun-10
07010203-579	99UM038	Elk River	285.59	5	50	36	06-Jul-99

07010203-579	99UM038	Elk River	285.59	5	50	36	21-Jul-99
HUC-11: 07010203050 (Snake River)							
07010203-529	09UM013	Snake River	35.69	7	40	69	11-Aug-09
07010203-529	09UM013	Snake River	35.69	7	40	74	22-Jun-09
07010203-558	07UM092	Snake River	28.26	6	40	75	31-Jul-07
07010203-558	09UM026	Snake River	23.13	6	40	81	10-Jun-09
07010203-558	07UM092	Snake River	28.26	6	40	74	11-Jul-07
HUC-11: 07010203060 (Upper St. Francis River)							
07010203-614	07UM079	County Ditch 14	8.03	6	40	0	16-Jun-09
07010203-614	07UM079	County Ditch 14	8.03	6	40	0	27-Jun-07
07010203-693	09UM036	St Francis River, West Branch	18.29	6	40	25	16-Jun-09
07010203-694	09UM039	County Ditch 13	7.84	6	40	24	17-Jun-09
07010203-695	09UM040	County Ditch 22	5.02	7	40	0	17-Jun-09
07010203-700	09UM035	St Francis River	88.39	5	50	29	17-Jun-09
07010203-700	09UM037	St Francis River	18.59	7	40	29	16-Jun-09
07010203-700	09UM038	St Francis River	40.59	6	40	69	18-Jun-09
HUC-11: 07010203070 (Battle Brook)							
07010203-696	09UM024	County Ditch 6	4.07	6	40	63	08-Jul-09
07010203-697	09UM025	County Ditch 5	4.68	6	40	53	17-Jun-09
07010203-535	10EM196	Battle Brook	29.73	7	40	0	16-Jun-10
07010203-535	99UM028	Battle Brook	32.21	7	40	23	09-Jul-99
07010203-535	99UM028	Battle Brook	32.21	7	40	35	18-Jun-09
HUC-11: 07010203080 (St. Francis River)							
07010203-702	09UM015	St Francis River	202.18	5	50	30	15-Jun-09
07010203-702	09UM015	St Francis River	202.18	5	50	29	27-Sep-11
07010203-704	09UM022	St Francis River	130.00	5	50	36	17-Jun-09
07010203-704	09UM022	St Francis River	130.00	5	50	50	27-Sep-11
07010203-704	09UM023	St Francis River	117.02	5	50	43	22-Jun-09
07010203-704	09UM023	St Francis River	117.02	5	50	39	12-Aug-09
HUC-11: 07010203090 (Tibbits Creek)							
07010203-522	07UM093	Tibbits Brook	27.54	6	40	75	01-Aug-07
07010203-522	09UM021	Tibbits Brook	30.48	6	40	56	20-Jul-09
07010203-522	07UM093	Tibbits Brook	27.54	6	40	82	12-Jul-07
07010203-522	09UM021	Tibbits Brook	30.48	6	40	70	09-Jun-09
07010203-522	09UM020	Tibbits Brook	7.70	7	40	76	09-Jun-09
07010203-523	09UM019	Trib. to Tibbits Brook	15.88	6	40	49	09-Jun-09
HUC-11: 07010203710 (Johnson Creek)							
07010203-561	09UM044	Trib. to Johnson Creek	15.24	11	37	57	15-Jun-09
07010203-633	09UM043	Johnson Creek	5.26	11	37	39	11-Jun-09
07010203-639	09UM041	Johnson Creek	53.30	5	50	32	23-Jun-09
07010203-724	09UM042	Neenah Creek	15.02	6	40	43	15-Jun-09

HUC-11: 07010203720 (Plum Creek)							
07010203-572	09UM027	Plum Creek	25.08	7	40	47	23-Jun-09
07010203-676	09UM028	Plum Creek	7.92	6	40	0	11-Jun-09
HUC-11: 07010203730 (Clearwater River)							
07010203-549	07UM087	Clearwater River	43.31	6	40	34	21-Jun-07
07010203-549	07UM087	Clearwater River	43.31	6	40	29	20-Aug-07
07010203-550	09UM029	County Ditch 44	13.44	6	40	0	10-Jun-09
07010203-550	09UM029	County Ditch 44	13.44	6	40	0	21-Jul-09
07010203-533	09UM030	County Ditch 20	12.75	6	40	10	10-Jun-09
07010203-717	09UM031	Clearwater River	80.96	5	50	35	10-Aug-09
07010203-545	09UM032	Three Mile Creek	12.38	6	40	9	11-Jun-09
07010203-545	09UM032	Three Mile Creek	12.38	6	40	16	20-Jul-09
07010203-511	09UM033	Clearwater River	174.01	5	50	36	23-Jun-09
HUC-11: 07010203750 (Silver Creek)							
07010203-555	07UM091	Silver Creek	45.48	7	40	19	30-Jul-07
07010203-557	09UM045	Silver Creek	51.88	5	50	0	24-Jun-09
07010203-662	09UM046	Silver Creek	20.06	6	40	0	08-Jun-09
07010203-557	09UM081	Silver Creek	52.08	5	50	29	10-Aug-09
HUC-11: 07010203770 (Otter Creek)							
07010203-690	09UM047	Otter Creek	19.41	6	40	53	08-Jun-09
HUC-11: 07010203790 (Ostego)							
07010203-527	09UM052	Trib. to Mississippi River	7.23	6	40	0	05-Jun-09
07010203-528	09UM048	Trib. to Mississippi River	12.50	6	40	0	05-Jun-09

Appendix 6. Biological Monitoring Results - Macroinvertebrate Index of Biological Integrity (IBI) Scores

National Hydrography Dataset (NHD) Assessment Segment (AUID)	Biological Station	Stream Segment	Drainage Area Mi^2	Macro-invertebrate Class	Threshold	M-IBI	Visit Date
HUC-11: 07010203010 (Upper Elk River)							
07010203-508	09UM001	Elk River	18.0	3	50.3	27.0	10-Sep-09
07010203-508	09UM004	Elk River	62.6	3	50.3	24.1	10-Sep-09
07010203-508	09UM005	Elk River	77.8	3	50.3	57.4	10-Sep-09
07010203-508	10EM138	Elk River	33.2	3	50.3	55.2	22-Sep-10
HUC-11: 07010203020 (Mayhew Creek)							
07010203-509	00UM042	Mayhew Creek	44.7	6	46.8	35.8	11-Sep-00
07010203-509	09UM003	Mayhew Creek	49.4	3	50.3	35.9	09-Sep-09
07010203-675	09UM002	Mayhew Creek	17.0	4	52.4	38.8	17-Aug-09
HUC-11: 07010203030 (Stony Brook and Rice Creek)							
07010203-512	09UM009	Rice Creek	45.8	6	46.8	71.7	09-Sep-09
07010203-512	09UM049	Rice Creek	37.7	6	46.8	61.6	17-Aug-09
07010203-520	09UM050	Stony Brook	6.2	4	52.4	10.0	22-Sep-10
07010203-546	09UM007	Stony Brook	23.2	6	46.8	66.2	17-Aug-09
07010203-546	09UM051	Stony Brook	14.1	4	52.4	36.7	10-Sep-09
07010203-685	09UM008	Trib. to Rice Creek	6.2	6	46.8	34.3	17-Aug-09
HUC-11: 07010203040 (Lower Elk River)							
07010203-507	09UM010	Elk River	169.8	5	35.9	75.5	11-Sep-09
07010203-538	00UM043	Briggs Creek	8.7	6	46.8	68.3	19-Sep-00
07010203-538	00UM043	Briggs Creek	8.7	6	46.8	67.7	12-Oct-00
07010203-538	00UM043	Briggs Creek	8.7	6	46.8	51.3	09-Sep-09
07010203-548	09UM017	Elk River	554.6	2	30.7	46.6	09-Sep-09
07010203-579	10EM084	Elk River	261.0	6	46.8	52.1	08-Sep-09
07010203-579	09UM014	Elk River	285.2	5	35.9	64.2	08-Sep-09
07010203-579	99UM038	Elk River	285.6	6	46.8	68.4	07-Sep-99
07010203-579	99UM038	Elk River	285.6	6	46.8	64.7	06-Oct-99
07010203-579	09UM016	Elk River	333.5	6	46.8	32.8	08-Sep-09
07010203-579	09UM016	Elk River	333.5	6	46.8	46.6	08-Sep-09
07010203-684	09UM006	Trib. to Elk River	15.1	6	46.8	34.7	09-Sep-09
07010203-689	09UM012	Trib. to Elk River	10.6	6	46.8	53.3	18-Aug-09

HUC-11: 07010203050 (Snake River)							
07010203-529	09UM013	Snake River	35.7	6	46.8	55.0	08-Sep-09
07010203-558	09UM026	Snake River	23.1	6	46.8	62.8	02-Sep-09
07010203-558	07UM092	Snake River	28.3	6	46.8	70.1	07-Aug-07
HUC-11: 07010203060 (Upper St. Francis River)							
07010203-614	07UM079	County Ditch 14	8.0	4	52.4	43.2	17-Aug-09
07010203-693	09UM036	St Francis River, West Branch	18.3	4	52.4	18.6	17-Aug-09
07010203-700	09UM035	St Francis River	88.4	3	50.3	46.3	23-Sep-09
07010203-700	09UM038	St Francis River	40.6	3	50.3	46.9	10-Sep-09
07010203-700	09UM037	St Francis River	18.6	4	52.4	41.1	17-Aug-09
HUC-11: 07010203070 (Battle Brook)							
07010203-535	10EM196	Battle Brook	29.7	6	46.8	25.0	14-Sep-10
07010203-535	99UM028	Battle Brook	32.2	6	46.8	62.8	07-Sep-99
07010203-535	99UM028	Battle Brook	32.2	6	46.8	41.7	23-Sep-09
07010203-697	09UM025	County Ditch 5	4.7	4	52.4	36.7	18-Aug-09
HUC-11: 07010203080 (St. Francis River)							
07010203-702	09UM015	St Francis River	202.2	6	46.8	72.9	01-Sep-09
07010203-704	09UM023	St Francis River	117.0	5	35.9	69.2	07-Oct-09
07010203-704	09UM022	St Francis River	130.0	6	46.8	68.5	23-Sep-09
07010203-704	09UM091	St Francis River	107.4	5	35.9	35.3	23-Sep-09
07010203-704	09UM091	St Francis River	107.4	5	35.9	36.3	23-Sep-09
HUC-11: 07010203090 (Tibbits Creek)							
07010203-522	07UM093	Tibbits Brook	27.5	6	46.8	49.0	07-Aug-07
07010203-522	09UM021	Tibbits Brook	30.5	6	46.8	41.6	02-Sep-09
07010203-522	09UM020	Tibbits Brook	7.7	6	46.8	37.1	18-Aug-09
07010203-523	09UM019	Trib. to Tibbits Brook	15.9	6	46.8	23.2	22-Sep-10
07010203-523	09UM019	Trib. to Tibbits Brook	15.9	6	46.8	22.0	22-Sep-10
HUC-11: 07010203710 (Johnson Creek)							
07010203-561	09UM044	Trib. to Johnson Creek	15.2	9	46.1	83.8	11-Sep-09
07010203-633	09UM043	Johnson Creek	5.3	9	46.1	67.1	11-Sep-09
07010203-639	09UM041	Johnson Creek	53.3	6	46.8	48.3	23-Sep-09
07010203-724	09UM042	Neenah Creek	15.0	9	46.1	57.7	09-Sep-09
HUC-11: 07010203720 (Plum Creek)							
07010203-572	09UM027	Plum Creek	25.1	6	46.8	24.6	23-Sep-09
HUC-11: 07010203730 (Clearwater River)							
07010203-549	07UM087	Clearwater River	43.3	6	46.8	52.2	20-Aug-07
07010203-550	09UM029	County Ditch 44	13.4	5	35.9	37.3	02-Sep-09
07010203-533	09UM030	County Ditch 20	12.8	6	46.8	22.4	02-Sep-09
07010203-717	09UM031	Clearwater River	81.0	5	35.9	22.1	02-Sep-09
07010203-545	09UM032	Three Mile Creek	12.4	6	46.8	82.5	09-Sep-09
07010203-511	09UM033	Clearwater River	174.0	5	35.9	41.2	23-Sep-09

HUC-11: 07010203750 (Silver Creek)							
07010203-555	07UM091	Silver Creek	45.5	6	46.8	22.4	20-Aug-07
07010203-557	09UM045	Silver Creek	51.9	5	35.9	24.5	01-Sep-09
07010203-662	09UM046	Silver Creek	20.1	6	46.8	37.0	18-Aug-09
HUC-11: 07010203770 (Otter Creek)							
07010203-690	09UM047	Otter Creek	19.4	6	46.8	43.8	18-Aug-09
HUC-11: 07010203790 (Ostego)							
07010203-527	09UM052	Trib. to Mississippi River	7.2	6	46.8	10.2	18-Aug-09
07010203-528	09UM048	Trib. to Mississippi River	12.5	6	46.8	8.5	18-Aug-09

Appendix 7. Good/Fair/Poor Index of Biological Integrity (IBI) Thresholds for Biological Stations on Non-assessed Channelized AUIDs

Ratings of good for channelized streams are based on Minnesota's general use threshold for aquatic life (Appendix 4). Stations with IBIs that score above this general use threshold would be given a rating of good. The fair rating is calculated as a negative 15 point departure from the general use threshold. Stations with IBI scores below the general use threshold, but above the fair threshold would be given a rating of fair. Stations scoring below the fair threshold would be considered poor.

Class	Class Name	Good	Fair	Poor
Fish				
1	Southern Rivers	>38	38-24	<24
2	Southern Streams	>44	44-30	<30
3	Southern Headwaters	>50	50-36	<36
4	Northern Rivers	>34	34-20	<20
5	Northern Streams	>49	49-35	<35
6	Northern Headwaters	>39	39-25	<25
7	Low Gradient	>39	39-25	<25
10	Southern Coldwater	>45	45-30	<30
11	Northern Coldwater	>37	37-22	<22
Invertebrates				
1	Northern Forest Rivers	>51	52-36	<36
2	Prairie Forest Rivers	>31	31-16	<16
3	Northern Forest Streams RR	>50	50-35	<35
4	Northern Forest Streams GP	>52	52-37	<37
5	Southern Streams RR	>36	36-21	<21
6	Southern Forest Streams GP	>47	47-32	<32
7	Prairie Streams GP	>38	38-23	<23
8	Northern Coldwater	>26	26-11	<11
9	Southern Coldwater	>46	46-31	<31

Appendix 8. Biological Monitoring Results for Non-Assessed Channelized AUIDs - Fish Index of Biological Integrity (IBI) Scores

National Hydrography Dataset (NHD) Assessment Segment (AUID)	Biological Station ID	Location of Biological Station	Drainage Area Mi^2	Fish Class	Good	Fair	Poor	F-IBI	Visit Date
HUC-11: 07010203020 (Mayhew Creek)									
07010203-509	00UM042	Mayhew Creek	44.69	6	>39	39-25	<25	**38**	2-Aug-00
07010203-509	00UM042	Mayhew Creek	44.69	6	>39	39-25	<25	18	7-Jul-00
07010203-509	09UM003	Mayhew Creek	49.42	6	>39	39-25	<25	**38**	7-Jul-09
HUC-11: 07010203030 (Mayhew Creek)									
07010203-685	09UM008	Unnamed Creek	6.23	6	>39	39-25	<25	**13**	17-Jun-09
HUC-11: 07010203040 (Lower Elk River)									
07010203-684	09UM006	Unnamed Creek	15.13	6	>39	39-25	<25	**24**	15-Jun-09
07010203-689	09UM012	Unnamed Creek	10.63	6	>39	39-25	<25	**19**	10-Jun-09
HUC-11: 07010203050 (Snake River)									
07010203-558	07UM092	Snake River	28.26	6	>39	39-25	<25	**75**	31-Jun-07
07010203-558	07UM092	Snake River	28.26	6	>39	39-25	<25	**74**	11-Jun-07
07010203-558	09UM026	Snake River	23.13	6	>39	39-25	<25	**81**	10-Jun-09
07010203-529	09UM013	Snake River	35.69	7	>39	39-25	<25	**69**	11-Aug-09
07010203-529	09UM013	Snake River	35.69	7	>39	39-25	<25	**74**	22-Jun-09
HUC-11: 07010203060 (St. Francis River)									
07010203-693	09UM036	West Branch St. Francis R.	18.29	6	>39	39-25	<25	**25**	16-Jun-09
07010203-614	07UM079	Unnamed Creek	8.03	6	>39	39-25	<25	**0**	16-Jun-09
07010203-614	07UM079	Unnamed Creek	8.03	6	>39	39-25	<25	**0**	27-Jun-07
07010203-694	09UM039	County Ditch 13	7.84	6	>39	39-25	<25	**24**	17-Jun-09
07010203-695	09UM040	County Ditch 22	5.02	7	>39	39-25	<25	**0**	17-Jun-09

HUC-11: 07010203070 (Battle Brook)									
07010203-696	09UM024	County Ditch 6	4.07	6	>39	39-25	<25	**63**	8-Jun-09
07010203-697	09UM025	County Ditch 5	4.68	6	>39	39-25	<25	**53**	17-Jun-09
HUC-11: 07010203090 (Tibbits Brook)									
07010203-522	09UM020	Tibbits Brook	7.7	7	>39	39-25	<25	**76**	9-Jun-09
07010203-522	07UM093	Tibbits Brook	27.54	6	>39	39-25	<25	**75**	1-Aug-07
07010203-522	07UM093	Tibbits Brook	27.54	6	>39	39-25	<25	**82**	12-Jul-07
07010203-522	09UM021	Tibbits Brook	30.48	6	>39	39-25	<25	**56**	20-Jul-09
07010203-522	09UM021	Tibbits Brook	30.48	6	>39	39-25	<25	**70**	9-Jun-09
07010203-523	09UM019	Unnamed Ditch	15.88	6	>39	39-25	<25	**49**	9-Jun-09
HUC-11: 07010203710 (Johnson Creek)									
07010203-724	09UM042	Unnamed Creek (Robinson Hill Creek)	15.02	6	>39	39-25	<25	**43**	15-Jun-09
HUC-11: 07010203720 (Plum Creek)									
07010203-676	09UM028	Plum Creek	7.92	6	>39	39-25	<25	**0**	11-Jun-09
07010203-572	09UM027	Plum Creek	25.08	7	>39	39-25	<25	**47**	23-Jun-09
HUC-11: 07010203730 (Clearwater River)									
07010203-533	09UM030	County Ditch 20	12.75	6	>39	39-25	<25	**10**	10-Jun-09
07010203-550	09UM029	County Ditch 44	13.44	6	>39	39-25	<25	**0**	21-Jun-09
07010203-550	09UM029	County Ditch 44	13.44	6	>39	39-25	<25	**0**	10-Jun-09
07010203-549	07UM087	Clearwater River	43.31	6	>39	39-25	<25	**29**	20-Aug-07
07010203-549	07UM087	Clearwater River	43.31	6	>39	39-25	<25	**34**	21-Jun-07
HUC-11: 07010203750 (Silver Creek)									
07010203-555	07UM091	Silver Creek	45.48	7	>39	39-25	<25	**19**	30-Jul-07
HUC-11: 07010203770 (Otter Creek)									
07010203-690	09UM047	Otter Creek	19.41	6	>39	39-25	<25	**53**	8-Jun-09
HUC-11: 07010203790 (Ostego)									
07010203-527	09UM052	Unnamed Creek	7.23	6	>39	39-25	<25	**0**	5-Jun-09

Appendix 9. Biological Monitoring Results for Non-Assessed Channelized AUIDs - Macroinvertebrate Index of Biological Integrity (IBI) Scores

National Hydrography Dataset (NHD) Assessment Segment (AUID)	Biological Station ID	Location of Biological Station	Drainage Area Mi^2	Macro-invertebrate Class	Good	Fair	Poor	M-IBI	Visit Date
HUC-11: 07010203020 (Mayhew Creek)									
07010203-509	00UM042	Mayhew Creek	44.69	6	>47	47-32	<32	**35.8**	11-Sep-00
07010203-509	09UM003	Mayhew Creek	49.42	3	>50	50-35	<35	**35.9**	9-Sep-09
HUC-11: 07010203030 (Mayhew Creek)									
07010203-685	09UM008	Unnamed Creek	6.23	6	>47	47-32	<32	**34.3**	17-Aug-09
HUC-11: 07010203040 (Lower Elk River)									
07010203-684	09UM006	Unnamed Creek	15.13	6	>47	47-32	<32	**34.7**	9-Sep-09
07010203-689	09UM012	Unnamed Creek	10.63	6	>47	47-32	<32	**53.4**	18-Aug-09
HUC-11: 07010203050 (Snake River)									
07010203-558	07UM092	Snake River	28.26	6	>47	47-32	<32	**70.1**	7-Aug-07
07010203-558	09UM026	Snake River	23.13	6	>47	47-32	<32	**62.8**	2-Sep-09
07010203-529	09UM013	Snake River	35.69	6	>47	47-32	<32	**54.9**	8-Sep-09
HUC-11: 07010203060 (St. Francis River)									
07010203-693	09UM036	West Branch St. Francis R.	18.29	4	>52	52-37	<37	**18.6**	17-Aug-09
07010203-614	07UM079	Unnamed Creek	8.03	4	>52	52-37	<37	**43.2**	17-Aug-09
HUC-11: 07010203070 (Battle Brook)									
07010203-697	09UM025	County Ditch 5	4.68	4	>52	52-37	<37	**36.7**	18-Aug-09
HUC-11: 07010203090 (Tibbits Brook)									
07010203-522	09UM020	Tibbits Brook	7.7	6	>47	47-32	<32	**37.1**	18-Aug-09
07010203-522	07UM093	Tibbits Brook	27.54	6	>47	47-32	<32	**49.0**	17-Aug-07
07010203-522	09UM021	Tibbits Brook	30.48	6	>47	47-32	<32	**41.6**	2-Sep-09
07010203-523	09UM019	Trib. to Tibbits Brook	15.88	6	>47	47-32	<32	**23.2**	22-Sep-10
07010203-523	09UM019	Trib. to Tibbits Brook	15.88	6	>47	47-32	<32	**22.0**	22-Sep-10

HUC-11: 07010203710 (Johnson Creek)									
07010203-724	09UM042	Unnamed Creek (Robinson Hill Creek)	15.02	9	>46	46-31	<31	**57.7**	9-Sep-09
HUC-11: 07010203720 (Plum Creek)									
07010203-572	09UM027	Plum Creek	25.08	6	>47	47-32	<32	**24.6**	23-Sep-09
HUC-11: 07010203730 (Clearwater River)									
07010203-533	09UM030	County Ditch 20	12.75	6	>47	47-32	<32	**22.4**	2-Sep-09
07010203-550	09UM029	County Ditch 44	13.44	5	>36	36-21	<21	**37.3**	2-Sep-09
07010203-549	07UM087	Clearwater River	43.31	6	>47	47-32	<32	**52.2**	20-Aug-07
HUC-11: 07010203750 (Silver Creek)									
07010203-555	07UM091	Silver Creek	45.48	6	>47	47-32	<32	**22.4**	20-Aug-07
HUC-11: 07010203770 (Otter Creek)									
07010203-690	09UM047	Otter Creek	19.41	6	>47	47-32	<32	**43.8**	18-Aug-09
HUC-11: 07010203790 (Ostego)									
07010203-527	09UM052	Unnamed Creek	7.23	6	>47	47-32	<32	**10.2**	18-Aug-09

Appendix 10. Fish Collection Information for the Mississippi River (St. Cloud) Watershed

Common name	Number of individuals	Number of sites collected
bigmouth buffalo	1	1
bigmouth shiner	985	28
black bullhead	327	27
black crappie	66	15
blackchin shiner	5	3
blacknose dace	1572	37
blacknose shiner	1215	17
blackside darter	1245	35
bluegill	80	18
bluntnose minnow	1869	31
bowfin	61	5
brassy minnow	63	16
brook silverside	2	2
brook stickleback	665	31
brown bullhead	1	1
brown trout	5	1
burbot	1	1
central mudminnow	4118	62
central stoneroller	432	12
channel catfish	25	2
common carp	155	14
common shiner	4494	46
creek chub	1748	40
fathead minnow	935	39
finescale dace	13	1
Gen: redhorses	2	2
golden shiner	194	20
greater redhorse	2	2
green sunfish	317	36
hornyhead chub	2703	32
hybrid Phoxinus	6	1
hybrid sunfish	87	11

Common name	Number of individuals	Number of sites collected
Iowa darter	131	19
johnny darter	2971	58
largemouth bass	67	7
logperch	720	20
longnose dace	268	16
mimic shiner	8	2
mottled sculpin	172	10
northern hogsucker	10	2
northern pike	319	43
northern redbelly dace	511	23
pearl dace	339	8
pumpkinseed	135	6
rock bass	300	23
sand shiner	68	5
shorthead redhorse	130	11
silver redhorse	35	4
smallmouth bass	267	7
smallmouth buffalo	4	1
spotfin shiner	364	21
spottail shiner	41	5
tadpole madtom	280	30
trout-perch	2	1
walleye	41	9
white sucker	6227	55
yellow bullhead	117	21
yellow perch	492	27