Minnesota River - Granite Falls Watershed Monitoring and Assessment Report

Minnesota Pollution Control Agency

August 2013

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List of acronyms

AUID Assessment Unit Identification Determination

CCSI Channel Condition and Stability Index

CD County Ditch

CI Confidence Interval

CLMP Citizen Lake Monitoring Program

CR County Road

CSAH County State Aid Highway

CSMP Citizen Stream Monitoring Program

CWA Clean Water Act

CWLA Clean Water Legacy Act

DOP Dissolved Orthophosphate

E Eutrophic

EPT Ephemeroptera, Plecoptera and Trichoptera

EQuIS Environmental Quality Information System

EX Exceeds Criteria (Bacteria)

EXP Exceeds Criteria, Potential Impairment

EXS Exceeds Criteria, Potential Severe Impairment

FS Full Support

FWMC Flow Weighted Mean Concentration

H Hypereutrophic

HUC Hydrologic Unit Code

IBI Index of Biotic Integrity

IF Insufficient Information

IWM Intensive Watershed Monitoring

K Potassium

LRVW Limited Resource Value Water

M Mesotrophic

MCES Metropolitan Council Environmental Services

MDA Minnesota Department of Agriculture

MDH Minnesota Department of Health

MDNR Minnesota Department of Natural Resources

MINLEAP Minnesota Lake Eutrophication Analysis Procedure

MPCA Minnesota Pollution Control Agency

MSHA Minnesota Stream Habitat Assessment

MTS Meets the Standard?

N Nitrogen

Nitrate-N Nitrate Plus Nitrite Nitrogen

NA Not Assessed

NHD National Hydrologic Dataset

NH_3 Ammonia

NS Not Supporting

NT No Trend

OP Orthophosphate

P Phosphorous

PCB Poly Chlorinated Biphenyls

PWI Protected Waters Inventory

RNR River Nutrient Region

SWAG Surface Water Assessment Grant

SWCD Soil and Water Conservation District

SWUD State Water Use Database

TALU Tiered Aquatic Life Uses

TKN Total Kjeldahl Nitrogen

TMDL Total Maximum Daily Load

TP Total Phosphorous

TSS Total Suspended Solids

USGS United States Geological Survey

WPLMN Watershed Pollutant Load Monitoring Network

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Executive summary

This assessment report is the first in a series of reports for watershed work being conducted in the Minnesota River - Granite Falls Watershed. The results of surface water monitoring activities in the watershed are reported here. Subsequent reports will explain stressor identification, Total Maximum Daily Loads (TMDLs), and restoration and protection plans for the watershed.

The Minnesota River - Granite Falls 8-digit Hydrologic Unit Code (HUC-8) major watershed, bisected by the Minnesota River, is comprised of two significant watersheds that do not have a hydrological connection and enter the Minnesota River from opposite sides. Hawk Creek and several smaller streams enter the Minnesota River from the north, and the Yellow Medicine River and several more streams enter the Minnesota River from the south. Since this HUC-8 is a flow-through watershed, main stem sites of the Minnesota River will not be reported. The main stem will be sampled comprehensively in 2014-2015 by the Minnesota Pollution Control Agency (MPCA) using large river protocols and reported on separately.

Much of the watershed was originally covered by prairie. The soils are silty or loamy throughout much of the watershed, resulting in high rates of infiltration in undeveloped areas. Cropland and rangeland are the primary land uses in the watershed. This overall area lies primarily within the Northern Glaciated Plains and the Western Corn-belt Plains ecoregions and has land use typical of these ecoregions. Significant portions of the watershed have been drained to increase agricultural and non-agricultural development. The highly manipulated hydrology within the watershed has resulted in a very effective drainage system that allows agriculture, the regions primary land use, to thrive throughout much of the watershed.

In 2010, a holistic approach was taken to assess all of the watershed's surface water bodies for aquatic life, recreation and fish consumption use support, where data was available. Sixty-nine streams were assessed for aquatic life or recreation support and twenty-one lakes were assessed for aquatic recreation in this effort. There were a total of 90 non-supporting assessments for aquatic life and/or recreation in the Minnesota River - Granite Falls Watershed, and only six supporting assessments.

While waterbody impairment is prevalent across the watershed, efforts to restore water quality and bring surface waters into attainment for designated uses are not futile, and some progress has been made. Future efforts to control sediment should include measures to stabilize stream bank channels. Based on the large number of impairments that are likely due to the intensive agriculture practices and development in the watershed, stressors to be examined should include: nutrients, turbidity, low dissolved oxygen, decreased habitat, and altered hydrology. Addressing nonpoint source pollution would benefit from a targeted approach to Best Management Practice (BMP) placement, identifying areas in the watershed that are likely more prone to be sources and pathways of contamination and working with those landowners to limit potential contaminants from being discharged from those sensitive areas. Collaborating with landowners will enable the agricultural economy of the region to move forward in a sustainable way that does not neglect water quality.

Introduction

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

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

The passage of Minnesota's Clean Water Legacy Act (CWLA) in 2006 provided a policy framework and the initial resources for state and local governments to accelerate efforts to monitor, assess, restore and protect surface waters. This work is implemented with funding from the Clean Water Fund created by the passage of the Clean Water Land, and Legacy Amendment to the state constitution. To facilitate the best use of agency and local resources, the MPCA has developed a watershed monitoring strategy which uses an effective and efficient integration of agency and local water monitoring programs to assess the condition of Minnesota's surface waters. This strategy 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 strategy behind the watershed monitoring approach is to intensively monitor streams and lakes within a major watershed to determine the overall health of water resources, identify impaired waters, and to identify waters in need of additional protection. The benefit of the approach is the opportunity to begin to address most, if not all, impairments through a coordinated TMDL process at the watershed scale, rather than the reach-by-reach and parameter-by-parameter approach often historically employed. 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 and restoring the quality of Minnesota's water resources.

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

I. The Watershed monitoring approach

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

Watershed pollutant load monitoring network

Funded with appropriations from Minnesota's Clean Water Legacy Fund, the Watershed Pollutant Load Monitoring Network (WPLMN) is a long-term program designed to measure and compare regional differences and long-term trends in water quality among Minnesota's major rivers including the Red, Rainy, St. Croix, Mississippi, and Minnesota, and the outlets of the major tributaries (8 digit HUC scale) draining to these rivers. Since the program's inception in 2007, the WPLMN has adopted a multi-agency monitoring design that combines site specific stream flow data from United States Geological Survey (USGS) and Minnesota Department of Natural Resources (MDNR) flow gaging stations with water quality data collected by the Metropolitan Council Environmental Services (MCES), local monitoring organizations, and MPCA WPLMN staff to compute annual pollutant loads at 79 river monitoring sites across Minnesota. Data will also be used to assist with: TMDL studies and implementation plans; watershed modeling efforts; and watershed research projects.

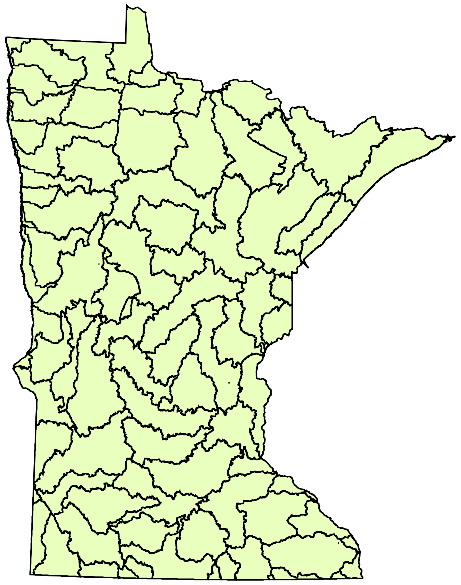

Figure 1. Major watersheds within Minnesota (8-Digit HUC)

Intensive watershed monitoring

The intensive watershed monitoring strategy utilizes a nested watershed design allowing the sampling of streams within watersheds from a coarse to a fine scale (Figure 1). Each watershed scale is defined by a hydrologic unit code (HUC). These HUCs define watershed boundaries for water bodies within a similar geographic and hydrologic extent. The foundation of this approach is the 81 major watersheds within Minnesota. Using this approach many of the smaller headwaters and tributaries to the main stem river are sampled in a systematic way so that a more holistic assessment of the watershed can be conducted and problem areas identified without monitoring every stream reach. Each major watershed is the focus of attention for at least one year within the 10-year cycle.

River/stream sites are selected near the outlet of each of three watershed scales. Within each scale, different water uses are assessed based on the opportunity for that use (i.e., fishing, swimming, supporting aquatic life such as fish and insects). The major river watershed is represented by the 8-HUC scale. The outlet of the major 8-HUC watershed (purple dot in Figure 3) is sampled for biology, water chemistry, and fish contaminants to allow for the assessment of aquatic life, aquatic recreation, and aquatic consumption use support.

The 11-HUC is the next smaller watershed scale which generally consists of major tributary streams with drainage areas ranging from 75 to 150 mi^2. Each 11-HUC outlet (green dots in Figure 2) is sampled for biology and water chemistry for the assessment of aquatic life and aquatic recreation use support. Within each 11-HUC, smaller watersheds (typically 10-20 mi^2) are sampled at each outlet that flows into the major 11-HUC tributaries. Each of these minor watershed outlets are sampled for biology (fish and macroinvertebrates) to assess aquatic life use support (red dots in Figure 2).

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.

Even when pooling MPCA and local resources, the MPCA is 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, generally provide the greatest aquatic recreational opportunity to Minnesota's citizens, and collectively represent 72% of the total lake area (greater than 10 acres) within Minnesota. Though the primary focus is on monitoring and assessing larger lakes, the MPCA is also committed to directly monitoring, or supporting the monitoring of, lakes between 100-499 acres ("small lakes") for assessment purposes.

Specific locations for sites sampled as part of the intensive monitoring effort in the Minnesota River - Granite Falls Watershed are shown in Figure 2 and are listed in Appendix 4 and 5.

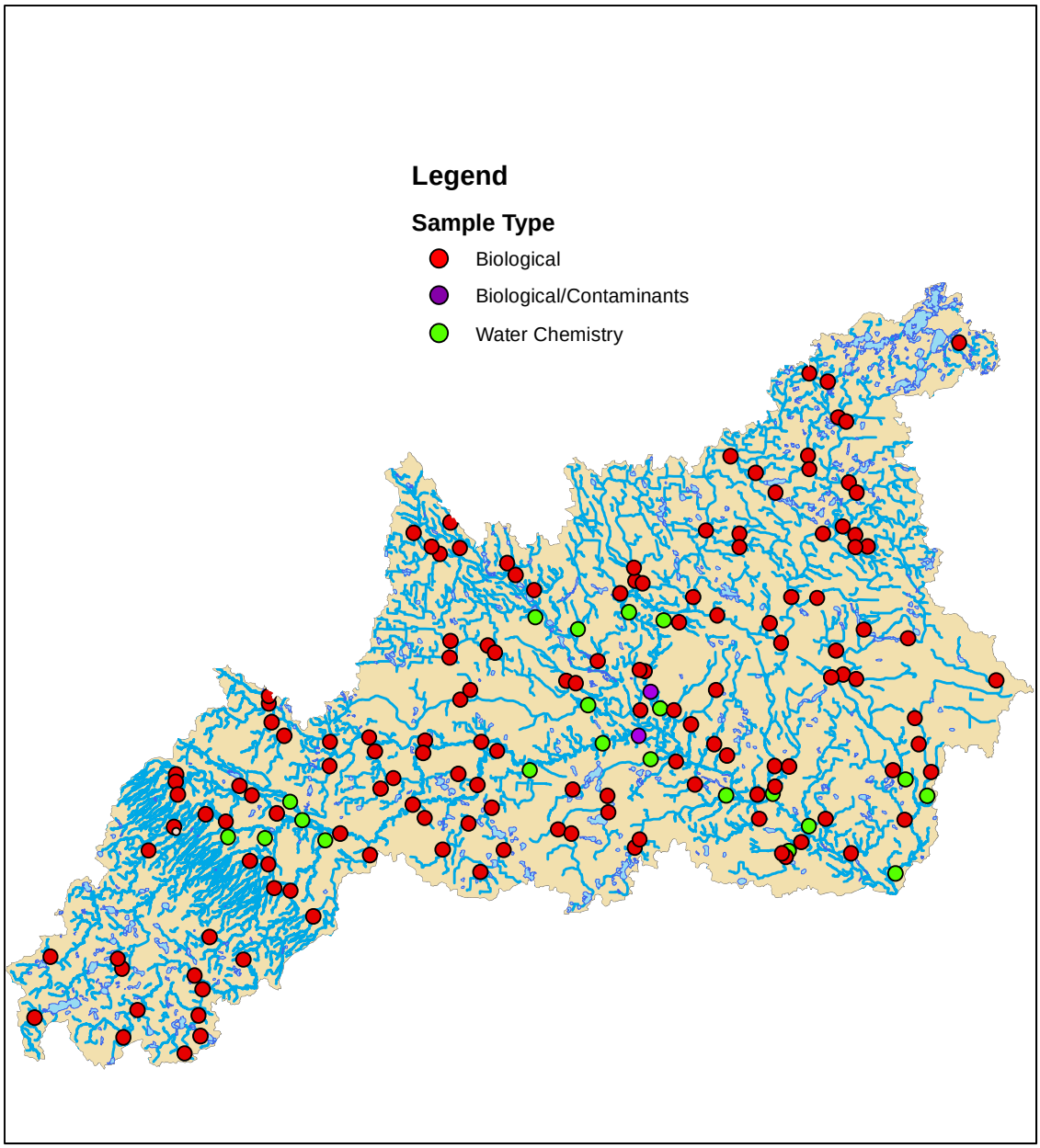

Figure 2. Intensive watershed monitoring sites for streams in the Minnesota River - Granite Falls Watershed

Citizen and local monitoring

Citizen monitoring is an important components 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). There are currently 44 lake and 38 stream citizen monitoring stations in the watershed (see Figure 3). Like the permanent load monitoring network 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 ten 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 Clean Water Legacy planning and tracking purposes will help local citizens/governments see how their efforts are being used to inform water quality management decisions and affect change.

The MPCA also passes through funding via Surface Water Assessment Grants (SWAGs) to local groups such as counties, soil and water conservation districts (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. HUC-11 outlet stream chemistry sites and lakes less than 500 acres that need monitoring are identified in the SWAG request for proposals (RFP) and local entities are invited to request funds to complete the sampling. SWAG 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.

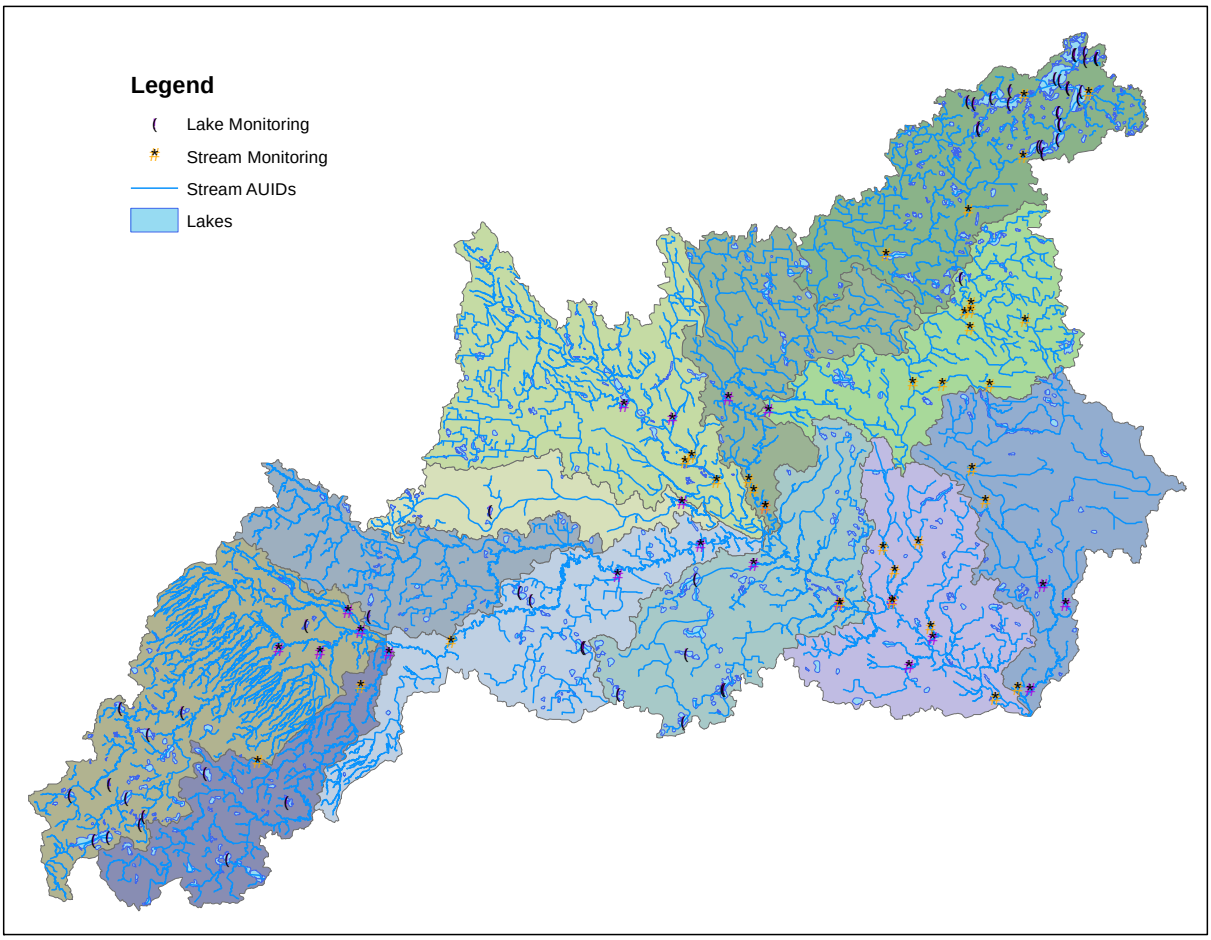

Figure 3. Monitoring locations of local groups, citizens and the MPCA lake monitoring staff in the Minnesota River - Granite Falls Watershed

II. Assessment methodology

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

Water quality standards

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

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

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

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

A small percentage of stream miles in the state (~1% of 92,000 miles) have been individually evaluated and re-classified as a Class 7 Limited Resource Value Water (LRVW). These streams

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

Assessment units

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

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

Determining use attainment

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

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

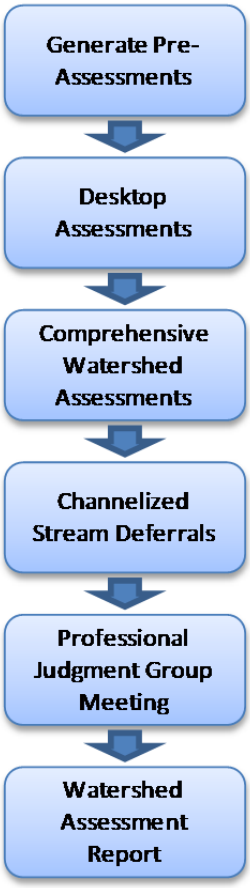

Figure 4. Flowchart of aquatic life use assessment process.

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

Any new impairment (i.e., waterbody not attaining its beneficial use) is first reviewed using Geographic Information System to determine if greater than 50% of the assessment unit is channelized. Currently, the MPCA is deferring any new impairments on channelized reaches until new aquatic life use standards have been developed as part of the Tiered Aquatic Life Use (TALU) framework. However, in this report, channelized reaches with biological data are evaluated on a "good-fair-poor" system to help evaluate their condition (see Section IV and Appendix 5.1).

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

Data management

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

Period of record

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

III. Watershed overview

The Minnesota River- Granite Falls 8-digit Hydrologic Unit Code (HUC) major watershed, bisected by the Minnesota River, is comprised of two significant watersheds that do not have a hydrological connection and enter the Minnesota River from opposite sides. The Hawk Creek and several smaller streams enter the Minnesota River from the north, and the Yellow Medicine River and several more streams enter the Minnesota River from the south. Since this HUC-8 is a flow-through watershed, main stem sites of the Minnesota River, will not be reported. The main stem will be sampled comprehensively in 2014-2015 by the MPCA using large river protocols.

The headwaters of the Yellow Medicine River occur on the edge of the Northern Glaciated Plains, also called the Prairie Couteau region, which is a series of rolling hills formed by glacial deposits. The Yellow Medicine River continues to run through the Western Corn Belt Plains where it drains into the Minnesota River near Granite Falls. The river flows through parts of Lincoln, Lyon, and Yellow Medicine Counties. Other streams include Mud Creek, Spring Creek, Hazel Creek, Boiling Spring Creek, Echo Creek, and Stoney Run Creek.

The headwaters of Hawk Creek start in the North Central Hardwood Forest (NCHF) ecoregion, but the majority of the watershed is in the Western Cornbelt Plains (WCBP) ecoregion (White and Omernik 2007) and flows into the Minnesota River from the north side of the river. The Hawk Creek Watershed includes several smaller streams including Chetomba, Beaver, Sacred Heart, Middle, Timm's, Brafee's, Smith and Palmer Creeks. Hawk Creek originates at Eagle Lake north of Willmar Minnesota and flows approximately 65 miles to its mouth at the Minnesota River near Granite Falls, Minnesota.

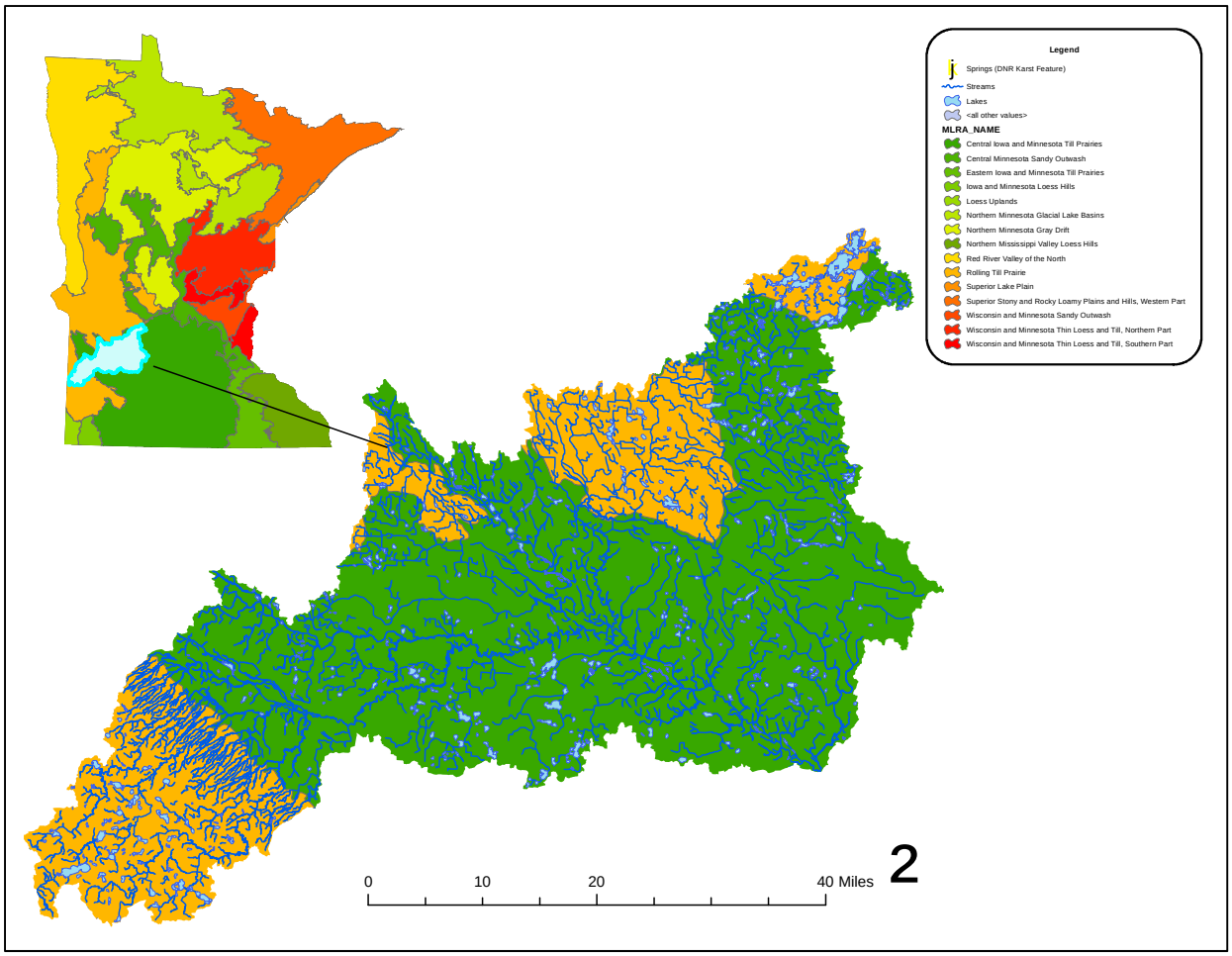

Figure 5. Major Land Resource Areas (MLRA) and springs in the Minnesota River - Granite Falls Watershed Minnesota

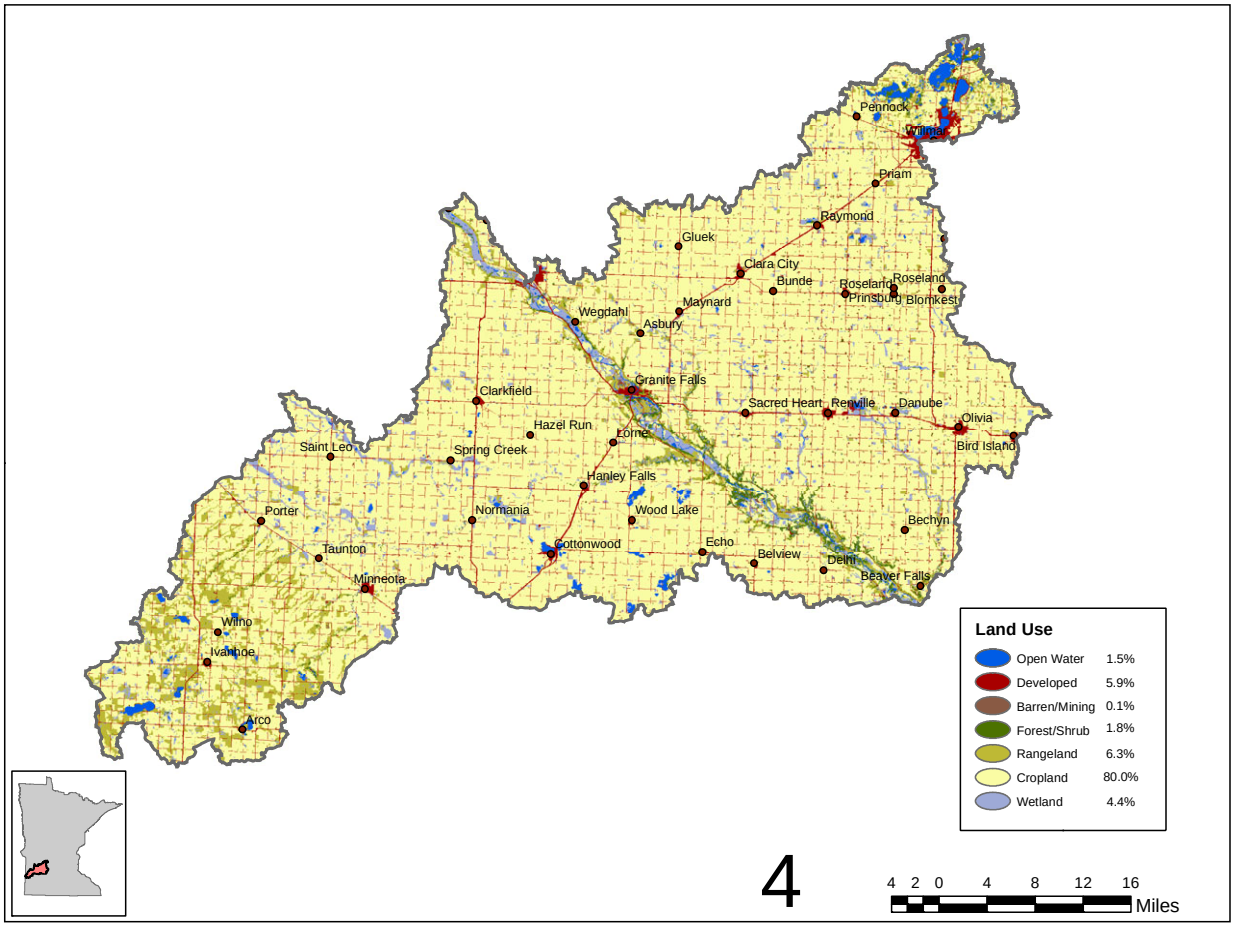

Figure 6. Land use in the Minnesota River - Granite Falls Watershed

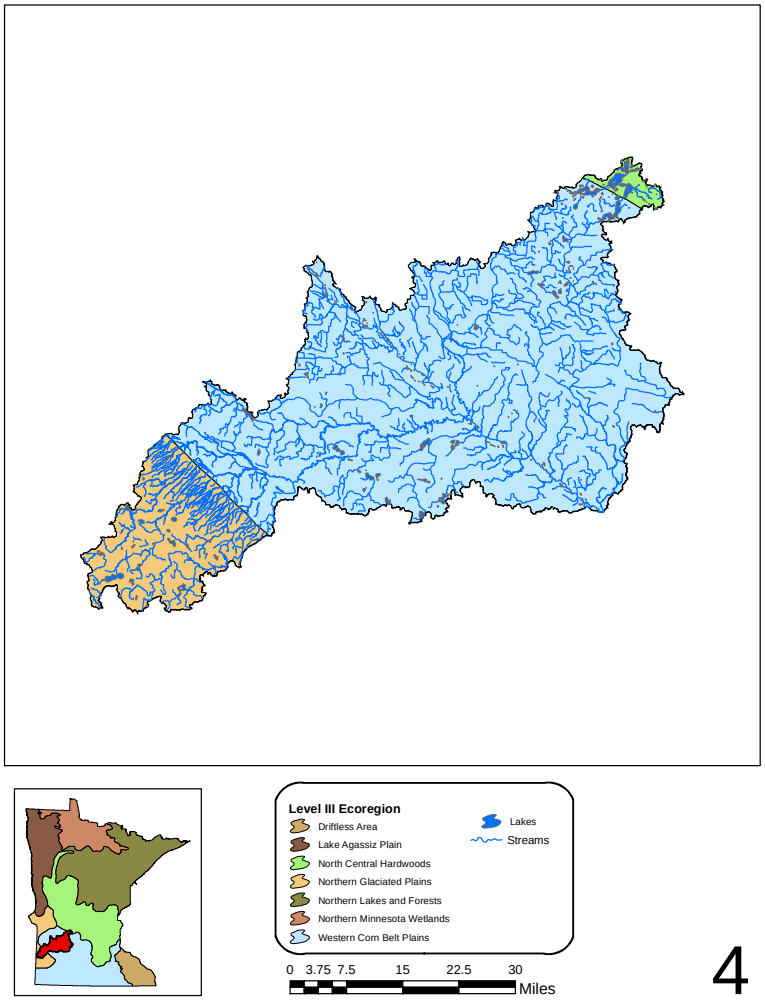

Figure 7. Ecoregions of the Minnesota River - Granite Falls Watershed

Land use summary

Much of the watershed is covered by till prairie plains and rolling tilling prairie. The soils are silty or loamy soils which are prevalent throughout much of the watershed, resulting in high rates of infiltration in undeveloped areas. Cropland and rangeland are the primary land uses in the watershed (approximately 86.3%, Figure 6). Overall land cover percentages in the watershed are: forest (1.7%), rangeland (6.3%), wetland (4.4%), cropland (80%), developed (5.9%), barren (0.1%) and open water (1.5). This overall area lies primarily within the Northern Glaciated Plains and the Western Corn-belt Plains eco-regions (Figure 7) and has land use typical of these eco-regions. Significant portions of the watershed have been drained to increase agricultural and non-agricultural development. The highly manipulated hydrology within the watershed has resulted in a very effective drainage system that allows agriculture, the regions primary land use, to thrive throughout much of the watershed. Corn and soybeans are the primary crops grown in the watershed however; there are areas of hay and pasture in hilly regions. Livestock production predominantly includes dairy, beef cattle, swine, and turkeys (YMRWD 2013).

Climate and precipitation

Average temperatures in the watershed range from a low of 7 degrees to a high of 84 degrees Fahrenheit. The record high temperature is 108 and the record low is -41 Fahrenheit. Precipitation historically has varied from 15 to 34 inches per year in the watershed. During the 2010 sampling year rainfall was 36 to 40 inches in the watershed, 16 inches above normal. Heavy rains fell in early June of the sampling year.

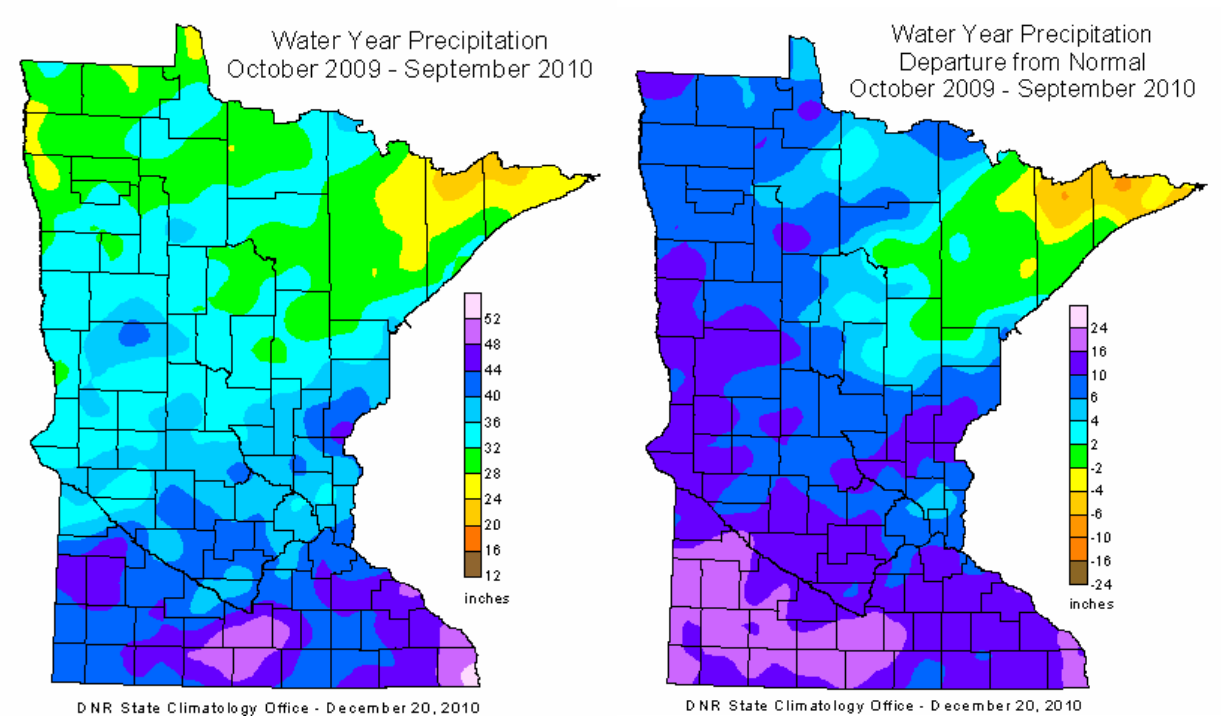

Figure 8. State-wide precipitation levels during the 2010 water year.

Figure 9 displays the areal average representation of precipitation in West Central Minnesota. An areal average is a spatial average of all the precipitation data collected within a certain area presented as a single dataset. This data is taken from the Western Regional Climate Center, available as a link off of the University of Minnesota Climate website: http://www.wrcc.dri.edu/spi/divplot1map.html.

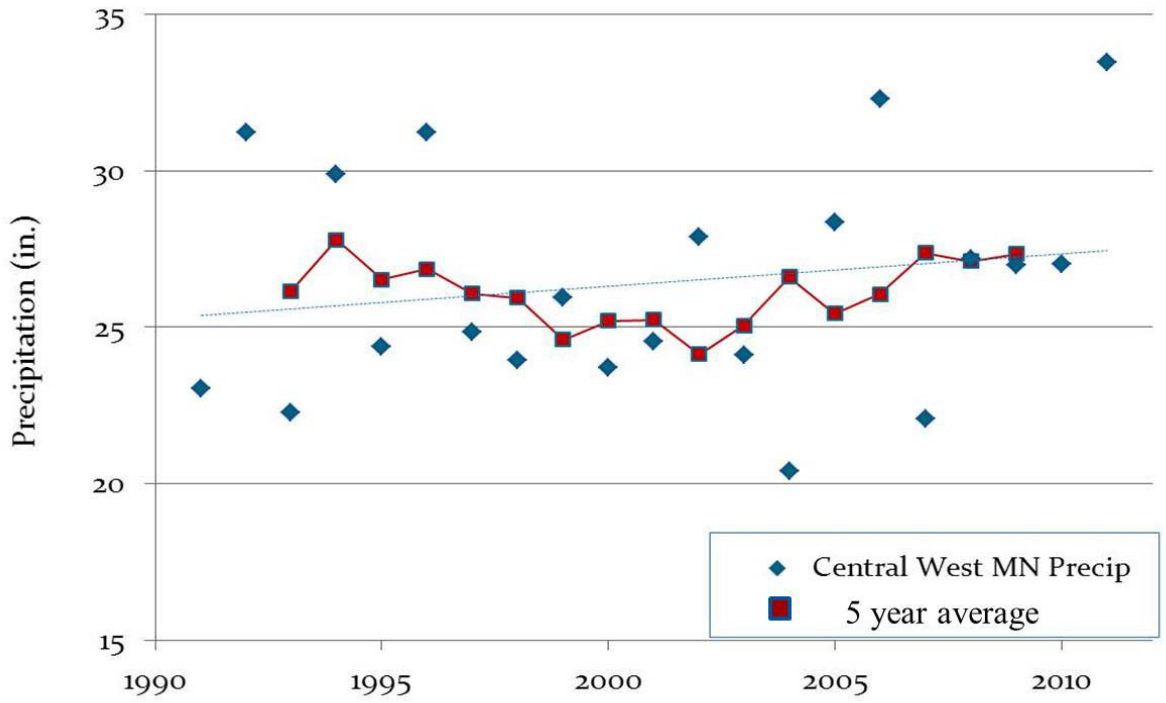

Figure 9. Precipitation trends in West Central Minnesota (1990-2010) with five year running average.

Rainfall in the West Central region has risen over the last 20 years. This follows with a statewide spatial average showing a statistically significant rising trend for the same time period. However, rainfall in the west-central region displays no significant trend since 1990. Though rainfall can vary in intensity and time of year, it would appear that west-central Minnesota precipitation has not changed dramatically over 20 years. Precipitation in west-central Minnesota does exhibit a statistically significant rising trend over the past 100 years, $p = 0.001$. This is a strong trend and matches similar trends throughout Minnesota.

Wetlands

Excluding the open water portions of lakes, ponds, and rivers, the Minnesota River - Granite Falls Watershed has approximately 54,000 acres of wetlands, equivalent to ~4% of the watershed area. Wetlands with herbaceous emergent vegetation are the most common wetland type in this watershed (Figure 10). Upper parts of the watershed, particularly in Upper Hawk Creek, South Branch Yellow Medicine River and Upper Yellow Medicine River subwatersheds support more wetlands and they are less connected to the stream network. In the flatter outwash central region of the Minnesota River - Granite Falls Watershed, wetlands are less frequent and are typically associated with the stream network. These estimates and distribution observations represent a snapshot of the location, type, and extent of wetlands occurring in 1980, which is the year that aerial imagery data was acquired to develop National Wetlands Inventory (NWI) maps in this part of Minnesota.

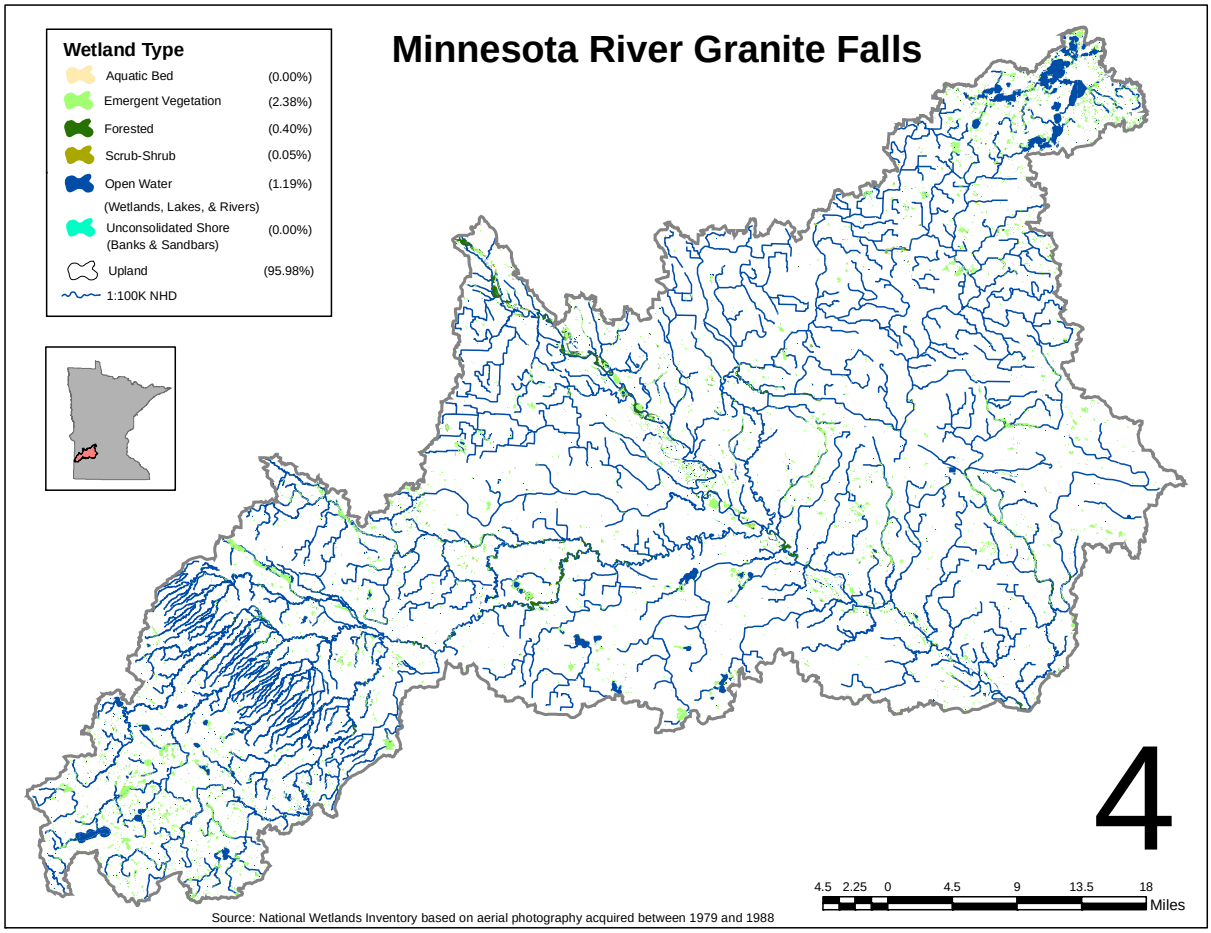

Figure 10. Distribution of wetlands by National Wetland Inventory type within the Minnesota River Granite Falls HUC8 watershed

Many changes to wetlands have likely occurred in this region since the early 1980s, though the NWI remains the best data available to estimate wetland extent. In 2003 the MPCA conducted a statistical survey of wetland quantity in the Redwood River watershed and compared the results with the NWI data (Genet and Olson 2008). The Redwood River Watershed and Minnesota River - Granite Falls Watershed are adjacent to each other, with the Redwood watershed occurring to the south of the Granite Falls Watershed. These two watersheds have very similar land uses and geologic settings thus it is reasonable to consider the 2008 results in the Redwood River with the Minnesota River - Granite Falls Watershed. Genet and Olson reported a 21% reduction in the area of depressional wetlands in the Redwood River Watershed between 1980 and 2003. Most

of these wetland area losses occurred in the smallest (< 5 ha) depressional wetlands. During the period 1980 to 2003 the number of depressional wetland basins in the Redwood Watershed decreased 55.5% compared with the NWI.

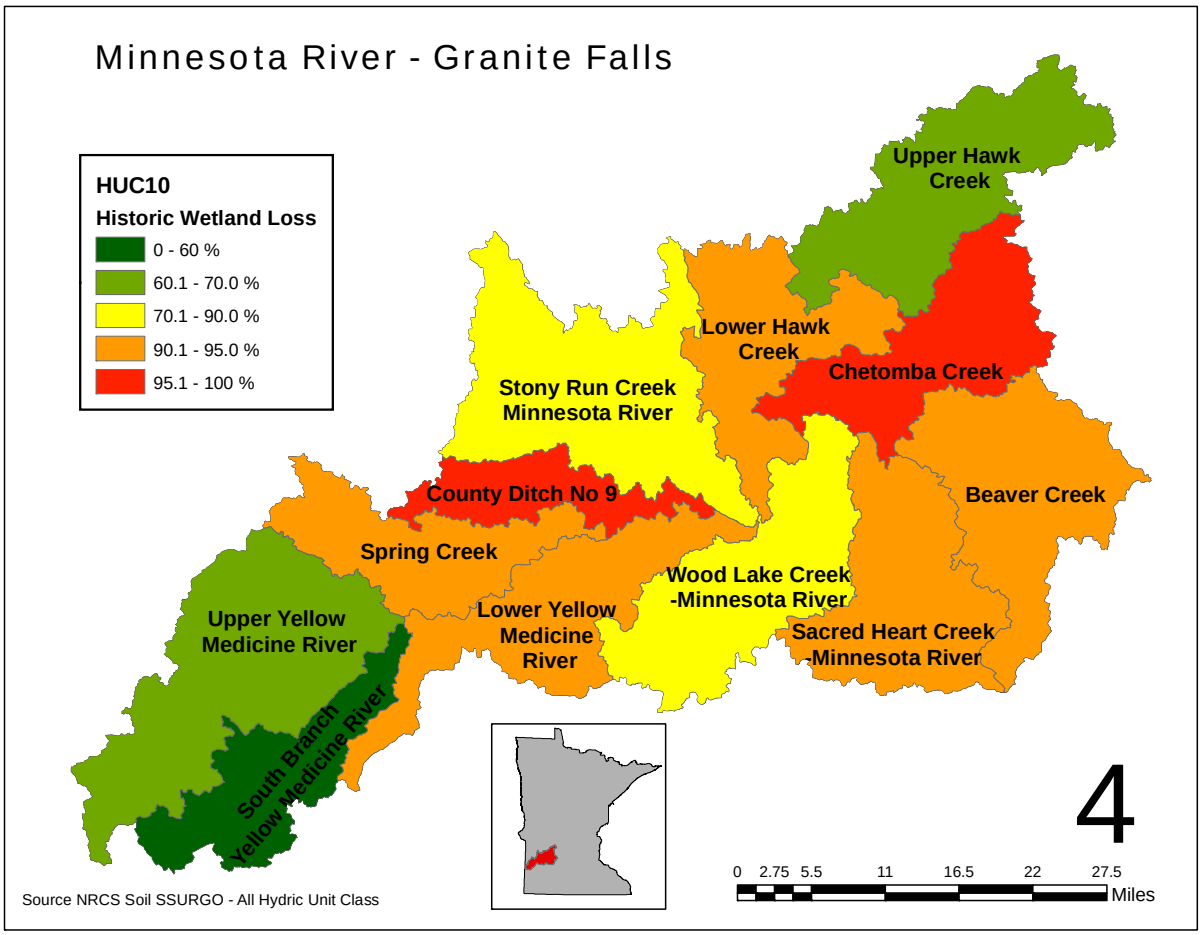

Figure 11. Estimated historic wetland loss as a percentage of current wetlands in each HUC10 subwatershed. Based on analysis of SSURGO data using "all hydric" soil components.

Soils data can be used to estimate the historic wetland extent prior to homesteading and settlement which set a foundation for significant wetland conversion. Analysis of Natural Resources Conservation Service digital soil survey (SSURGO) soil map units that are classed as "all hydric" suggest approximately 473,000 acres of wetland or 36% of the Granite Falls Watershed occurred prior to settlement. Another estimate of historic wetland extent is available from work by the U.S. Fish and Wildlife Service (USFWS) in partnership with Ducks Unlimited (DU). In the prairie pothole region of western and southern Minnesota USFWS and DU had photo interpreters delineate drained wetland polygons in extent and based on upper soil surface mottle patterns evident on 1991 spring black and white aerial imagery. The result was a GIS coverage called the Restorable Wetland Inventory (RWI). Based on the RWI data 19% of the Granite Falls Watershed was likely wetland during presettlement time. Approximately 67% of the RWI polygons are less than 1.0 acre in size. In contrast the SSURGO map units are typically much larger many of the small RWI polygons are not specifically delineated within SSURGO hydric soil components. The focus of the RWI was designed to delineate historic depressional "pothole" type wetlands consequently wetlands often associated with streams or wetlands which occurred on flats are frequently absent on the RWI. Thus it is not surprising the SSURGO coverage suggests greater extent of historic wetland area in this watershed.

Figure 11 presents analysis of SSURGO results of estimated extent of historic wetlands in the HUC 10 subwatersheds within the Minnesota River - Granite Falls Watershed. Categories of percent wetland loss within each subwatershed were calculated for each HUC10 subwatershed using GIS; where:

100 – ((Current NWI wetland area) / (Sum SSURGO "all hydric" components)*100) = estimated historic loss

Similar to the modern estimated wetland distribution in the Granite Falls Watershed (HUC8) the greatest percentage of remaining historic wetlands occurs in the upper reaches of the watershed. Notably the South Branch Yellow Medicine River (0702000404) supports approximately 44% (lost 56%) of the historic wetlands; the Upper Yellow Medicine River and the Upper Hawk Creek have lost 65% and 69% of the historic wetlands respectively. In contrast the two most heavily drained subwatersheds are Chetomba Creek and County Ditch No. 9 subwatersheds; both have lost an estimated 97% of their historic wetlands.

Wetland condition

The MPCA began biological monitoring of wetland condition in the early 1990s, focusing on wetlands with emergent vegetation (i.e., marshes) in a depressional geomorphic setting. More information about wetland condition monitoring can be accessed at http://www.pca.state.mn.us/index.php/water/water-types-and-programs/surface-water/wetlands/wetland-monitoring-and-assessment.html. This work resulted in the development of plant and macroinvertebrate (aquatic bugs, snails, leeches, and crustaceans) IBIs for evaluating the ecological condition or health of this type of wetland habitat. Both IBIs are on a 0 to 100 scale with higher scores indicating better condition. Today, these indicators are used in a statewide survey of wetland condition where results can be summarized statewide and for each of Minnesota's ecoregions (Genet 2012). Ninety eight percent (98%) of the Minnesota River Yellow Medicine River Watershed occurs in the Temperate Prairies Ecoregion with only two percent (2%) in the Mixed Wood Plains Ecoregion this portion lying in the NE part of the Upper Hawk Creek Watershed. Wetland condition in the Temperate Prairies Ecoregion is among the worst in the state. Invertebrate index results found 47% of depressional wetlands are in poor condition while 33% of these marsh-type wetlands are in good condition (Genet 2012). Plant index results show 17% of the depressional wetlands are estimated to be in good condition and 54% in poor condition. Invasive plants, particularly narrow-leaf (*Typha angustifolia*) and hybrid cattails (*Typha* X *glauca*) and also reed canary grass (*Phalaris arundinacea*) are believed to contribute to the difference between invertebrate and plant results as their ubiquity in this region of the state is likely more detrimental to plant communities. These invasive plants often readily dominate wetland habitats outcompeting native species (Genet 2012). Their invasiveness is aided by their tolerance of nutrient enrichment, hydrologic alterations and toxic pollutants such as chlorides (Galatowitsch 2012).

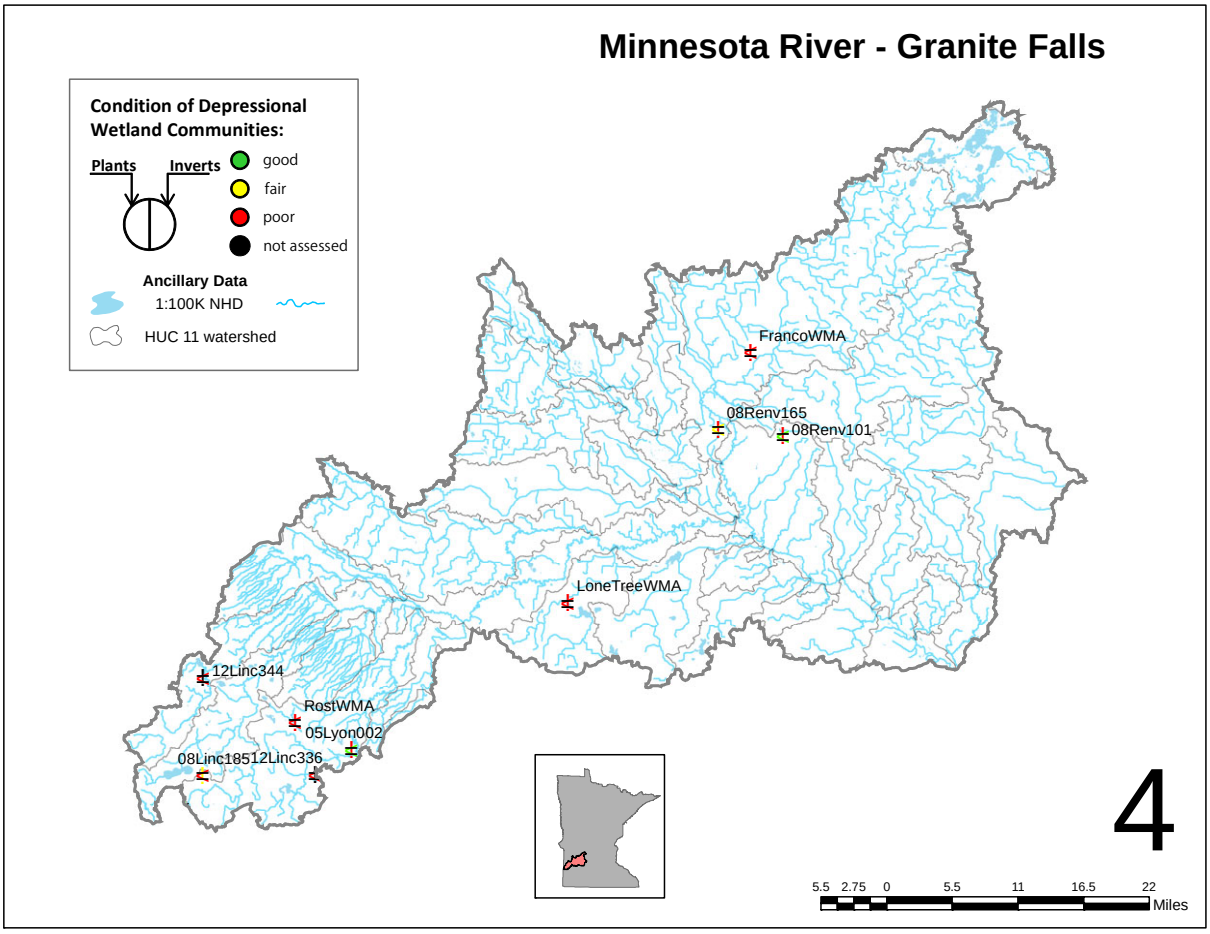

Figure 12. Depressional wetland IBI results (invertebrate and plant community indices) for the eight MPCA wetland biological study sites located in the Minnesota River - Granite Falls HUC8 watershed

MPCA ambient wetland condition data is available for eight depressional wetlands in the Minnesota River -Granite Falls Watershed. Invertebrate and plant condition results for these sites are presented in Figure 12. Five of these eight wetland study sites were randomly selected to estimate wetland quality in the Temperate Prairie Ecoregion as part of a probabilistic survey. Three of the wetlands were targeted study sites to develop invertebrate and plant biological indicators. The invertebrate community IBI scores in these eight wetlands range from 21 to 74 (0 to 100 scale with 100 being high integrity). Plant community scores in these eight wetlands ranges from 13 to 75 (0 to 100 scale with 100 being high integrity). Overall no watershed pattern is evident in this small set of wetland condition study sites. All eight wetland study sites appear to have some degree of biological impairment as each site was assessed as being in "poor" condition based on either or both the invertebrate and plant community indicator. Franco WMA is a state wildlife management area wetland which had an invertebrate score of 24 and a plant score of 16 in 2003. In 2002 this site had an invertebrate IBI score of 21 and a plant score of 13. The highest plant IBI result – 75 in this watershed; came from 08Linc185, a small wetland in the upper reaches of the Upper Yellow Medicine River sampled in 2008. This same wetland had an invertebrate IBI score of 41. This wetland is a small privately owned depressional wetland in a cattle pasture which was created by constructing a low berm to catch water flowing off adjacent hills and into a natural swale. The highest invertebrate IBI score (74) in the Granite Falls HUC8 was 08Ren101 (Rosaasen Slough WMA). A replicate invertebrate community score from this site was 65 and the wetland plant IBI score for this same site in 2008 was 35. Rossaasen Slough WMA is a 32 acre wetland on a state wildlife

management area. It is a flow-through wetland that is near the headwaters of Wood Lake Creek – Minnesota River.

Franco WMA (12-0013-00) located in the Upper Hawk Watershed had poor quality invertebrate and plant community integrity scores. Both the invertebrate and plant community IBI scores fall below the 303(d) impairment thresholds for depressional wetlands. Furthermore it is hydrologically connected to downstream impaired waters. In meeting these two criteria the MPCA listed Franco WMA wetland as an impaired wetland, failing to meet its expected aquatic life designated uses. The plant community of Franco WMA has very low richness with only four species occurring during both the 2003 and 2002 MPCA sampling visits. Invasive plants narrow-leaf (*Typha angustifolia*) and hybrid cattails (*Typha* X *glauca*) dominate the plant community.

IV. Watershed-wide data collection methodology

Watershed pollutant load monitoring network

Water quality sampling occurs throughout the year at all major river and major watershed outlet WPL Minnesota sites in the WPLMN. In 2009 and 2010, between 36 and 57 mid-stream grab samples were collected at the Hawk Creek site near Granite Falls, focusing the sampling frequency greatest during periods of moderate to high flow (Figure 13). For the Yellow Medicine River near Granite Falls, there were between 27 and 46 samples collected in 2008, 2009 and 2010 (Figure 14). In 2007, there were 16 samples collected; nitrate plus nitrite nitrogen (nitrate-N) was the only parameter used for analysis. Because correlations between concentration and flow exist for many of the monitored analytes, and because these relationships can shift between storms or with season, computation of accurate load estimates requires frequent sampling of all major runoff events. Low flow periods are also sampled and are well represented but sampling frequency tends to be less as concentrations are generally more stable when compared to periods of elevated flow. Despite discharge related differences in sample collection frequency, this staggered approach to sampling generally results in samples being well distributed over the entire range of flows.

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

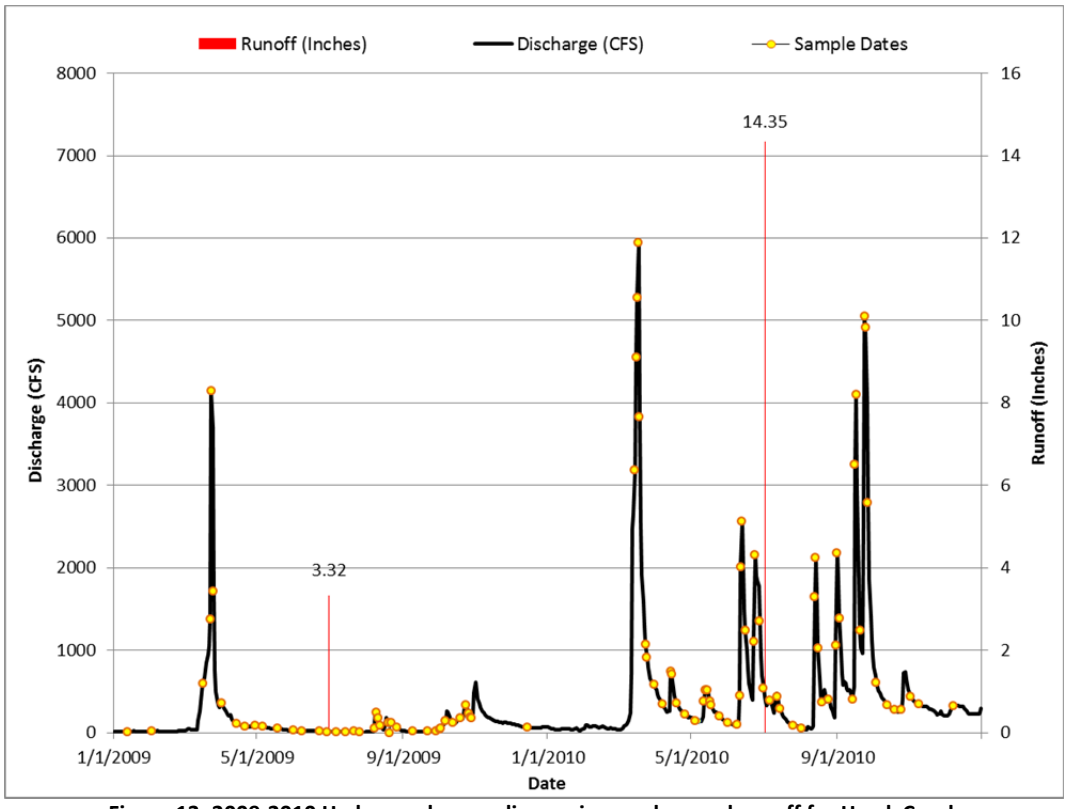

Figure 13. 2009-2010 Hydrograph, sampling regime and annual runoff for Hawk Creek

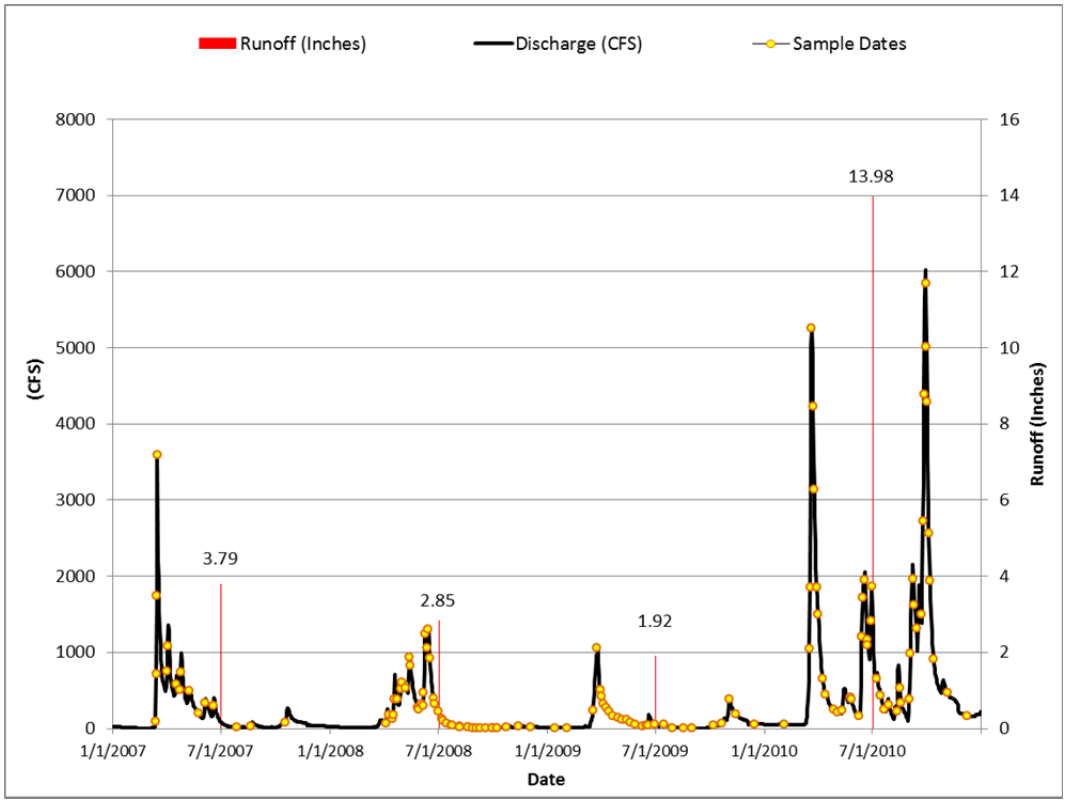

Figure 14. 2007-2010 Hydrograph, sampling regime and annual runoff for the Yellow Medicine River

Stream water sampling

Twenty-one water chemistry stations were sampled from May thru September in 2010, and again in June thru August of 2011, to provide sufficient water chemistry data to assess all components of the Aquatic Life and Recreation Use Standards. Following the IWM design, water chemistry stations were placed at the outlet of each 11 HUC subwatershed that was >40 square miles in area (purple circles and green circles/triangles in Figure 2). Surface Water Assessment Grants (SWAG) were awarded to the Hawk Creek Watershed Project and the Yellow Medicine River Watershed District. These sites were co-located with existing stations from previous monitoring projects in the watershed. (See Appendix 2 for locations of stream water chemistry monitoring sites. See Appendix 1 for definitions of stream chemistry analytes monitored in this study). Chemistry data for the Minnesota River - Granite Falls Watershed submitted by wastewater treatment plants as part of their discharge permit was also reviewed.

Stream biological sampling

The biological monitoring component of the intensive watershed monitoring in the Minnesota River - Granite Falls Watershed was completed during the summer of 2010. A total of 123 sites were newly established across the watershed and sampled. These sites were located near the outlets of most minor HUC-14 watersheds. In addition, five existing biological monitoring stations within the watershed were revisited in 2010. These monitoring stations were initially established as part of a random Minnesota River Basin wide survey in 2003, or as part of a 2004 survey which investigated the quality of channelized streams with intact riparian zones. While data from the last 10 years contributed to the watershed assessments, the majority of data utilized for the 2012 assessment was collected in 2010. A total of 117 AUIDs were sampled for biology in the Minnesota River - Granite Falls Watershed. Waterbody assessments to determine aquatic life use support were conducted for 33 AUIDs. Waterbody assessments were not conducted on 84 AUIDs because criteria for channelized reaches had not been developed prior

to the assessments. Nonetheless, the biological information that was not used in the assessment process will be crucial to the stressor identification process and will also be used as a basis for long term trend results in subsequent reporting cycles. Qualitative good-fair-poor ratings for non-assessed reaches area included in Appendix 5.1.

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

Fish contaminants

Mercury was analyzed in fish tissue samples collected from the Yellow Medicine River, Hawk Creek, and 12 lakes in the watershed. Polychlorinated biphenyls (PCBs) were measured in fish from the Yellow Medicine River, Hawk Creek, and four lakes. MPCA biomonitoring staff collected the fish from the rivers in 2010. Minnesota MDNR fisheries staff collected all other fish.

Select fish species from Foot (34018100) and Willmar (34018000) lakes were tested for perfluorochemicals (PFCs). The specific PFC that bioaccumulates in fish and is a known health concern for human consumption is perfluorooctane sulfonate (PFOS). Therefore, it is the only PFC concentration reported here for fish tissue. PFCs became a contaminant of emerging concern in 2004 when high concentrations of PFOS were measured in fish from the Mississippi River, Pool 2. Extensive statewide monitoring of lakes and rivers for PFCs in fish was continued through 2010.

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

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

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

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

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

Lake water sampling

Intensive Watershed Monitoring (IWM) efforts for lakes took place in 2009-2010. However, other monitoring of lakes has occurred in the Minnesota River - Granite Falls Watershed in the past. Lake water chemistry and Secchi data used in this report was taken from the MPCA's EQuIS database. This data was collected by both MPCA staff and local partners including Citizens Lake Monitoring Program (CLMP) volunteers. Volunteers enrolled in the MPCA's CLMP help to provide additional data in years between IWM efforts. Sampling methods are similar among monitoring groups and are described in the document entitled "MPCA Standard Operating Procedure for Lake Water Quality" found at http://www.pca.state.mn.us/index.php/view-document.html?gid=6492. The lake water quality assessment standard requires eight observations/samples within a 10-year period for phosphorus, chlorophyll-a and Secchi depth.

Wetland monitoring

The MPCA began developing biological monitoring methods for wetlands in the early 1990s, focusing on wetlands with emergent vegetation (i.e., marshes) in a depressional geomorphic setting. This work has resulted in the development of plant and macroinvertebrate (aquatic bugs, snails, leeches, and crustaceans) IBIs for the Temperate Prairies (TP), Mixed Wood Plains (MWP) and the Mixed Wood Shield (MWS) level II ecoregions in Minnesota. These IBIs are suitable for evaluating the ecological condition or health of depressional wetland habitats. All of the wetland IBIs are scored on a 0 to 100 scale with higher scores indicating better condition. Wetland sampling protocols can be viewed at http://www.pca.state.mn.us/index.php/water/water-types-and-programs/surface-water/wetlands/wetland-monitoring-and-assessment.html. Today, these indicators are used in a statewide survey of wetland condition where results can be summarized statewide and for each of Minnesota's three level II ecoregions (Genet 2012).

V. Individual watershed results

HUC-10 watershed units

Assessment results for aquatic life and recreation use are presented for each HUC-10 watershed unit within the Minnesota River - Granite Falls Watershed. The primary objective is to portray all the full support and impairment listings within a 10-HUC watershed unit resulting from the complex and multi-step assessment and listing process. A summary table of assessment results for the entire 8-HUC watershed including aquatic consumption, and drinking water assessments where applicable is included in Appendix 3. This scale provides a robust assessment of water quality condition at a practical size for the development, management, and implementation of effective TMDLs and protection strategies. The graphics presented for each of the HUC-10 watershed units contain the assessment results from the 2012 Assessment Cycle as well as any impairment listings from previous assessment cycles. Discussion of assessment results focuses primarily on the 2010 intensive watershed monitoring effort, but also considers available data from the last 10 years.

The following pages provide an account of each HUC-10 watershed. Each account includes a brief description of the subwatershed, and summary tables of the results for each of the following: a) stream aquatic life and aquatic recreation assessments; b) biological condition of channelized streams and ditches; c) stream habitat quality; d) channel stability; e) water chemistry for the HUC-10 outlet (where applicable); and f) lake aquatic recreation assessments. Following the tables is a narrative summary of the assessment results and pertinent water quality projects completed or planned for the subwatershed. A brief description of each of the summary tables is provided below.

Stream assessments

A table is provided in each section summarizing aquatic life and aquatic recreation assessments of all assessable stream reaches within the watershed (i.e., where sufficient information was available to make an assessment). Primarily, these tables reflect the results of the 2012 assessment process (2014 EPA reporting cycle); however, impairments from previous assessment cycles are also included and are distinguished from new impairments via cell shading (see footnote section of each table). These tables also denote the results of comparing each individual aquatic life and aquatic recreation indicator to their respective criteria (i.e., standards); determinations were made during the desktop phase of the assessment process (see Figure 4). Assessment of aquatic life is derived from the analysis of biological (fish and invertebrate IBIs), dissolved oxygen, turbidity, chloride, pH and un-ionized ammonia (NH_3) data, while the assessment of aquatic recreation in streams is based solely on bacteria (Escherichia coli or fecal coliform) data. Included in each table is the specific aquatic life use classification for each stream reach: cold water community (2A); cool or warm water community (2B); or indigenous aquatic community (2C). Stream reaches that do not have sufficient information for either an aquatic life or aquatic recreation assessment (from current or previous assessment cycles) are not included in these tables, but are included in Appendix 5.2 and Appendix 5.3. Where applicable and sufficient data exists, assessments of other designated uses (e.g., class 7, drinking water, aquatic consumption) are discussed in the summary section of each HUC-10 as well as in the Watershed-Wide Results and Discussion section.

Channelized stream evaluations

Biological criteria have not been developed yet for channelized streams and ditches; therefore, assessment of fish and macroinvertebrate community data for aquatic life use support was not possible at some monitoring stations. A separate table provides a narrative rating of the condition of fish and macroinvertebrate communities at such stations based on IBI results. Evaluation criteria are based on aquatic life use assessment thresholds for each individual IBI class.

IBI scores above this threshold are given a "good" rating, scores falling below this threshold by less than ~15 points (i.e., value varies slightly by IBI class) are given a "fair" rating, and scores falling below the threshold by more than ~15 points are given a "poor" rating. For more information regarding channelized stream evaluation criteria refer to Appendix 5.1.

Stream habitat results

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

Stream stability results

Stream channel stability information evaluated during each invertebrate sampling visit is provided in each HUC-10 section. These tables display the results of the Channel Condition and Stability Index (CCSI), which rates the geomorphic stability of the stream reach sampled for biology. These results may provide an indication of recent stream channel geomorphic changes and loss of habitat quality, which may be related to changes in watershed hydrology, stream gradient, sediment supply, or sediment transport capacity. The CCSI score is comprised of three scoring zones associated with three different areas of the stream channel (upper banks, lower banks, and substrate). Within each zone, individual metrics are rated and summed and both the zone and total scores are included in the 11HUC tables. The CCSI total score range is from 13 to 138 where higher scores indicate greater channel instability. The final row in each table displays the average CCSI scores and a rating for the HUC-11 watershed. The CCSI was recently implemented in 2008, and is collected once at each biological station. Consequently, the CCSI ratings are only available for biological visits sampled in 2010 or later.

Watershed outlet water chemistry results

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

Lake assessments

A summary of lake water quality is provided in the HUC-10 sections where available data exists. For lakes with sufficient data, basic modeling was completed. Assessment results for all lakes in the watershed are available in Appendix 3.2. Lake models and corresponding morphometric inputs can be found in Appendix 6.2.

County Ditch 9 Watershed Unit HUC 0702000401

This watershed unit is direct tributary to the Minnesota River located on the south west side of the river. This 78 square mile drainage area is comprised mainly of cropland and developed land and includes the towns of Hazel Run and Minnesota Falls. Hazel Creek (County Ditch 9) is the only assessed stream in the subwatershed and represents the outlet (site 10MN014) of the 10 digit HUC. The other streams in this subwatershed are unnamed streams that flow into Hazel Creek. The streams in this watershed unit are all designated as warmwater. Stokke Lake is the only named lake in the subwatershed and is located in the middle part of the subwatershed.

Table 1. Aquatic life and recreation assessments on stream reaches: County Ditch 9 Watershed Unit.

AUID ***Reach Name***, *Reach Description*	Reach Length (miles)	Use Class	Biological Station ID	Location of Biological Station	Aquatic Life Indicators: Fish IBI	Invert IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides	Bacteria	Aquatic Life	Aquatic Rec.
07020004-536, Hazel Creek, Unnamed cr to Minnesota R	30.37	2C	10MN014 10MN047	Upstream of Hwy 274, 3 mi. S of Granite Falls Upstream of CR 8, 1 mi. NW of Hazel Run	MTS	EXP	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: = existing impairment, listed prior to 2012 reporting cycle; = new impairment; = full support of designated use.

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

Table 2. Non-assessed biological stations on channelized AUIDs in the County Ditch 9 10-HUC

AUID ***Reach Name***, *Reach Description*	Reach Length (miles)	Use Class	Biological Station ID	Location of Biological Station	Fish IBI	Invert IBI
07020004-536, Hazel Creek, Unnamed cr to Minnesota R	30.37	2C	10MN047	Upstream of CR 8, 1 mi. NW of Hazel Run	poor	poor
07020004-707, Unnamed creek, Headwaters to CD 9	2.86	2B, 3C	10MN048	Upstream of 260th Ave, 1.5 mi. N of Hazel Run	poor	poor

Table 3. Minnesota Stream Habitat Assessment (MSHA): County Ditch 9 10-HUC.

# Visits	Biological Station ID	Reach Name	Land Use (0-5)	Riparian (0-15)	Substrate (0-27)	Fish Cover (0-17)	Channel Morph. (0-36)	MSHA Score (0-100)	MSHA Rating
1	03MN050	Hazel Creek	0	7	8	9	10	34	poor
1	10MN014	Hazel Creek	0	10.5	21.4	12	31	74.9	good
1	10MN047	Hazel Creek	0	8	3	12	4	27	poor
3	10MN048	Trib. to Hazel Creek	0	8.3	9	6	4.6	28	poor

Table 4. Outlet water chemistry results for Hazel Creek in the County Ditch 9 HUC 10

Station location:	**Hazel Creek, At HWY 274, 3 mi. S of Granite Falls**							
STORET/EQuIS ID:	**S006-172**							
Station #:	**10MN014**							
Parameter	**Units**	**# of Samples**	**Minimum**	**Maximum**	**Mean**	**Median**	**WQ Standard[1]**	**# of WQ Exceedances[2]**
Escherichia coli	MPN/100ml	17	35.5	920.8	214.5	116.2	1260.0	0
Ammonia-nitrogen	mg/l	10	0.16	0.52	0.20	0.16		
Inorganic nitrogen (nitrate and nitrite)	mg/l	10	5.66	17.60	11.68	11.75		
Kjeldahl nitrogen	mg/l	10	0.7	1.9	1.2	1.2		
Phosphorus	ug/l	10	32.0	262.0	152.7	164.0		
Orthophosphate	ug/l	0						
Total suspended solids	mg/l	10	2.0	38.0	15.4	15.5		
Total volatile solids	mg/l	10	2.0	7.0	3.7	3.5		
Hardness, carbonate	mg/l	9	452.0	778.0	646.9	662.0		
Calcium	mg/l	9	103.0	167.0	140.6	140.0		
Magnesium	mg/l	9	47.4	87.7	71.9	77.0		
Chloride	mg/l	7	16.4	29.3	22.3	23.4	230.0	0

Station location:	Hazel Creek, At HWY 274, 3 mi. S of Granite Falls							
STORET/EQuIS ID:	S006-172							
Station #:	10MN014							
Parameter	**Units**	**# of Samples**	**Minimum**	**Maximum**	**Mean**	**Median**	**WQ Standard[1]**	**# of WQ Exceedances[2]**
Sulfate	mg/l	7	201.0	452.0	315.1	296.0		
Specific conductance	uS/cm	19	859.0	1414.0	1214.6	1245.0		
pH	--	19	7.8	8.8	8.2	8.2	6.5-9.0	0
Dissolved oxygen (DO)	mg/l	19	7.1	13.8	9.0	8.7	5.0	0
Temperature, water	deg C	19	12.7	25.0	19.7	19.8		
Turbidity	NTRU	0					25.0 NTU	0
Transparency, tube with disk	cm	19	24.0	60.0	48.8	50.0		

[1]Total suspended solids and transparency tube standards are surrogate standards derived from the turbidity standard of 25.
[2]Represents exceedances of individual maximum standard for E. coli (1260/100ml).
****Data found in the table above was compiled using the results from data collected at the outlet monitoring station in the County Ditch 9 10 HUC, a component of the IWM work conducted between May and September in 2010 and 2011. This specific data does not necessarily reflect all data that was used to assess the AUID.**

Table 5. Channel condition and stability assessment (CCSI): Stony Run Creek 10- HUC

Visit Date	Biological Station ID	Stream Name	Upper Banks (43-4)	Lower Banks (46-5)	Substrate (37-3)	Channel Evolution (11-1)	CCSI Score (137-13)	CCSI Rating
05-Aug-10	10MN014	Hazel Creek	28	24	17	11	80	severely unstable
04-Aug-10	10MN047	Hazel Creek	29	12	21	7	69	moderately unstable
04-Aug-10	10MN048	Trib. to Hazel Creek	27	12	11	3	53	moderately unstable

Qualitative channel stability ratings

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

Table 6. Lake Assessments for the County Ditch 9 10 HUC

Lake ID	Lake Name	County	HUC-10	Ecoregion	Lake Area (ha)	Max Depth (m)	Mean Depth (m)	Watershed Area (ha)	% Littoral	Aquatic Recreation Use Support
87-0067-00	Stokke	Yellow Medicine	0702000401	WCBP	33			82		IF

Summary

Stream water quality data were available for a length of Hazel Creek from an unnamed tributary to the Minnesota River. Only one AUID was assessable for Hazel Creek, and only the outlet site was assessable for biology. This AUID is approximately 30 miles long. Water chemistry data were collected near the outlet of the County Ditch Number 9 HUC-10 subwatershed. Hazel Creek exceeded the standard for bacteria and is considered impaired for aquatic recreation use. This impairment was based on two geometric mean exceedances. No individual sampling event exceeded the water quality standard of 1260 MPN/100ml. Since bacteria can be highly variable, standards include a geometric mean calculation. The same reach is considered impaired for aquatic life use based on invertebrates, but impairment listing is currently deferred based on channelization in the stream reach. Dissolved oxygen flux could be an issue as indicated by the maximum D.O. value was over 12 mg/L.

Fish IBIs for the outlet site were above the threshold and confidence interval. The other two biological stations upstream were located on channelized reaches, and were not assessed. According to the channelized site rating these upstream sites rated poor for fish IBI and had a high abundance of tolerant species. The invertebrate community is impaired throughout watershed based on both warmwater criteria and channelized site rating criteria. Habitat conditions on the assessable reach at the watershed outlet are much improved over upstream, channelized reaches. Despite this, the invertebrate community is impaired, with the community being dominated by relatively tolerant, net-spinning caddisflies. A high proportion of tolerant net-spinners is typical of high gradient streams in areas with predominately agricultural or urban land uses, and the commonly associated stressors, including high nutrients, altered hydrologic regime, and habitat alteration. Habitat scores are only good at the outlet site and are poor upstream. Evidence of channelization has greatly reduced the habitat quality of Hazel Creek and tributaries. Excess nutrients as indicated by the presence of algae, duck weed, macrophytes, are problems at all of the sites.

There was not enough information to adequately assess the water chemistry in Stokke Lake.

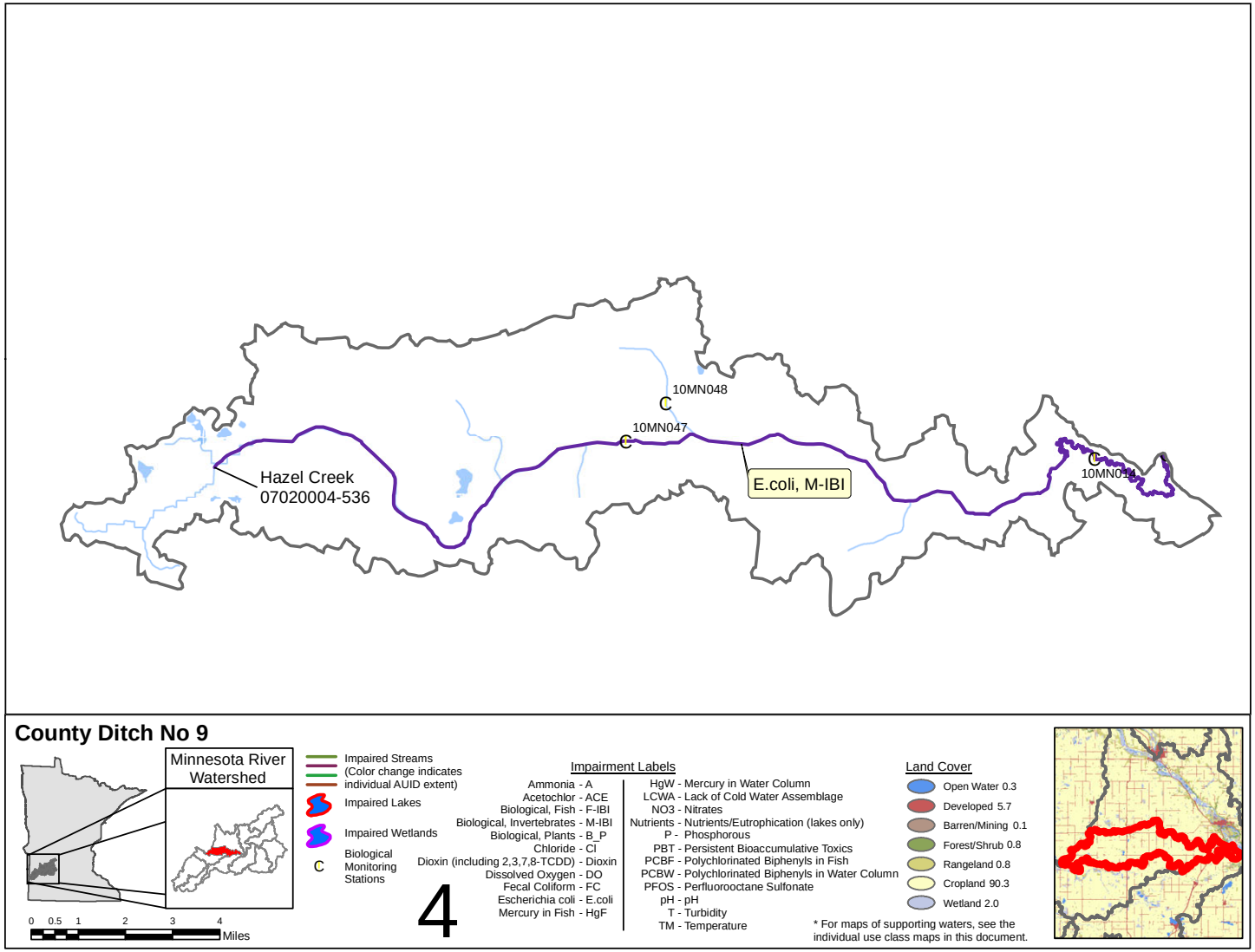

Figure 15. Currently listed impaired waters by parameter and land use characteristics in the County Ditch 9 Watershed Unit.

Stony Run Creek - Minnesota River Watershed Unit HUC 0702000402

This watershed unit is a collection of smaller tributaries that flow into the Minnesota River from both the north and south side of the river. The subwatershed is located in the northern part of the Minnesota River - Granite Falls HUC 8. This 259 square mile drainage area is comprised mainly of cropland, rangeland and developed land and includes the towns of Lisbon and Sparta upstream and the city of Granite Falls downstream. There are two outlet sites for intensive watershed monitoring in this subwatershed. Stony Run Creek is the largest tributary on the southern side of the subwatershed that flows directly to the Minnesota River and is represented by the outlet station 10MN015. The largest tributary on the north side of the Minnesota River is Palmer Creek and is represented by the outlet site 10MN007. Other smaller tributaries in this watershed unit are Brafees Creek, Judicial Ditch 23, and County Ditches 36A and 39. The streams in this watershed unit are all designated as warmwater. No assessed lakes are in this subwatershed.

Table 7. Aquatic life and recreation assessments on stream reaches: Stony Run Creek- Minnesota River Watershed Unit

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.
					Fish IBI	Invert IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides			
07020004-534, Palmer Creek (County Ditch 68), Headwaters to Minnesota R	17.76	2C	10MN007	Downstream of 15th Ave, 2 mi. N of Granite Falls	MTS	MTS	IF	EXS	MTS	MTS	MTS		EX	IF	NS
07020004-610, Brafees Creek, T116 R40W S1, north line to Minnesota R	2.82	2C	10MN076	Upstream of 20th Ave, 0.5 mi. E of Wegdahl	MTS	MTS	--	MTS		--				FS	NA
07020004-674, Judicial Ditch 23, Unnamed cr to Minnesota R	2	2B, 3C	10MN121	Upstream of Hwy 212, 3 mi. W of Montevideo	MTS	MTS	--	--		--	--			FS	NA
07020004-682, County Ditch 36A, Unnamed cr to Minnesota R	2.34	2B, 3C	10MN116	Upstream of CR 15, 2 mi. SE of Montevideo	MTS		--	IF		--				FS	NA

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.
					Fish IBI	Invert IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides			
07020004-713, County Ditch 39, CD 6A to Minnesota R	3.89	2B, 3C	10MN051	Upstream of CR 39 1 mi. S of Granite Falls	EXS	EXP	--	--		--	--			NS	NA
07020004-535, Stony Run Creek, T116 R40W S30, west line to Minnesota R	13.54	2C	10MN015 10MN123	Upstream of Hwy 212, 4 mi. NW of Granite Falls Upstream of CR C3, 5 mi. NE of Clarkfield			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: = existing impairment, listed prior to 2012 reporting cycle; = new impairment; = full support of designated use.

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

Table 8. Non-assessed biological stations on channelized AUIDs in the Stony Run Creek 10-HUC

AUID *Reach Name*, *Reach Description*	Reach Length (miles)	Use Class	Biological Station ID	Location of Biological Station	Fish IBI	Invert IBI
07020004-535, Stony Run Creek, T116 R40W S30, west line to Minnesota R	13.54	2C	10MN123	Upstream of CR C3, 5 mi. NE of Clarkfield	poor	poor
07020004-535, Stony Run Creek, T116 R40W S30, west line to Minnesota R	13.54	2C	10MN015	Upstream of Hwy 212, 4 mi. NW of Granite Falls	good	good
07020004-709, Unnamed ditch, Unnamed ditch to JD 21	2.82	2B, 3C	10MN052	Upstream of 440th St, 1.5 mi. NE of Clarkfield	poor	poor
07020004-710, Unnamed creek, Unnamed cr to Minnesota R	1.66	2B, 3C	10MN058	Upstream of Hwy 212, 2 mi. W of Montevideo	fair	poor
07020004-708, County Ditch 36, Unnamed ditch to JD 21	1.12	2B, 3C	10MN118	Upstream of 290th Ave, 4.5 mi. N of Hazel Run	good	poor
07020004-711, County Ditch 90, Unnamed cr to Unnamed cr	1.17	2B, 3C	10MN120	Downstream of 200th St, 5 mi. W of Montevideo	fair	poor
07020004-714, County Ditch 6A, Unnamed cr to CD 39	1.66	2B, 3C	10MN050	Upstream of 270th Ave, 1.5 mi. SW of Granite Falls	good	poor
07020004-673, Judicial Ditch 23, Unnamed ditch to Unnamed cr	4.55	2B, 3C	10MN132	Upstream of 186th St, 2 mi. W of Montevideo	good	fair
07020004-580, Stony Run Creek, Headwaters to T116 R41W S25, east line	9.59	2B, 3C	10MN114	Upstream of 440th St, S of CR 5, 3 mi. NE of Clarkfield	poor	poor

Table 9. Minnesota Stream Habitat Assessment (MSHA): Stony Run Creek 10-HUC.

# Visits	Biological Station ID	Reach Name	Land Use (0-5)	Riparian (0-15)	Substrate (0-27)	Fish Cover (0-17)	Channel Morph. (0-36)	MSHA Score (0-100)	MSHA Rating
1	10MN007	Palmer Creek	0	4.5	21.6	11	23	60.1	fair
1	10MN015	Stony Run Creek	1.75	11.5	23.6	13	26	75.85	good
2	10MN050	County Ditch 36, Branch A	0	8	16	10	8	42	poor
1	10MN051	County Ditch 39	2.5	11.5	18.7	13	27	72.7	good
1	10MN052	Trib. to Judicial Ditch 21	0	8	9	10	4	31	poor
1	10MN058	Trib. to Minnesota River	0	13	11.2	16	23	63.2	fair
1	10MN076	Brafees Creek	0	11	16.5	13	24	64.5	fair
1	10MN114	Stony Run Creek	0	7.5	8	13	9	37.5	poor
1	10MN116	County Ditch 36, Branch A	0	3	16.8	7	14	40.8	poor
3	10MN118	County Ditch 36	0	7.2	14.2	11.3	9.7	42.4	fair
1	10MN120	County Ditch 90	2	9.5	8.7	16	19	55.2	fair

# Visits	Biological Station ID	Reach Name	Land Use (0-5)	Riparian (0-15)	Substrate (0-27)	Fish Cover (0-17)	Channel Morph. (0-36)	MSHA Score (0-100)	MSHA Rating
1	10MN121	Judicial Ditch 23	2.5	12.5	18.3	12	31	76.3	good
1	10MN123	Stony Run Creek	0	8	18	10	10	46	fair
3	10MN132	Judicial Ditch 23	0.7	8.7	12.7	11	12	45	fair

Qualitative habitat ratings

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

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

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

Table 10. Channel condition and stability assessment (CCSI): Stony Run Creek 10- HUC.

Visit Date	Biological Station ID	Stream Name	Upper Banks (43-4)	Lower Banks (46-5)	Substrate (37-3)	Channel Evolution (11-1)	CCSI Score (137-13)	CCSI Rating
03-Aug-10	10MN007	Palmer Creek	24	23	4	7	58	moderately unstable
04-Aug-10	10MN015	Stony Run Creek	16	10	15	3	44	fairly stable
03-Aug-10	10MN050	County Ditch 6, Branch A	27	14	11	3	55	moderately unstable
04-Aug-10	10MN051	County Ditch 39	21	18	15	5	59	moderately unstable
04-Aug-10	10MN052	Trib. to Judicial Ditch 21	26	6	14	1	47	moderately unstable
03-Aug-10	10MN058	Trib. to Minnesota River	17	8	6	1	32	fairly stable
03-Aug-10	10MN076	Brafees Creek	25	22	12	7	66	moderately unstable
04-Aug-10	10MN114	Stony Run Creek	21	14	11	3	49	moderately unstable
04-Aug-10	10MN118	County Ditch 36	21	10	8	3	42	fairly stable
03-Aug-10	10MN120	County Ditch 90	24	4	22	7	57	moderately unstable
03-Aug-10	10MN121	Judicial Ditch 23	32	30	8	7	77	moderately unstable
04-Aug-10	10MN123	Stony Run Creek	26	16	8	3	53	moderately unstable
03-Aug-10	10MN132	Judicial Ditch 23	21	7	11	7	46	moderately unstable

Qualitative channel stability ratings

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

Table 11. Outlet water chemistry results for Palmer Creek in the Stony Run Creek HUC 10

Station location:	**Palmer Creek at 15th Ave. 2 mi. N of Granite Falls**							
STORET/EQuIS ID:	**S002-136**							
Station #:	**10MN007**							
Parameter	**Units**	**# of Samples**	**Minimum**	**Maximum**	**Mean**	**Median**	**WQ Standard[1]**	**# of WQ Exceedances[2]**
Escherichia coli	MPN/100ml	0					1260.0	0
Ammonia-nitrogen	mg/l	10	0.16	0.16	0.16	0.16		
Inorganic nitrogen (nitrate and nitrite)	mg/l	10	1.57	10.70	6.24	6.43		
Kjeldahl nitrogen	mg/l	10	0.4	2.3	1.2	1.3		
Phosphorus	ug/l	10	23.0	218.0	112.7	105.0		
Orthophosphate	ug/l	0						
Total suspended solids	mg/l	10	4.0	31.0	11.2	8.0		
Total volatile solids	mg/l	10	2.0	7.0	3.2	2.0		
Hardness, carbonate	mg/l	10	485.0	1040.0	830.0	925.0		
Calcium	mg/l	10	103.0	193.0	162.9	180.0		
Magnesium	mg/l	10	55.4	137.0	103.0	115.5		
Chloride	mg/l	10	10.5	25.3	20.2	20.9	230.0	0
Sulfate	mg/l	10	291.0	774.0	545.6	612.0		
Specific conductance	uS/cm	15	949.0	1878.0	1533.9	1660.0		
pH	--	15	8.0	8.4	8.2	8.2	6.5-9.0	0
Dissolved oxygen (DO)	mg/l	15	8.9	14.0	10.4	10.0	5.0	0
Temperature, water	deg C	15	10.6	24.5	19.3	19.8		
Turbidity	NTRU	16	3.0	25.0	10.4	9.3	25.0 NTU	0
Transparency, tube with disk	cm	16	20.0	100.0	62.1	60.5		

[1]Total suspended solids and transparency tube standards are surrogate standards derived from the turbidity standard of 25.
[2]Represents exceedances of individual maximum standard for E. coli (1260/100ml).

****Data found in the table above was compiled using the results from data collected at the outlet monitoring station on Palmer Creek in the Stony Run Creek 10 HUC, a component of the IWM work conducted between May and September in 2010, and 2011. This specific data does not necessarily reflect all data that was used to assess the AUID.**

Table 12.Outlet water chemistry results for Stony Run Creek in the Stony Run Creek HUC 10

Station location:	**Stony Run Creek at HWY 212, 4 mi. NW of Granite Falls**							
STORET/EQuIS ID:	**S006-171**							
Station #:	**10MN015**							
Parameter	**Units**	**# of Samples**	**Minimum**	**Maximum**	**Mean**	**Median**	**WQ Standard[1]**	**# of WQ Exceedances[2]**
Escherichia coli	MPN/100ml	17	26.6	960.9	165.1	93.3	1260.0	0
Ammonia-nitrogen	mg/l	10	0.16	0.16	0.16	0.16		
Inorganic nitrogen (nitrate and nitrite)	mg/l	10	0.60	12.30	6.43	6.76		
Kjeldahl nitrogen	mg/l	10	0.4	1.4	0.9	0.9		
Phosphorus	ug/l	10	17.0	163.0	84.0	73.0		
Orthophosphate	ug/l	0						
Total suspended solids	mg/l	10	2.0	19.0	8.0	6.5		
Total volatile solids	mg/l	10	2.0	5.0	2.5	2.0		
Hardness, carbonate	mg/l	9	574.0	724.0	651.8	629.0		
Calcium	mg/l	9	122.0	159.0	143.8	141.0		
Magnesium	mg/l	9	65.1	79.5	71.1	69.6		
Chloride	mg/l	7	17.0	24.7	20.9	21.4	230.0	0
Sulfate	mg/l	7	232.0	359.0	290.0	275.0		
Specific conductance	uS/cm	16	916.0	1315.0	1093.8	1072.0		
pH	--	19	7.9	8.6	8.2	8.2	6.5-9.0	0
Dissolved oxygen (DO)	mg/l	19	7.9	12.3	9.4	9.3	5.0	0
Temperature, water	deg C	19	11.0	26.4	18.8	18.8		
Turbidity	NTRU	0					25.0 NTU	0
Transparency, tube with disk	cm	19	37.0	60.0	57.1	60.0		

[1]Total suspended solids and Transparency tube standards are surrogate standards derived from the turbidity standard of 25.
[2]Represents exceedances of individual maximum standard for E. coli (1260/100ml).

****Data found in the table above was compiled using the results from data collected at the outlet monitoring station on Stony Run Creek in the Stony Run Creek 10 HUC, a component of the IWM work conducted between May and September in 2010 and 2011. This specific data does not necessarily reflect all data that was used to assess the AUID.**

Summary

Stream water quality data were available for Palmer Creek (County Ditch 68) from its headwaters to the Minnesota River. This AUID is approximately 18 miles long. Water chemistry data were collected approximately one mile upstream of the confluence with the Minnesota River. Palmer Creek exceeded the standard for bacteria and is considered impaired for aquatic recreation use. This impairment was based on five geometric mean exceedances and seven individual samples that exceeded the water quality standard of 1260 MPN/100ml. Levels of bacteria in this reach were high, suggesting that recreational use is not recommended. The same reach shows evidence of aquatic life stressors based on marginal dissolved oxygen, turbidity, and invertebrates. Dissolved oxygen flux could be an issue as indicated by the maximum D.O. value over 12 mg/L. Fish and invertebrates for Palmer Creek were in good condition on the downstream portion of the stream. Habitat was fair, but there were indications of stress due to cattle access and trampling, and there is some channel incision at the sampling site. Excess nutrients may also be a problem based on the presence of excess algae.

Stream water quality data were available for Stony Run Creek to the confluence of the Minnesota River. This AUID is approximately 14 miles long. Water chemistry data were collected approximately one mile upstream of the confluence with the Minnesota River. Stony Run Creek exceeded the standard for bacteria and is considered impaired for aquatic recreation use. This impairment was based on one geometric mean exceedance, while no individual sample exceeded the water quality standard of 1260 MPN/100ml. The same reach was not assessed for aquatic life due to channelization in the sampling reach. Fish and invertebrate IBI scores are poor in the headwater reaches and improve closer to the outlet. Habitat and CCSI scores are poor in the headwater areas of Stony Creek, but improve downstream. Excess nutrients are likely an issue in Stony Run Creek based on the presence of macrophytes and duck weed. Dissolved oxygen flux could be an issue as indicated by the maximum D.O. value over 12 mg/L. Flow impediments to Stony Run Creek are also present and include rock dams and perched culverts.

The smaller direct tributaries to the Minnesota River in this subwatershed that were assessed include Brafees Creek, Judicial Ditch 23, County Ditch 36 A, and County Ditch 39. Brafees Creek and Judicial Ditch 23 are in full support of aquatic life based on biology. Habitat and channel stability scores indicated fair conditions that likely have been negatively impacted by the amount of intensive agriculture and upstream channelization in the watershed. Problems in these systems include excess sediment, eroded banks and channel incision. County Ditch 39 has impaired fish and invertebrates, likely caused by upstream channelization. This stream showed signs of excessive sedimentation and channel incision. The remaining smaller channelized streams showed poor invertebrate IBIs, slightly better fish IBIs, and fair to poor habitat conditions.

The pattern of invertebrate and fish community health in this watershed is a reflection of channel condition, site-specific riparian extent and in-stream habitat conditions. All of the biological stations located above the river valley were located in channelized stream reaches that lack diverse in-stream habitat, and have little to no remaining riparian zone. Without exception, these streams fell below the warmwater impairment threshold, and all but one (10MN132) had a channelized site rating of poor for invertebrates. Conditions were slightly better for fish. Biological stations that were located on stream reaches in the valley tended to have natural channel conditions, with intact riparian zones and diverse in-stream habitats. The land in the valley, closer to the Minnesota River mainstem, is higher gradient and less suitable for farming, thus the immediate land use around these stations had a higher proportion of forested land compared to streams above the valley. All sites located in these conditions, except one, had M-IBI scores above the threshold. The site falling below the threshold (10MN051) was within the lower confidence interval.

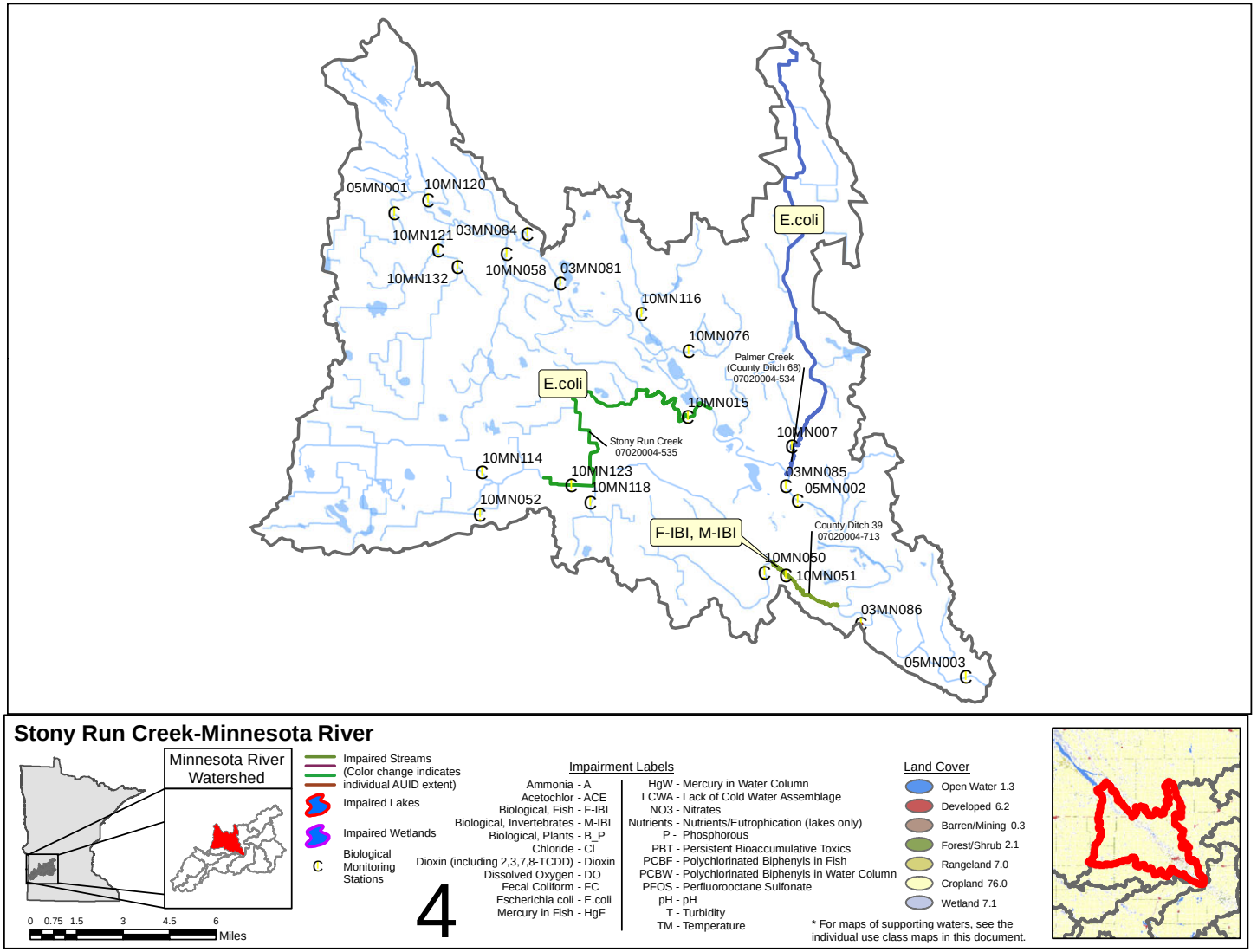

Figure 16. Currently listed impaired waters by parameter and land use characteristics in the Stony Run Creek- Minnesota River Watershed Unit.

Upper Yellow Medicine River Watershed Unit HUC 0702000403

This watershed unit is a network of Prairie Coteau streams that form the headwaters of the Yellow Medicine River. The subwatershed is located in the southwestern part of the Minnesota River - Granite Falls HUC 8. This 254 square mile drainage area is comprised mainly of cropland, rangeland and developed land. The towns of Shaokatan, Royal, Ivanhoe, Alta Vista, Porter, Wergeland, and Taunton are located in this subwatershed. Four outlet sites for intensive watershed monitoring in this subwatershed were selected for IWM water chemistry. Two of the sites (10MN011 and 10MN002) are located on the mainstem of the Yellow Medicine River. The other two monitoring stations are located on tributaries (10MN010, Mud Creek and 10MN017, unnamed creek). Other tributaries in this watershed unit are the North Branch Yellow Medicine River, County Ditch 8 and several unnamed tributaries. The streams in this watershed unit are all designated as warmwater. There are 10 sampled lakes in this subwatershed.

Table 13. Aquatic life and recreation assessments on stream reaches: Upper Yellow Medicine River Watershed Unit.

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.
					Fish IBI	Invert IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides			
07020004-545, Unnamed creek, Headwaters to Yellow Medicine R	3.05	2B, 3C	10MN017	Upstream of CR 26, 1 mi. NE of Taunton			--	--	MTS	--			EX	NA	NS
07020004-584, Yellow Medicine River, Headwaters to Mud Cr	44.65	2B, 3C	10MN002 10MN060 10MN011 07MN070	Downstream of 280th Ave, 2 mi. W of Taunton Downstream of Hwy 19, 1 mi. W of Ivanhoe Upstream of CR 3, 3.5 mi. N of Minneota Upstream of CR 110, 2 mi. NE of Ivanhoe	EXP	MTS	IF	EXS	MTS	MTS	--		EX	NS	NS
07020004-694, Unnamed creek, Ash Lk to Yellow Medicine R	2.76	2B, 3C	10MN059	Adjacent to Hwy 75, 1.5 mi. SW of Ivanhoe	EXS	EXP	--	--		--				NS	NA

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.
					Fish IBI	Invert IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides			
07020004-543, Mud Creek, Headwaters to T114 R43W S35, south line	29.2	2C	10EM126 10MN075 10MN010	Upstream of 567th St, 1 mi. NE of Wood Lake Upstream of 110th Ave, 3.5 N of Taunton Upstream of 320th St, 5.5 mi. N of Minneota	MTS	EXP	IF	EXS	MTS	MTS	--		EX	NS	NS
07020004-542, Yellow Medicine River, North Branch, CD 8 to Yellow Medicine R	39.9	2C, 3C	10MN071	Downstream of 270th St, 2.5 mi. NW of Taunton	EXP	EXS	IF	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: = existing impairment, listed prior to 2012 reporting cycle; = new impairment; = full support of designated use.

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

Table 14. Non-assessed biological stations on channelized AUIDs in the Upper Yellow Medicine River 10-HUC

AUID ***Reach Name***, *Reach Description*	Reach Length (miles)	Use Class	Biological Station ID	Location of Biological Station	Fish IBI	Invert IBI
07020004-584, Yellow Medicine River, Headwaters to Mud Cr	44.65	2B, 3C	07MN070	Upstream of CR 110, 2 mi. NE of Ivanhoe	fair	poor
07020004-543, Mud Creek, Headwaters to T114 R43W S35, south line	29.2	2C	10MN010	Upstream of 320th St, 5.5 mi. N of Minneota	good	poor
07020004-545, Unnamed creek, Headwaters to Yellow Medicine R	3.05	2B, 3C	10MN017	Upstream of CR 26, 1 mi. NE of Taunton	good	poor
07020004-542, Yellow Medicine River, North Branch, CD 8 to Yellow Medicine R	39.9	2C, 3C	10MN071	Downstream of 270th St, 2.5 mi. NW of Taunton	fair	good
07020004-695, Unnamed creek, Unnamed cr to Unnamed cr	5.98	2B, 3C	10MN066	Downstream of CR 1, 3 mi. W of Minneota	good	good
07020004-592, Unnamed creek, Headwaters to Unnamed cr	1.56	2B, 3C	10MN022	Downstream of 130th Ave, 9 mi. W of Arco	poor	fair
07020004-584, Yellow Medicine River, Headwaters to Mud Cr	44.65	2B, 3C	10MN060	Downstream of Hwy 19, 1 mi. W of Ivanhoe	fair	fair
07020004-912, County Ditch 8, Biggs Lk (41-0084-00) to N Br Yellow Medicine R	0.94	2C, 3B	10MN061	Upstream of CR 101, 6.5 mi. W of Ivanhoe	poor	fair

Table 15. Minnesota Stream Habitat Assessment (MSHA): Upper Yellow Medicine River 10-HUC.

# Visits	Biological Station ID	Reach Name	Land Use	Riparian	Substrate (0-27)	Fish Cover	Channel Morph.	MSHA Score	MSHA Rating
2	03MN042	Yellow Medicine River, North Branch	0	10	19	11	20	60	fair
1	07MN070	Yellow Medicine River	0	10.5	12.3	5	15	42.8	poor
1	10EM016	Yellow Medicine River, North Branch	0	5	19.6	8	30	62.6	fair
1	10EM126	Mud Creek	0	8	9	7	8	32	poor
1	10MN002	Yellow Medicine River	2.5	10	16.05	13	24	65.55	fair
1	10MN010	Mud Creek	2.5	9.5	9.8	6	11	38.8	poor
1	10MN011	Yellow Medicine River	0	6.5	17.1	12	23	58.6	fair
1	10MN017	Trib. to Yellow Medicine River	0	8	10	16	18	52	fair
1	10MN022	Trib. to Lake Shaokatan	0	11	9	10	6	36	poor
1	10MN059	Trib. to Yellow Medicine River	0	9	9	14	8	40	poor
1	10MN060	Yellow Medicine River	0	5	13.5	6	18	42.5	poor

# Visits	Biological Station ID	Reach Name	Land Use	Riparian	Substrate (0-27)	Fish Cover	Channel Morph.	MSHA Score	MSHA Rating
1	10MN061	County Ditch 8	0	7	9	9	4	29	poor
1	10MN065	Trib. to Yellow Medicine River, North Br	1.5	13	20.4	13	29	76.9	good
1	10MN066	Unnamed creek	0	11.5	14.1	14	23	62.6	fair
1	10MN071	Yellow Medicine River, North Branch	0	10	17.9	12	27	66.9	good
1	10MN075	Mud Creek	0	8.5	14.8	11	17	51.3	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 16. Channel Condition and Stability Assessment (CCSI): Upper Yellow Medicine River 10 HUC.

Visit Date	Biological Station ID	Stream Name	Upper Banks (43-4)	Lower Banks (46-5)	Substrate (37-3)	Channel Evolution (11-1)	CCSI Score (137-13)	CCSI Rating
10-Aug-10	10EM016	Yellow Medicine River, North Branch	24	16	19	5	64	moderately unstable
11-Aug-10	10EM126	Mud Creek	15	10	13	5	43	fairly stable
11-Aug-10	10MN002	Yellow Medicine River	31	30	22	11	94	severely unstable
11-Aug-10	10MN010	Mud Creek	36	24	14	7	81	severely unstable
11-Aug-10	10MN011	Yellow Medicine River	36	30	26	11	103	severely unstable
12-Aug-10	10MN017	Trib. to Yellow Medicine River	32	24	19	5	80	severely unstable

Visit Date	Biological Station ID	Stream Name	Upper Banks (43-4)	Lower Banks (46-5)	Substrate (37-3)	Channel Evolution (11-1)	CCSI Score (137-13)	CCSI Rating
03-Aug-10	10MN022	Trib. to Lake Shaokatan	7	4	6	1	18	stable
04-Aug-10	10MN059	Trib. to Yellow Medicine River	5	3	10	7	25	stable
04-Aug-10	10MN060	Yellow Medicine River	20	6	11	7	44	fairly stable
04-Aug-10	10MN061	County Ditch 8	15	4	9	1	29	fairly stable
10-Aug-10	10MN065	Trib. to Yellow Medicine River, North Br	29	24	18	7	78	moderately unstable
11-Aug-10	10MN066	Unnamed creek	30	24	12	7	73	moderately unstable
10-Aug-10	10MN071	Yellow Medicine River, North Branch	27	22	32	5	86	severely unstable
11-Aug-10	10MN075	Mud Creek	21	8	13	5	47	moderately unstable

Qualitative channel stability ratings

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

Table 17. Outlet water chemistry results for Yellow Medicine River in the Upper Yellow Medicine River HUC 10

Station location:	**Yellow Medicine River at Lyon Lincoln Rd. ¼ mi. E CSAH 8, 2 mi. W of Taunton**							
STORET/EQuIS ID:	**S002-323**							
Station #:	**10MN002**							
Parameter	**Units**	**# of Samples**	**Minimum**	**Maximum**	**Mean**	**Median**	**WQ Standard[1]**	**# of WQ Exceedances[2]**
Escherichia coli	MPN/100ml	17	71.9	1046.2	479.7	422.9	1260	0
Ammonia-nitrogen	mg/l	10	0.16	0.16	0.16	0.16		
Inorganic nitrogen (nitrate and nitrite)	mg/l	10	0.20	3.84	1.76	1.53		
Kjeldahl nitrogen	mg/l	10	0.5	3.4	1.5	1.5		
Phosphorus	ug/l	10	22	298	135	137		
Orthophosphate	ug/l	0						
Total suspended solids	mg/l	10	2	157	57	47		

Station location:	Yellow Medicine River at Lyon Lincoln Rd. ¼ mi. E CSAH 8, 2 mi. W of Taunton							
STORET/EQuIS ID:	S002-323							
Station #:	10MN002							
Parameter	Units	# of Samples	Minimum	Maximum	Mean	Median	WQ Standard[1]	# of WQ Exceedances[2]
Total volatile solids	mg/l	10	2	23	8	8		
Hardness, carbonate	mg/l	9	430	732	543	540		
Calcium	mg/l	9	100	169	125	126		
Magnesium	mg/l	9	44	75	56	57		
Chloride	mg/l	7	9	18	14	14	230	0
Sulfate	mg/l	7	209	446	295	290		
Specific conductance	uS/cm	19	729	1247	1021	1036		
pH	--	19	8.0	8.4	8.2	8.2	6.5-9	0.0
Dissolved oxygen (DO)	mg/l	19	7.4	9.7	8.5	8.4	5.0	0.0
Temperature, water	deg C	19	8.0	29.8	15.3	14.1		
Turbidity	NTRU	0					25 NTU	0
Transparency, tube with disk	cm	19	7	60	32	29		

[1]Total suspended solids and transparency tube standards are surrogate standards derived from the turbidity standard of 25.
[2]Represents exceedances of individual maximum standard for E. coli (1260/100ml).

****Data found in the table above was compiled using the results from data collected at the outlet monitoring station on the Yellow Medicine River in the Upper Yellow Medicine 10 HUC, a component of the IWM work conducted between May and September in 2010 and 2011. This specific data does not necessarily reflect all data that was used to assess the AUID.**

Table 18. Outlet water chemistry results for Mud Creek in the Upper Yellow Medicine River HUC 10

Station location:	Mud Creek just S of CSAH 27 on Unn St. 5.5 mi. N of Minnesota							
STORET/EQuIS ID:	S002-321							
Station #:	10MN010							
Parameter	Units	# of Samples	Minimum	Maximum	Mean	Median	WQ Standard[1]	# of WQ Exceedances[2]
Escherichia coli	MPN/100ml	17	16.1	770.1	240.5	156.5	1260.0	0
Ammonia-nitrogen	mg/l	10	0.16	0.16	0.16	0.16		
Inorganic nitrogen (nitrate and nitrite)	mg/l	10	0.22	5.14	2.26	2.01		
Kjeldahl nitrogen	mg/l	10	0.8	2.0	1.2	1.0		

Station location:	Mud Creek just S of CSAH 27 on Unn St. 5.5 mi. N of Minnesota							
STORET/EQuIS ID:	S002-321							
Station #:	10MN010							
Parameter	**Units**	**# of Samples**	**Minimum**	**Maximum**	**Mean**	**Median**	**WQ Standard[1]**	**# of WQ Exceedances[2]**
Phosphorus	ug/l	10	50.0	404.0	236.0	243.5		
Orthophosphate	ug/l	0						
Total suspended solids	mg/l	10	2.0	29.0	12.5	11.0		
Total volatile solids	mg/l	10	2.0	11.0	3.8	2.0		
Hardness, carbonate	mg/l	9	493.0	1060.0	834.7	854.0		
Calcium	mg/l	9	116.0	233.0	186.3	189.0		
Magnesium	mg/l	9	49.4	115.0	89.6	94.6		
Chloride	mg/l	7	10.0	23.8	18.5	20.0	230.0	0
Sulfate	mg/l	7	281.0	832.0	635.6	657.0		
Specific conductance	uS/cm	19	850.0	1876.0	1502.9	1579.0		
pH	--	19	7.6	8.5	7.9	7.8	6.5-9.0	0.0
Dissolved oxygen (DO)	mg/l	19	3.7	19.7	7.6	6.6	5.0	2.0
Temperature, water	deg C	19	10.7	32.6	21.0	21.9		
Turbidity	NTRU	0					25.0 NTU	0
Transparency, tube with disk	cm	19	6.0	60.0	33.5	27.0		

[1]Total suspended solids and transparency tube standards are surrogate standards derived from the turbidity standard of 25.
[2]Represents exceedances of individual maximum standard for E. coli (1260/100ml).

****Data found in the table above was compiled using the results from data collected at the outlet monitoring station on Mud Creek in the Upper Yellow Medicine 10 HUC, a component of the IWM work conducted between May and September in 2010 and 2011. This specific data does not necessarily reflect all data that was used to assess the AUID.**

Table 19. Outlet water chemistry results for Yellow Medicine River in the Upper Yellow Medicine River HUC 10

Station location:	**Yellow Medicine River At CR 3, 3.5 mi. N of Minnesota**							
STORET/EQuIS ID:	**S006-173**							
Station #:	**10MN011**							
Parameter	**Units**	**# of Samples**	**Minimum**	**Maximum**	**Mean**	**Median**	**WQ Standard[1]**	**# of WQ Exceedances[2]**
Escherichia coli	MPN/100ml	17	32.4	2419.6	587.9	378.4	1260.0	2
Ammonia-nitrogen	mg/l	10	0.16	0.16	0.16	0.16		
Inorganic nitrogen (nitrate and nitrite)	mg/l	10	0.99	5.08	2.59	2.38		
Kjeldahl nitrogen	mg/l	10	0.5	1.4	1.1	1.4		
Phosphorus	ug/l	10	24.0	241.0	130.7	140.5		
Orthophosphate	ug/l	0						
Total suspended solids	mg/l	10	2.0	118.0	44.1	39.5		
Total volatile solids	mg/l	10	2.0	21.0	7.8	5.0		
Hardness, carbonate	mg/l	9	453.0	797.0	603.1	604.0		
Calcium	mg/l	9	107.0	182.0	141.2	136.0		
Magnesium	mg/l	9	45.1	83.1	60.8	60.5		
Chloride	mg/l	7	10.4	20.9	15.4	16.1	230.0	0
Sulfate	mg/l	7	253.0	550.0	366.4	352.0		
Specific conductance	uS/cm	19	824.0	1411.0	1127.8	1132.0		
pH	--	19	7.8	8.4	8.1	8.2	6.5-9.0	0
Dissolved oxygen (DO)	mg/l	19	6.2	10.3	7.9	7.8	5.0	0
Temperature, water	deg C	19	10.7	30.2	20.5	20.4		
Turbidity	NTRU	0					25.0 NTU	0
Transparency, tube with disk	cm	19	7.0	60.0	24.8	17.5		

[1]Total suspended solids and transparency tube standards are surrogate standards derived from the turbidity standard of 25.
[2]Represents exceedances of individual maximum standard for E. coli (1260/100ml).

****Data found in the table above was compiled using the results from data collected at the outlet monitoring station on the Yellow Medicine River in the Upper Yellow Medicine 10 HUC, a component of the IWM work conducted between May and September in 2010 and 2011. This specific data does not necessarily reflect all data that was used to assess the AUID.**

Table 20. Outlet water chemistry results for Tributary to Yellow Medicine River in the Upper Yellow Medicine River HUC 10

Station location:	**Tributary to Yellow Medicine River at CR 26, 1 mi. NE of Taunton**							
STORET/EQuIS ID:	**S006-170**							
Station #:	**10MN017**							
Parameter	**Units**	**# of Samples**	**Minimum**	**Maximum**	**Mean**	**Median**	**WQ Standard[1]**	**# of WQ Exceedances[2]**
Escherichia coli	MPN/100ml	17	59.8	2419.6	967.0	920.8	1260.0	3
Ammonia-nitrogen	mg/l	10	0.16	0.16	0.16	0.16		
Inorganic nitrogen (nitrate and nitrite)	mg/l	10	0.80	8.98	5.04	5.10		
Kjeldahl nitrogen	mg/l	10	0.5	2.6	1.2	1.1		
Phosphorus	ug/l	10	16.0	169.0	112.6	129.0		
Orthophosphate	ug/l	0						
Total suspended solids	mg/l	10	2.0	58.0	18.6	13.5		
Total volatile solids	mg/l	10	2.0	14.0	4.1	2.0		
Hardness, carbonate	mg/l	9	16.0	979.0	751.0	803.0		
Calcium	mg/l	9	180.0	228.0	202.4	201.0		
Magnesium	mg/l	9	70.3	99.6	81.0	76.7		
Chloride	mg/l	7	16.7	24.2	20.3	20.3	230.0	0
Sulfate	mg/l	7	476.0	732.0	559.9	518.0		
Specific conductance	uS/cm	19	1303.0	1761.0	1509.9	1512.0		
pH	--	19	7.7	8.7	8.0	8.0	6.5-9.0	0
Dissolved oxygen (DO)	mg/l	19	5.6	9.3	7.5	7.4	5.0	0
Temperature, water	deg C	19	10.0	28.3	19.1	19.5		
Turbidity	NTRU	0					25.0 NTU	0
Transparency, tube with disk	cm	19	2.0	60.0	28.8	23.0		

[1]Total suspended solids and transparency tube standards are surrogate standards derived from the turbidity standard of 25.
[2]Represents exceedances of individual maximum standard for E. coli (1260/100ml).

****Data found in the table above was compiled using the results from data collected at the outlet monitoring station on unnamed creek in the Upper Yellow Medicine 10 HUC, a component of the IWM work conducted between May and September in 2010 and 2011. This specific data does not necessarily reflect all data that was used to assess the AUID.**

Table 21. Lake Assessments for the Upper Yellow Medicine River HUC 10

Lake ID	Lake Name	County	HUC-10	Ecoregion	Lake Area (ha)	Max Depth (m)	Mean Depth (m)	Watershed Area (ha)	% Littoral	Aquatic Recreation Use Support
41-0054-00	Anderson	Lincoln	0702000403	NGP	138			5,866		IF
41-0055-00	North Ash	Lincoln	0702000403	NGP	38	1.0	1*	1,064	100	IF
41-0057-00	South Ash	Lincoln	0702000403	NGP	61	1.5	1*	809	100	IF
41-0062-00	Oak	Lincoln	0702000403	NGP	43	3.0	1*	293	100	FS
41-0067-00	Perch	Lincoln	0702000403	NGP	83	2.7	1.5	339	100	NS
41-0082-00	Steep Bank	Lincoln	0702000403	NGP	84	2.0	1*	726	100	NS
41-0084-00	Biggs	Lincoln	0702000403	NGP	52			2,457		IF
41-0089-00	Shaokotan	Lincoln	0702000403	NGP	422	3.7	2.0	3,568	100	NS
41-0096-00	Widmark Marsh	Lincoln	0702000403	NGP	9			84	100	IF
42-0099-00	Conger's Slough	Lyon	0702000403	WCBP	31			361	100	IF

* **Estimated mean depth**

Summary

This subwatershed is located primarily in the Prairie des Coteau region of Minnesota, a rolling landscape where streams can change from low to high gradient, with less channelization throughout. As with other regions of the state, less channelization translates to better in-stream habitat conditions. For the most part this holds true for this subwatershed, although there is still a very high percentage of cropland and grazing, so riparian extent is typically limited.

The invertebrate communities in Mud Creek and the North Branch Yellow Medicine River reflect poor invertebrate habitat conditions throughout. Many streams sampled had low flows, with invertebrate communities dominated by taxa characteristic of wetlands. The only site scoring above the threshold was a channelized reach (10MN071) with an intact riparian zone and good in-stream habitat.

The condition of the invertebrate community on the Yellow Medicine River mainstem appears to be related to flow conditions and riparian zone. The upper and lower reaches had higher flows at the time of sampling with scores above the threshold. The middle reaches had much lower flow conditions with M-IBIs scoring below the threshold. All of the streams were classified as low gradient streams, but the upper and lower reaches had wooded riparian zones and abundant in-stream, woody habitat. The middle reaches lacked a wooded riparian zone and the associated habitat.

The two small tributaries to the mainstem Yellow Medicine River reflected conditions throughout the subwatershed, with low gradient, wetland-like streams scoring poorly, and one high gradient site with a wooded riparian zone scoring above the threshold.

Stream water quality data were available for a tributary to Yellow Medicine River from the headwaters to the Yellow Medicine River. This AUID is approximately three miles long. Water chemistry data were collected approximately one mile upstream of the confluence with the Yellow Medicine River. The Unnamed Creek exceeded the standard for bacteria and is considered impaired for aquatic recreation use. This impairment was based on three geometric mean exceedances and three individual samples that exceeded the water quality standard of 1260 MPN/100ml. The same reach was not assessed for aquatic life due to channelization in the stream reach, but the fish community had a good rating and the invertebrate community had a poor rating. MSHA indicated fair habitat conditions, however, CCSI scores indicated the stream channel is severely unstable. Excess sedimentation and middle channel bars were present in the sampling reach.

Stream water quality data were available for Mud Creek from the headwaters to T114 R43W S35, south line. This AUID is approximately 29 miles long. Mud Creek exceeded the standard for bacteria and is considered impaired for aquatic recreation use. This impairment was based on two geometric mean exceedances. No individual samples exceeded the water quality standard of 1260 MPN/100ml. This same reach is considered impaired for aquatic life use based on invertebrates. The reach could also have dissolved oxygen flux issues based on observed readings over 12mg/L. The stream also showed signs of excess nutrients by the presence of algae, macrophytes, and duckweed. Slow flow conditions, animal access to the stream, and turbidity issues were also noted at the time of sampling. The channelized upstream portions of Mud Creek appear to be fairly stable, but become less stable going downstream. Habitat scores for Mud Creek are also poor.

Stream water quality data were available for the Yellow Medicine River from the headwaters to Mud Creek. This AUID is approximately 45 miles long. Water chemistry data were collected at two stations located upstream of the confluence with the North Branch of the Yellow Medicine River, and upstream of the confluence with Mud Creek. The Yellow Medicine River exceeded the standard for bacteria and is considered impaired for aquatic recreation use. This impairment was based on three geometric mean exceedances and one individual sample that exceeded the water quality standard of 1260 MPN/100ml. The same reach is considered impaired for aquatic life use based on existing turbidity impairment from 2010. Fish IBIs for channelized headwater reaches of the Yellow Medicine River were fair. Invertebrate IBIs were fair to poor. Habitat scores increase going downstream and range from mainly poor in the headwaters to fair and good downstream where the stream has not been altered. Channel stability appears to decrease going downstream. Turbidity, excess nutrients and low flow conditions in the headwaters appear to be issues in this watershed.

Lakes in this region are typically shallow and have watersheds that primarily consist of cropland and pasture. Four lakes in the Upper Yellow Medicine River Watershed Unit had sufficient data for aquatic recreation use assessment. Oak Lake was found to be fully supporting aquatic recreation use. Although Oak Lake's watershed is approximately half cropland, natural areas appear to be intact around the shoreline. This provides a buffer for excess nutrients entering the lake during runoff events. It is critical that these natural areas are protected in order to maintain good water quality and prevent nutrient inputs. Three lakes - Perch, Steep Bank, and Shaokotan, were found to be impaired for aquatic recreation use (excess nutrients) suggesting that during certain times of the year the lake may not be suitable for recreation. All three impaired lakes had high concentrations of phosphorus, which in turn causes high Chl-a concentrations and nuisance algal blooms. Land use within these watersheds is dominated by cropland and best land management practices need to be implemented to limit nutrient inputs into these lakes. Internal loading is likely a significant source of nutrients in shallow lakes and needs to be addressed as well. Lake Shaokotan is part of the MDNR's Sentinel Lakes program and has a comprehensive lake report available at: http://www.pca.state.mn.us/index.php/water/water-types-and-programs/surface-water/lakes/sentinel-lakes.html. Six additional lakes had water quality data available but the data sets were not large enough for an assessment decision to be made resulting in an insufficient information designation (Table 18).

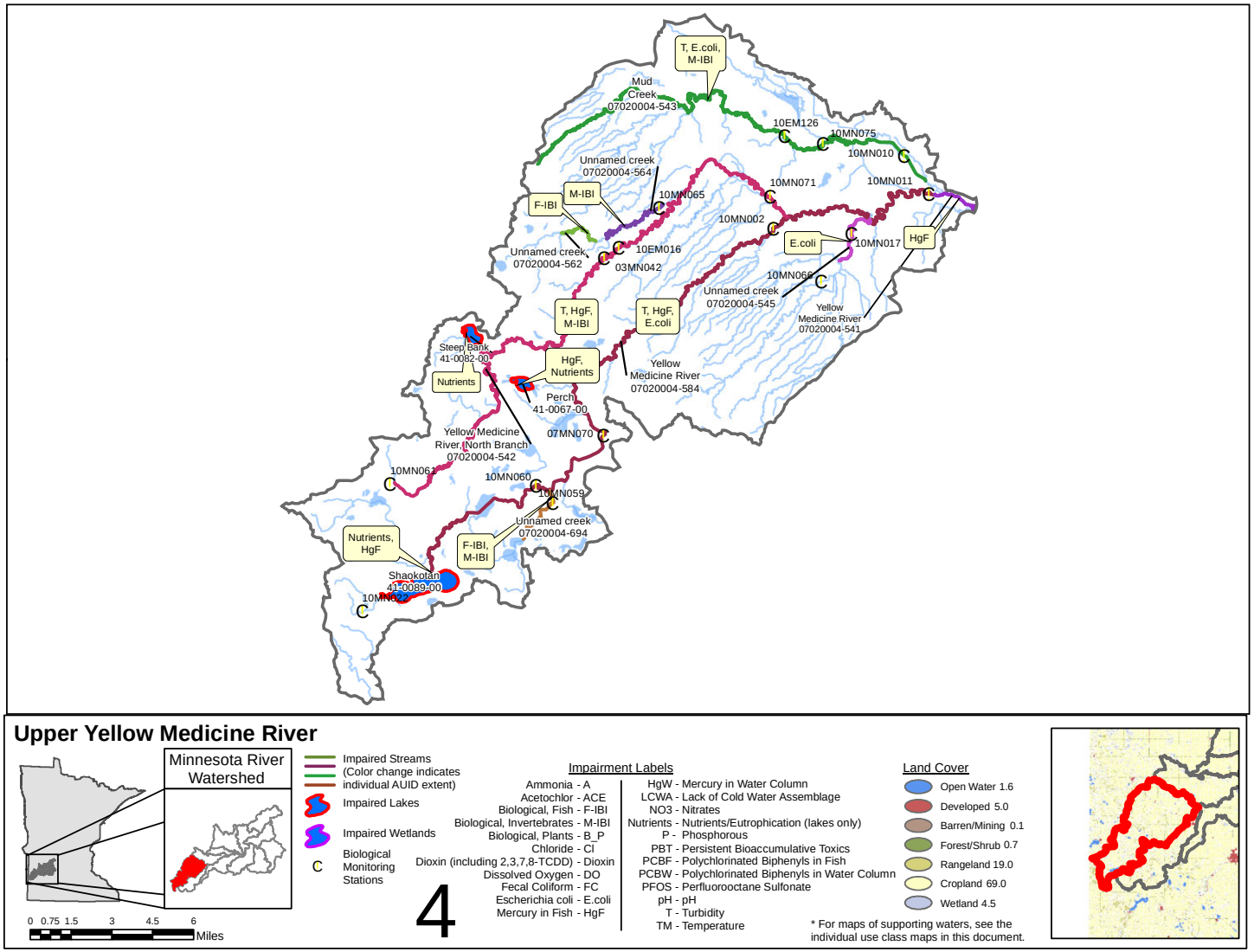

Figure 17. Currently listed impaired waters by parameter and land use characteristics in the Upper Yellow Medicine River Watershed Unit

South Branch Yellow Medicine River Watershed Unit HUC 0702000404

This watershed unit is a network of streams on the edge of the Prairie Coteau that form the headwaters of the South Branch of the Yellow Medicine River. The subwatershed is located in the southwestern part of the Minnesota River - Granite Falls HUC 8. This 124 square mile drainage area is comprised mainly of cropland, rangeland and developed land. The towns of Arco, Ash Lake, Lake Stay, Nordland, and Minneota are located in this subwatershed. One outlet site for intensive watershed monitoring in this subwatershed was selected on the South Branch of the Yellow Medicine River (10MN003) for IWM water chemistry. Other tributaries in this watershed unit are Judicial Ditch 29, County Ditch 35 and few small unnamed tributaries. The streams in this watershed unit are all designated warmwater. There are three sampled lakes in this subwatershed.

Table 22. Aquatic life and recreation assessments on stream reaches: South Branch Yellow Medicine 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.
					Fish IBI	Invert IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides			
07020004-503, Yellow Medicine River, South Branch (County Ditch 35), Headwaters to Yellow Medicine R	62.65	2B, 3C	03MN039 10MN003 10MN030 10MN024 03MN041 10EM062 03MN038 03MN040	3 mi. S of Minneota on CR 3 Downstream of CR 26, 2 mi. N of Minneota Downstream of 340th St, 1 mi. S of Minneota Downstream of CR 5, 3.5 mi. NW of Arco 3 mi. E of Ivanhoe (WMA) 0.25 mi. downstream of 280th St, 7.5 mi. SW of Minneota Upstream of CR, 8 mi. W of Ivanhoe Upstream of CR 127, 5 mi. SE of Ivanhoe	MTS	MTS	IF	EXS	MTS	MTS	MTS		EX	NS	NS
07020004-550, Judicial Ditch 29, T111 R44W S16, south line to S Br Yellow Medicine R	1.73	2B, 3C	10MN028	T111 R44W S16, south line to S Br Yellow Medicine R			IF	MTS		MTS	--		EX	IF	NS
07020004-595, Unnamed creek, Headwaters to Unnamed cr	4.74	2B, 3C	10MN029	Headwaters to Unnamed cr	EXS	EXP	IF	MTS		MTS			EX	NS	NS

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

Table 23. Non-Assessed biological stations on channelized AUIDs in the South Branch Yellow Medicine River 10-HUC

AUID *Reach Name*, *Reach Description*	**Reach Length (miles)**	**Use Class**	**Biological Station ID**	**Location of Biological Station**	**Fish IBI**	**Invert IBI**
07020004-503, Yellow Medicine River, South Branch (County Ditch 35), Headwaters to Yellow Medicine R	62.65	2B, 3C	03MN040	Upstream of CR 127, 5 mi. SE of Ivanhoe	fair	good
07020004-503, Yellow Medicine River, South Branch (County Ditch 35), Headwaters to Yellow Medicine R	62.65	2B, 3C	03MN041	3 mi. E of Ivanhoe (WMA)	poor	poor
07020004-600, Unnamed creek, CD 34 to CD 35	5.19	2B, 3C	10MN023	Downstream of CR 123, 4 mi, SW of Arco	poor	poor
07020004-549, Judicial Ditch 29, T111 R44W S33, east line to T111 R44W S21, north line	4.2	7	10MN027	Downstream of 260th Ave, 2 mi. E of Arco	poor	fair
07020004-550, Judicial Ditch 29, T111 R44W S16, south line to S Br Yellow Medicine R	1.73	2B, 3C	10MN028	Upstream of CR 126, 3.5 mi. NE of Arco	fair	fair
07020004-503, Yellow Medicine River, South Branch (County Ditch 35), Headwaters to Yellow Medicine R	62.65	2B, 3C	10MN024	Downstream of CR 5, 3.5 mi. NW of Arco	fair	poor
07020004-549, Judicial Ditch 29, T111 R44W S33, east line to T111 R44W S21, north line	4.2	7	10MN025	Upstream of 240th St, 1 mi. NE of Arco	good	fair

Table 24. Minnesota Stream Habitat Assessment (MSHA): South Branch Yellow Medicine River 10-HUC.

# Visits	Biological Station ID	Reach Name	Land Use (0-5)	Riparian (0-15)	Substrate (0-27)	Fish Cover (0-17)	Channel Morph. (0-36)	MSHA Score (0-100)	MSHA Rating
1	03MN038	Yellow Medicine River, South Branch	1	10.5	20	16	27	74.5	good
1	03MN039	Yellow Medicine River, South Branch	0	12	20	17	36	85	good
2	03MN040	Yellow Medicine River, South Branch	0	9	13.3	11.5	23.5	57.35	fair
1	03MN041	Yellow Medicine River, South Branch	1	8	8	2	11	30	poor
1	10EM062	Yellow Medicine River, South Branch	2.5	13.5	19.6	13	36	84.6	good
1	10MN003	Yellow Medicine River, South Branch	0	8	17.7	15	23	63.7	fair
2	10MN023	County Ditch 35	0	9.5	11.5	10.5	8	39.5	poor
1	10MN024	County Ditch 35	0	8.5	14	6	12	40.5	poor
1	10MN025	Judicial Ditch 29	0	10	19.9	14	22	65.9	fair
1	10MN027	Judicial Ditch 29	0	7.5	3.05	6	5	21.55	poor
2	10MN028	Judicial Ditch 29	0.6	9	16.6	10.5	15.5	52.2	fair
1	10MN029	Trib. to Yellow Medicine River, South Br	0	12.5	11.5	15	22	61	fair
1	10MN030	Yellow Medicine River, South Branch	0	11	14.1	15	24	64.1	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 25. Channel Condition and Stability Assessment (CCSI): South Branch Yellow Medicine River 10-HUC

# Visits	Biological Station ID	Stream Name	Upper Banks (43-4)	Lower Banks (46-5)	Substrate (37-3)	Channel Evolution (11-1)	CCSI Score (137-13)	CCSI Rating
05-Aug-10	03MN040	Yellow Medicine River, South Branch						
05-Aug-10	10EM062	Yellow Medicine River, South Branch	24	14	24	5	67	moderately unstable
11-Aug-10	10MN003	Yellow Medicine River, South Branch	30	30	28	11	99	severely unstable
03-Aug-10	10MN023	County Ditch 35	9	5	6	2	22	stable
04-Aug-10	10MN024	County Ditch 35	15	6	9	3	33	fairly stable
05-Aug-10	10MN025	Judicial Ditch 29	17	12	6	3	38	fairly stable
04-Aug-10	10MN027	Judicial Ditch 29	13	6	9	3	31	fairly stable
05-Aug-10	10MN028	Judicial Ditch 29	14	20	22	7	63	moderately unstable
04-Aug-10	10MN029	Trib. to Yellow Medicine River, South Br	8	7	6	3	24	stable
04-Aug-10	10MN030	Yellow Medicine River, South Branch	20	30	28	6	84	severely unstable

Qualitative channel stability ratings

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

Table 26. Outlet water chemistry results for South Branch Yellow Medicine River in the South Branch Yellow Medicine River HUC 10

Station location:	**South Branch Yellow Medicine River At CR 26, two mi. N of Minnesota**							
STORET/EQuIS ID:	**S002-320**							
Station #:	**10MN003**							
Parameter	**Units**	**# of Samples**	**Minimum**	**Maximum**	**Mean**	**Median**	**WQ Standard[1]**	**# of WQ Exceedances[2]**
Escherichia coli	MPN/100ml	17	98.5	1986.3	702.1	517.2	1260.0	0
Ammonia-nitrogen	mg/l	10	0.16	0.16	0.16	0.16		
Inorganic nitrogen (nitrate and nitrite)	mg/l	10	1.02	6.95	3.51	3.28		
Kjeldahl nitrogen	mg/l	10	0.2	1.7	1.1	1.2		
Phosphorus	ug/l	10	22.0	276.0	146.6	156.5		
Orthophosphate	ug/l	0						
Total suspended solids	mg/l	10	2.0	105.0	47.8	58.5		
Total volatile solids	mg/l	10	2.0	18.0	8.1	8.0		
Hardness, carbonate	mg/l	9	477.0	707.0	595.9	577.0		
Calcium	mg/l	9	117.0	164.0	141.9	142.0		
Magnesium	mg/l	9	45.0	72.3	58.7	59.5		
Chloride	mg/l	7	10.3	33.5	16.9	14.4	230.0	0
Sulfate	mg/l	7	242.0	454.0	335.9	332.0		
Specific conductance	uS/cm	18	816.0	1310.0	1072.5	1082.0		
pH	--	19	8.0	8.7	8.2	8.2	6.5-9.0	0
Dissolved oxygen (DO)	mg/l	19	6.8	11.1	8.2	8.1	5.0	0
Temperature, water	deg C	19	11.0	30.5	20.5	20.8		
Turbidity	NTRU	0					25.0 NTU	0
Transparency, tube with disk	cm	19	8.0	60.0	25.2	18.0		

[1]Total suspended solids and transparency tube standards are surrogate standards derived from the turbidity standard of 25.
[2]Represents exceedances of individual maximum standard for E. coli (1260/100ml)
****Data found in the table above was compiled using the results from data collected at the outlet monitoring station on the South Branch Yellow Medicine River in the South Branch Yellow Medicine 10 HUC, a component of the IWM work conducted between May and September in 2010 and 2011. This specific data does not necessarily reflect all data that was used to assess the AUID.**

Table 27. Lake assessment data for lakes in the South Branch Yellow Medicine 10 HUC.

Lake ID	Lake Name	County	HUC-10	Ecoregion	Lake Area (ha)	Max Depth (m)	Mean Depth (m)	Watershed Area (ha)	% Littoral	Aquatic Recreation Use Support
41-0024-00	Gislason	Lincoln	0702000404	NGP	49			423		IF
41-0034-00	Stay	Lincoln	0702000404	NGP	89	1.8	1*	2,444	100	NS
41-0045-00	Hawksnest	Lincoln	0702000404	NGP	109	0.7	1*	380	100	IF

* **Estimated mean depth**

Summary

Streams in this subwatershed flow through a predominately agricultural landscape, with most streams having a low gradient invertebrate classification. The headwaters of the South Branch Yellow Medicine River, including Judicial Ditch 35, included four channelized sites, all of which received poor modified stream ratings. Judicial Ditch 29 included three channelized reaches, all of which received fair modified stream ratings.

All of the reaches in the lower half of the South Branch Yellow Medicine River, as well as the reach in its lower most tributary, were assessable, and all of them had relatively healthy invertebrate communities and scored above their respective stream class thresholds. The common link between these reaches was that all had wooded riparian zones, and relatively high quality in-stream habitat. The intact riparian zone serves to maintain bank stability and contribute important invertebrate habitat, despite a high percentage of agriculture in the watershed.

Stream water quality data were available for the South Branch of the Yellow Medicine River (County Ditch 35) from the headwaters to the Yellow Medicine River. This AUID is approximately 63 miles long. Water chemistry data were collected approximately one mile upstream of the confluence with the Yellow Medicine River. The South Branch of the Yellow Medicine River exceeded the standard for bacteria and is considered impaired for aquatic recreation use. This impairment was based on 11 geometric mean exceedances and six individual samples that exceeded the water quality standard of 1260 MPN/100ml. Levels of bacteria in this reach were high, suggesting that recreational use is not recommended. The same reach is considered impaired for aquatic life use based on an existing turbidity impairment from 2002. Both fish IBI and invertebrate IBI show support for aquatic life. Fish IBIs in the headwater channelized reaches were mainly fair. Invertebrate IBIs were mixed in the channelized reaches. Channel stability decreases and habitat improves starting upstream to downstream.

Lakes in this region are typically shallow and have watersheds that primarily consist of cropland and pasture. One lake in the South Branch Yellow Medicine River Watershed Unit had sufficient data for aquatic recreation use assessment. Stay Lake was found to be impaired for aquatic recreation use (excess nutrients). Stay Lake had high concentrations of phosphorus, which in turn causes high Chl-a concentrations and nuisance algal blooms. Land use within Stay Lake's watersheds is dominated by cropland and best land management practices need to be implemented to limit nutrient inputs into these lakes. Internal loading is likely a significant source of nutrients in Stay Lake and needs to be addressed. Two additional lakes had water quality data available but the data sets were not large enough for an assessment decision to be made, resulting in an insufficient information designation (Table 24).

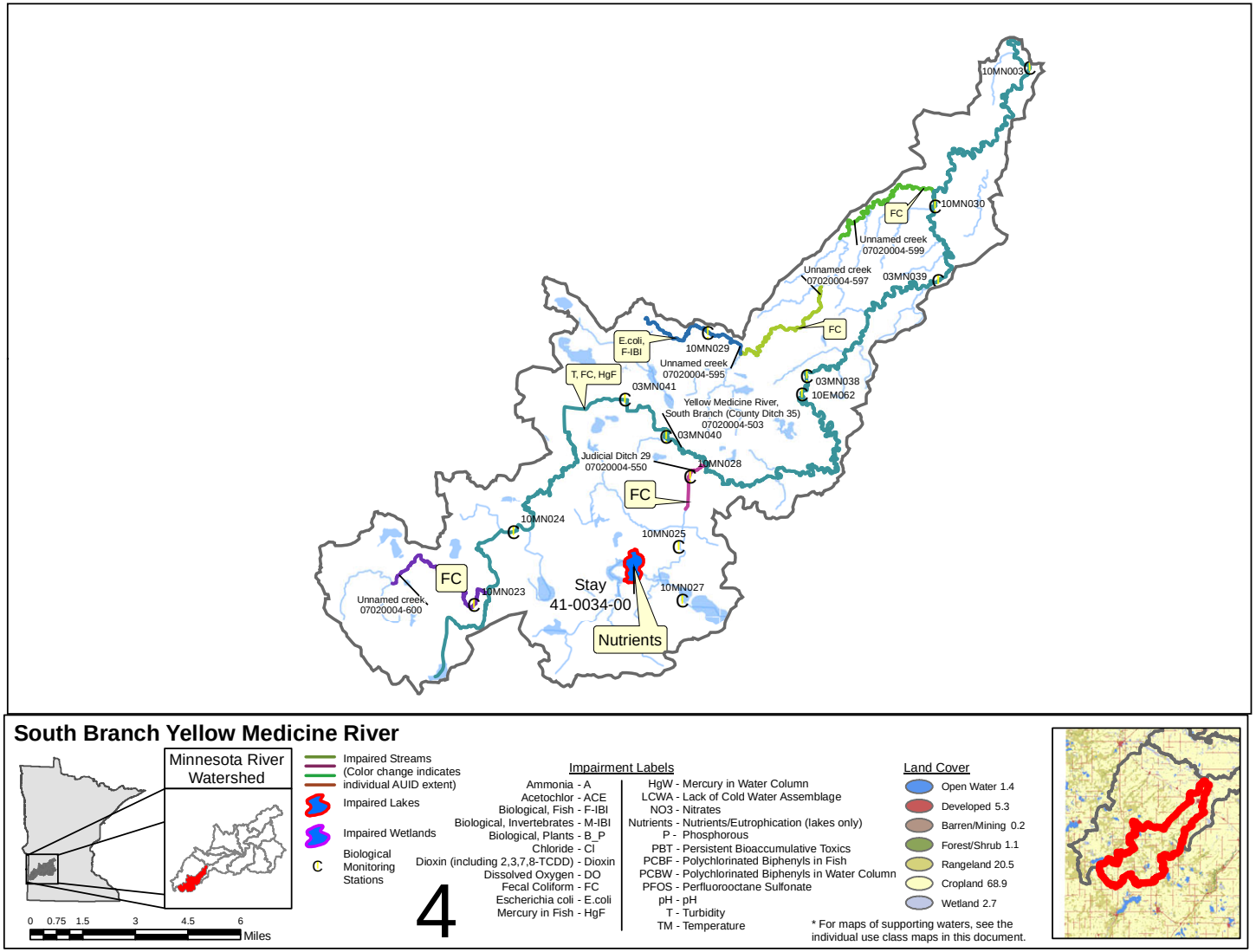

Figure 18. Currently listed impaired waters by parameter and land use characteristics in the South Branch Yellow Medicine River Watershed Unit

Spring Creek Watershed Unit HUC 0702000405

This watershed unit is a network of streams that flow through drained wetlands and form Spring Creek, which flows into the Yellow Medicine River. The subwatershed is located in the west central part of the Minnesota River - Granite Falls HUC 8. This 129 square mile drainage area is comprised mainly of cropland, wetland and developed land. The towns of St. Leo, Burton, Swede Prairie, and Hazel Run are located in this subwatershed. There was no outlet site for intensive watershed monitoring in this subwatershed selected on Spring Creek for IWM water chemistry due to low flow conditions at the outlet site. Spring Creek has been selected to be a part of the WPLMN program where intensive long-term stream chemistry monitoring will occur every year beginning in 2013. Other tributaries in this watershed unit are County Ditch 48 and five small unnamed tributaries. The streams in this watershed unit are all designated warmwater. There was one unnamed lake that was sampled in this subwatershed.

Table 28. Aquatic life and recreation assessments on stream reaches: Spring 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.
					Fish IBI	Invert IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides			
07020004-538, Spring Creek, Headwaters to Yellow Medicine R	41.24	2B, 3C	10MN037 91MN014 10EM190	Upstream of 380th St, 2 mi. W of Spring Creek Upstream of 470th St, 5 mi NW of Hanley Falls Upstream and downstream of CR D3, 5 mi. E of St Leo	EXS		EXS	EXS		--	--		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: = existing impairment, listed prior to 2012 reporting cycle; = new impairment; = full support of designated use.

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

Table 29. Non-assessed biological stations on channelized AUIDs in the Spring Creek 10-HUC

AUID *Reach Name*, *Reach Description*	Reach Length (miles)	Use Class	Biological Station ID	Location of Biological Station	Fish IBI	Invert IBI
07020004-538, Spring Creek, Headwaters to Yellow Medicine R	41.24	2B, 3C	10EM190	Upstream and downstream of CR D3, 5 mi. E of St Leo	poor	poor
07020004-538, Spring Creek, Headwaters to Yellow Medicine R	41.24	2B, 3C	10MN037	Upstream of 380th St, 2 mi. W of Spring Creek	poor	poor
07020004-539, Unnamed ditch, Unnamed cr to Spring Cr	3.85	2B, 3C	10MN046	Downstream of 230th Ave, 2 mi. NE of St Leo	poor	poor
07020004-697, County Ditch 48, Unnamed cr to Unnamed cr	1.89	2B, 3C	10MN068	Upstream of CR D3, 8.5 mi. N of Minneota	poor	poor

Table 30. Minnesota Stream Habitat Assessment (MSHA): Spring Creek 10-HUC.

# Visits	Biological Station ID	Reach Name	Land Use (0-5)	Riparian (0-15)	Substrate (0-27)	Fish Cover (0-17)	Channel Morph.	MSHA Score	MSHA Rating
1	10EM190	Spring Creek	0	9	12	15	7	43	poor
1	10MN037	Spring Creek	0	9.5	9	5	6	29.5	poor
1	10MN046	Trib. to Spring Creek	0	11.5	18	12	13	54.5	fair
1	91MN014	Spring Creek	0	6	6.25	12	12	36.25	poor

Table 31. Channel Condition and Stability Assessment (CCSI): South Branch Yellow Medicine River 10-HUC.

# Visits	Biological Station ID	Stream Name	Upper Banks (43-4)	Lower Banks (46-5)	Substrate (37-3)	Channel Evolution (11-1)	CCSI Score (137-13)	CCSI Rating
10-Aug-10	10EM190	Spring Creek	12	8	9	3	32	fairly stable
10-Aug-10	10MN037	Spring Creek	7	14	9	1	31	fairly stable
10-Aug-10	10MN046	Trib. to Spring Creek	27	20	10	5	62	moderately unstable
10-Aug-10	10MN068	County Ditch 48	24	16	11	3	54	moderately unstable

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

Table 32. Lake Assessment Data for the Spring Creek 10 HUC.

Lake ID	Lake Name	County	HUC-10	Ecoregion	Lake Area (ha)	Max Depth (m)	Mean Depth (m)	Watershed Area (ha)	% Littoral	Aquatic Recreation Use Support
87-0098-00	Unnamed	Yellow Medicine	0702000405	WCBP	12			124		IF

Summary

Only one stream AUID on Spring Creek was assessable for water chemistry. This reach is impaired for aquatic recreation use due to high levels of E. coli. Dissolved oxygen levels were also below the standard. Sampling in channelized portions of Spring Creek show poor fish and invertebrate IBIs and support a previous fish IBI impairment on Spring Creek. Excess nutrients, by evidence of extreme algae blooms, duck weed and macrophytes, are present in the stream. Fish and invertebrate samples in the tributaries to Spring Creek rated poorly. Channel stability is fairly stable in this watershed but habitat is poor with excess sediment in many portions of Spring Creek. In 2011, the most downstream sampling location had good transparency which fostered the growth of emergent and submergent vegetation along stream bank edges. In 2012, the channel was dry and not flowing for a good portion of the summer. There was not enough information available to adequately assess the unnamed lake in the Spring Creek subwatershed.

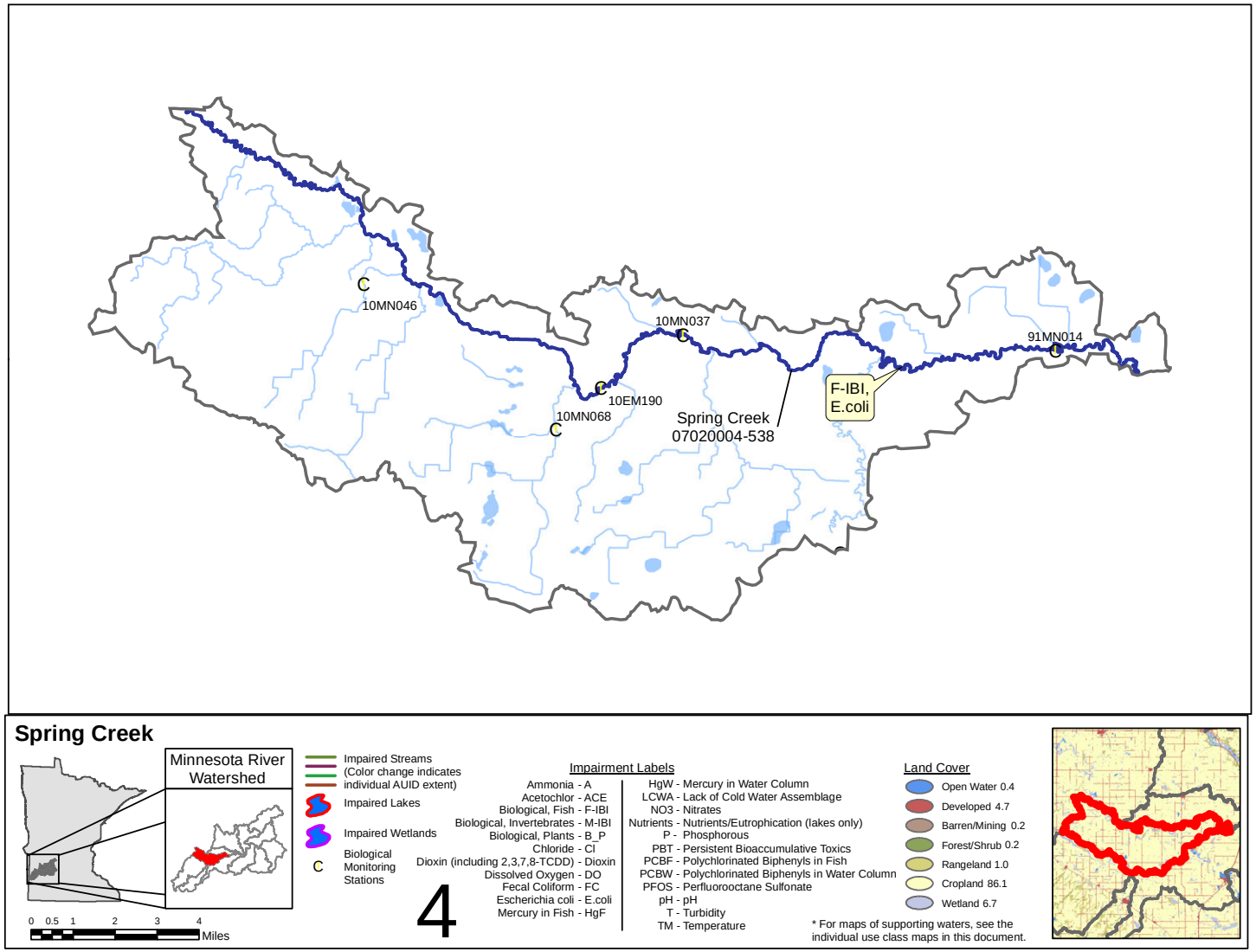

Figure 19. Currently listed impaired waters by parameter and land use characteristics in the Spring Creek Watershed Unit.

Lower Yellow Medicine River Watershed Unit HUC 0702000406

This watershed unit is a flow-through network of the mainstem Yellow Medicine River and smaller tributaries which flow into the Minnesota River. The subwatershed is located in the south central part of the Minnesota River - Granite Falls HUC 8. This 169 square mile drainage area is comprised mainly of cropland and developed land. The towns of Westerheim, Vallers, Cottonwood, Lucas, Normania, Sandnes and Hanley Falls are located in this subwatershed. There are two outlet sites for intensive watershed monitoring in this subwatershed, at the Judicial Ditch 17 outlet (station 10MN012) and the mainstem Yellow Medicine River outlet (station 10MN001). The Yellow Medicine River mainstem has been selected to be a part of the WPLMN program where intensive long-term stream chemistry monitoring will occur every year beginning in 2013. Other tributaries in this watershed unit are Judicial Ditch 37, Judicial Ditch 7, Judicial Ditch 24, County Ditch 4, and Tributary to Cottonwood Lake. The streams in this watershed unit are all designated warmwater. There were three sampled lakes in this subwatershed.

Table 33. Aquatic life and recreation assessments on stream reaches: Lower Yellow Medicine Watershed Unit.

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.
					Fish IBI	Invert IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides			
07020004-502, Yellow Medicine River, Spring Cr to Minnesota R	27.82	2B, 3C	90MN015	Upstream of Hwy 67, 5 mi SE of Granite Falls	MTS	MTS	MTS	EXS	MTS	MTS	MTS		MTS	NS	FS
07020004-513, Yellow Medicine River, S Br Yellow Medicine R to Spring Cr	33.62	2B, 3C	10MN038 03MN048 10MN045 10MN096	Upstream of CR 10, 4 mi. NE of Minneota 5 mi. SW of Hanley Falls Upstream of 480th Ave, 4 mi. NW of Cottonwood Just S of CR D1, 0.5 mi. W of Normania	EXP	EXP	IF	EXS		MTS	MTS		EX	NS	NS
07020004-622, Judicial Ditch 17, CD 3 to Yellow Medicine R	1.03	2B, 3C	10MN012	Downstream of CR 18, 1 mi. W of Hanley Falls			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: = existing impairment, listed prior to 2012 reporting cycle; = new impairment; = full support of designated use.

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

Table 34. Non-assessed biological stations on channelized AUIDs in the Lower Yellow Medicine River 10-HUC

AUID *Reach Name*, *Reach Description*	Reach Length (miles)	Use Class	Biological Station ID	Location of Biological Station	Fish IBI	Invert IBI
07020004-622, Judicial Ditch 17, CD 3 to Yellow Medicine R	1.03	2B, 3C	10MN012	Downstream of CR 18, 1 mi. W of Hanley Falls	good	fair
07020004-670, Judicial Ditch 24, Unnamed ditch to JD 17	6.18	2B, 3C	10MN043	Downstream of 170th Ave, 2 mi. NW of Cottonwood	poor	poor
07020004-663, County Ditch 4, Headwaters to CD 55	4.79	2B, 3C	10MN070	Upstream of CR 67, 4 mi. W of Cottonwood	fair	poor
07020004-634, County Ditch 37, Unnamed cr to Unnamed cr	2.69	2B, 3C	10MN062	Downstream of CSAH 8 (320th St), 2 mi. SE of Minneota	fair	good
07020004-636, Judicial Ditch 7, Unnamed ditch to Yellow Medicine R	3.13	2B, 3C	10MN064	Upsteam of 370th St, 6 mi. NE of Minneota	fair	good
07020004-703, Unnamed creek, Unnamed ditch to Unnamed ditch	2.48	2B, 3C	10MN130	Upstream of Hwy 23, 0.5 mi. S of Cottonwood	poor	fair

Table 35. Minnesota Stream Habitat Assessment (MSHA): Lower Yellow Medicine 10-HUC.

# Visits	Biological Station ID	Reach Name	Land Use	Riparian (0-15)	Substrate (0-27)	Fish Cover (0-17)	Channel Morph.	MSHA Score	MSHA Rating
3	03MN048	Yellow Medicine River	0	8.666666667	15.43333333	5.666666667	16	45.76666667	fair
1	10MN012	Judicial Ditch 17	1.25	8.5	18.2	8	22	57.95	fair
2	10MN038	Yellow Medicine River	0	10.75	19.25	11	21	62	fair
1	10MN043	Trib. to Judicial Ditch 24	0	8	18	11	13	50	fair

# Visits	Biological Station ID	Reach Name	Land Use	Riparian (0-15)	Substrate (0-27)	Fish Cover (0-17)	Channel Morph.	MSHA Score	MSHA Rating
1	10MN045	Yellow Medicine River	0	7.5	19.1	8	18	52.6	fair
1	10MN062	County Ditch 37	0	10.5	12.4	11	17	50.9	fair
2	10MN064	Judicial Ditch 7	0	7	13.8	11	17	48.8	fair
1	10MN070	County Ditch 4	0	8	9	9	9	35	poor
1	10MN096	Yellow Medicine River	0	7	16.8	11	17	51.8	fair
1	10MN130	Trib. to Cottonwood Lake	0	7.5	8	5	5	25.5	poor

Qualitative habitat ratings

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

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

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

Table 36. Channel Condition and Stability Assessment (CCSI): Lower Yellow Medicine River 10 HUC

# Visits	Biological Station ID	Stream Name	Upper Banks (43-4)	Lower Banks (46-5)	Substrate (37-3)	Channel Evolution (11-1)	CCSI Score (137-13)	CCSI Rating
12-Aug-10	03MN048	Yellow Medicine River	34	22	30	7	93	severely unstable
03-Aug-10	10MN012	Judicial Ditch 17	29	20	12	5	66	moderately unstable
12-Aug-10	10MN038	Yellow Medicine River	27	20	28	5	80	severely unstable
03-Aug-10	10MN043	Trib. to Judicial Ditch 24	36	20	13	5	74	moderately unstable
12-Aug-10	10MN045	Yellow Medicine River	32	20	20	7	79	moderately unstable

# Visits	Biological Station ID	Stream Name	Upper Banks (43-4)	Lower Banks (46-5)	Substrate (37-3)	Channel Evolution (11-1)	CCSI Score (137-13)	CCSI Rating
10-Aug-10	10MN062	County Ditch 37	24	16	13	3	56	moderately unstable
03-Aug-10	10MN064	Judicial Ditch 7	36	22	23	5	86	severely unstable
03-Aug-10	10MN070	County Ditch 4	32	14	13	7	66	moderately unstable
12-Aug-10	10MN096	Yellow Medicine River	40	30	23	11	104	severely unstable
03-Aug-10	10MN130	Trib. to Cottonwood Lake	26	14	11	3	54	moderately unstable
24-Aug-10	90MN015	Yellow Medicine River	18	14	9	3	44	fairly stable

Qualitative channel stability ratings

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

Table 37. Outlet water chemistry results for Yellow Medicine River in the Lower Yellow Medicine River HUC 10

Station location:	**Yellow Medicine River at 560th St. 5.25 mi. NE of Hanley Falls**							
STORET/EQuIS ID:	**S002-316**							
Station #:	**10MN001**							
Parameter	**Units**	**# of Samples**	**Minimum**	**Maximum**	**Mean**	**Median**	**WQ Standard[1]**	**# of WQ Exceedances[2]**
Escherichia coli	MPN/100ml	17	14.6	1413.6	323.7	159.7	1260.0	0
Ammonia-nitrogen	mg/l	10	0.16	0.16	0.16	0.16		
Inorganic nitrogen (nitrate and nitrite)	mg/l	10	1.73	8.47	4.52	4.48		
Kjeldahl nitrogen	mg/l	10	0.7	2.2	1.4	1.3		
Phosphorus	ug/l	10	37.0	300.0	205.2	230.0		
Orthophosphate	ug/l	0						
Total suspended solids	mg/l	10	3.0	107.0	49.4	48.0		
Total volatile solids	mg/l	10	2.0	16.0	7.8	7.5		
Hardness, carbonate	mg/l	9	426.0	806.0	625.1	601.0		
Calcium	mg/l	9	102.0	174.0	139.4	131.0		
Magnesium	mg/l	9	41.6	90.1	67.2	68.9		
Chloride	mg/l	7	9.4	25.4	17.2	17.6	230.0	0

Station location:	Yellow Medicine River at 560th St. 5.25 mi. NE of Hanley Falls							
STORET/EQuIS ID:	S002-316							
Station #:	10MN001							
Parameter	**Units**	**# of Samples**	**Minimum**	**Maximum**	**Mean**	**Median**	**WQ Standard[1]**	**# of WQ Exceedances[2]**
Sulfate	mg/l	7	227.0	577.0	393.0	380.0		
Specific conductance	uS/cm	19	738.0	1469.0	1199.3	1195.0		
pH	--	19	7.8	8.7	8.2	8.2	6.5-9.0	0
Dissolved oxygen (DO)	mg/l	19	6.7	13.1	8.3	8.1	5.0	0
Temperature, water	deg C	19	12.7	27.8	21.4	21.5		
Turbidity	NTRU	0					25.0 NTU	0
Transparency, tube with disk	cm	19	3.5	60.0	18.6	14.5		

[1]Total suspended solids and transparency tube standards are surrogate standards derived from the turbidity standard of 25.
[2]Represents exceedances of individual maximum standard for E. coli (1260/100ml)

Table 38. Outlet water chemistry results for Judicial Ditch 17 in the Lower Yellow Medicine River HUC 10

Station location:	Judicial Ditch 17 at CR 18, 1 mi. W of Hanley Falls							
STORET/EQuIS ID:	S002-319							
Station #:	10MN012							
Parameter	**Units**	**# of Samples**	**Minimum**	**Maximum**	**Mean**	**Median**	**WQ Standard[1]**	**# of WQ Exceedances[2]**
Escherichia coli	MPN/100ml	17	19.7	1553.1	377.1	178.5	1260.0	1
Ammonia-nitrogen	mg/l	10	0.16	0.16	0.16	0.16		
Inorganic nitrogen (nitrate and nitrite)	mg/l	10	1.88	13.50	8.07	8.21		
Kjeldahl nitrogen	mg/l	10	1.4	2.6	2.0	2.0		
Phosphorus	ug/l	10	97.0	264.0	183.1	178.5		
Orthophosphate	ug/l	0						
Total suspended solids	mg/l	10	7.0	30.0	17.2	16.0		
Total volatile solids	mg/l	10	2.0	10.0	7.2	7.0		
Hardness, carbonate	mg/l	9	509.0	846.0	737.2	751.0		
Calcium	mg/l	9	108.0	149.0	131.9	136.0		
Magnesium	mg/l	9	58.0	115.0	99.1	103.0		
Chloride	mg/l	7	12.3	29.9	24.1	24.9	230.0	0

Station location:	Judicial Ditch 17 at CR 18, 1 mi. W of Hanley Falls							
STORET/EQuIS ID:	S002-319							
Station #:	10MN012							
Parameter	**Units**	**# of Samples**	**Minimum**	**Maximum**	**Mean**	**Median**	**WQ Standard[1]**	**# of WQ Exceedances[2]**
Sulfate	mg/l	7	293.0	625.0	525.7	563.0		
Specific conductance	uS/cm	19	943.0	1640.0	1416.4	1482.0		
pH	--	19	7.5	8.6	7.9	7.9	6.5-9.0	0
Dissolved oxygen (DO)	mg/l	19	4.9	14.6	8.5	8.2	5.0	1
Temperature, water	deg C	19	13.8	26.8	19.9	20.1		
Turbidity	NTRU	0					25.0 NTU	0
Transparency, tube with disk	cm	19	14.5	56.0	32.2	32.0		

[1]Total suspended solids and transparency tube standards are surrogate standards derived from the turbidity standard of 25.
[2]Represents exceedances of individual maximum standard for E. coli (1260/100ml)

Table 39. Lake assessment data for the Lower Yellow Medicine River 10 HUC

Lake ID	Lake Name	County	HUC-10	Ecoregion	Lake Area (ha)	Max Depth (m)	Mean Depth (m)	Watershed Area (ha)	% Littoral	Aquatic Recreation Use Support
42-0014-00	Cottonwood	Lyon	0702000406	WCBP	155	2.4	1*	5,262	100	NS
87-0060-00	Spellman	Yellow Medicine	0702000406	WCBP	121	1.5	1*	638	100	IF
87-0061-00	Miedd	Yellow Medicine	0702000406	WCBP	59			106		IF

*** Estimated mean depth**

Summary

All sites on the Lower Yellow Medicine River mainstem, as well as the non-assessable headwater tributary Judicial Ditch 7, were determined to show full support for aquatic life, with only a single site scoring just below the impairment threshold. The mainstem sites all had wooded riparian zones which contribute to more stable banks, and higher quality invertebrate habitat associated with the presence of woody debris. The stations on Judicial Ditch 7 lacked riparian zones, but had relatively high flows for a low gradient stream. Higher natural flows can contribute to higher quality invertebrate communities, when other factors such as riparian extent or diverse habitats are limited. The four non-assessable reaches associated with tributaries in the lower half of the watershed all had M-IBI scores below the threshold; two received fair and two received fair-modified stream ratings.

Stream water quality data were available for Judicial Ditch 17 from County Ditch 3 to the Yellow Medicine River. This AUID is approximately one mile long. Water chemistry data were collected approximately one mile upstream of the confluence with the Yellow Medicine River. Judicial Ditch 17 exceeded the standard for bacteria and is considered impaired for aquatic recreation use. This impairment was based on two geometric mean exceedances and one individual sample exceeded the water quality standard of 1260 MPN/100ml. The same reach was not assessed for aquatic life because of channelization in the stream, but the fish IBI rating was good and the invertebrate rating was fair. Habitat and stream channel stability were fair. Some excess sediment was noted in the reach but overall conditions were average. Upstream channelized tributaries to County Ditch 17 showed poor fish and invertebrates as well as poor habitat, excess sediment and evidence of excess nutrients.

Stream water quality data were available for the Yellow Medicine River from Spring Creek to the Minnesota River. This AUID is approximately 28 miles long. Water chemistry data were collected approximately five miles upstream of the confluence with the Minnesota River. The Yellow Medicine River meets the standard for bacteria and is considered fully supporting for aquatic recreation use. One individual sample exceeded the water quality standard of 1260 MPN/100ml. Levels of bacteria in this reach were low, suggesting that use of this river reach for aquatic recreation is safe. The same reach is considered impaired for aquatic life use based on an existing turbidity impairment from 2002. Fish and invertebrate IBIs show support of aquatic life. Habitat is primarily fair, but channel stability decreases going downstream.

Lakes in this region are typically shallow and have watersheds that primarily consist of cropland and pasture. One lake in the Lower Yellow Medicine River Watershed Unit had sufficient data for aquatic recreation use assessment. Cottonwood Lake was found to be impaired for aquatic recreation use (excess nutrients). Cottonwood Lake had high concentrations of phosphorus, which in turn causes high Chl-a concentrations and nuisance algal blooms. Land use within Cottonwood Lake's watershed is dominated by residential development which surrounds the majority of the shoreline, along with cropland. Best land management practices need to be implemented to limit nutrient inputs into this lake. Internal loading is likely a significant source of nutrients in Cottonwood Lake and needs to be addressed. Two additional lakes had water quality data available but the data sets were not large enough for an assessment decision to be made resulting in an insufficient information designation (Table 39).

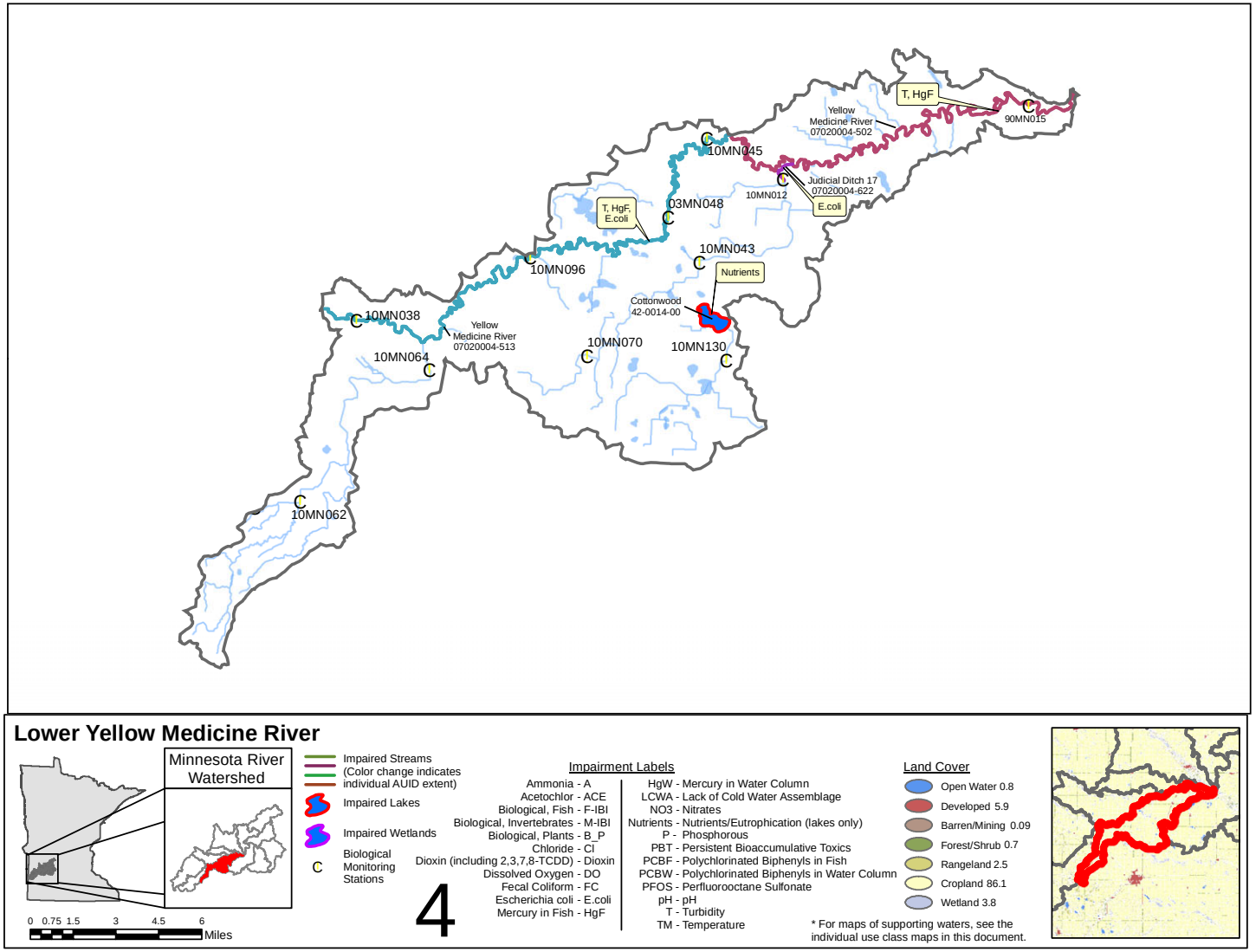

Figure 20. Currently listed impaired waters by parameter and land use characteristics in the Lower Yellow Medicine River Watershed Unit

Upper Hawk Creek Watershed Unit HUC 0702000407

This watershed unit is a network of deep headwater lakes, shallow lakes, and channelized streams that form the headwaters of Hawk Creek. The subwatershed is located in the northeast part of the Minnesota River - Granite Falls HUC 8. This 195 square mile drainage area is comprised mainly of cropland, rangeland, developed land and lakes. The towns of Dovre, Pennock, St. Johns, Lone Tree, Raymond, Edwards, and the city of Willmar are located in this subwatershed. There were no sites selected for intensive watershed monitoring in this subwatershed due to the abundance of lakes in this watershed. The streams in this subwatershed include Hawk Creek and a few unnamed tributaries to Hawk Creek. Hawk Creek is designated as Class 7, as are a couple of unnamed tributaries. There are also a few stream reaches in this subwatershed that are designated warmwater. This lake-rich subwatershed has 17 sampled lakes.

Table 40. Aquatic life and recreation assessments on stream reaches: Upper Hawk 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.
					Fish IBI	Invert IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides			
07020004-508, Hawk Creek, T119 R35W S19, north line to T118 R37W S31, south line	27.11	7	03MN007 10MN147 10MN081 10MN106	Upstream of CR 116, 4 mi. SW of Willmar Upstream of 150th Ave, 2 mi. W of Raymond Upstream of 130th Ave, 5 mi. NW of Raymond Downstream of Hwy 23, 2 mi. NE of Raymond			--			MTS	MTS		--		
07020004-524, Unnamed creek, T119 R36W S4, north line to Hawk Cr	13.65	7	07MN047 10MN089 10EM110	Downstream of CR 37, 5.5 mi. N of Raymond Upstream of 140th Ave, 5 mi. NW of Raymond Upstream of 120th St NW, 1.5 mi. E of Pennock			IF			MTS	--		--		

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

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

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

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

Table 41. Non-assessed biological stations on channelized AUIDs in the Upper Hawk Creek 10-HUC

AUID *Reach Name*, *Reach Description*	Reach Length (miles)	Use Class	Biological Station ID	Location of Biological Station	Fish IBI	Invert IBI
07020004-510, Hawk Creek, T117 R37W S6, north line to Chetomba Cr	10.45	2B, 3C	03MN016	1 mi. S.W. of Clara City, downstream of 100th St. S.E.	good	fair
07020004-524, Unnamed creek, T119 R36W S4, north line to Hawk Cr	13.65	7	07MN047	Downstream of CR 37, 5.5 mi. N of Raymond	poor	fair
07020004-508, Hawk Creek, T119 R35W S19, north line to T118 R37W S31, south line	27.11	7	03MN007	Upstream of CR 116, 4 mi. SW of Willmar	fair	fair
07020004-508, Hawk Creek, T119 R35W S19, north line to T118 R37W S31, south line	27.11	7	10MN081	Upstream of 130th Ave, 5 mi. NW of Raymond	good	fair
07020004-578, Unnamed creek, Headwaters to Unnamed cr	4.16	7	10MN086	Downstream of CR 1, 1 mi. S of Pennock	fair	poor
07020004-510, Hawk Creek, T117 R37W S6, north line to Chetomba Cr	10.45	2B, 3C	10MN133	Upstream of 40th St, in Clara City	fair	poor
07020004-508, Hawk Creek, T119 R35W S19, north line to T118 R37W S31, south line	27.11	7	10MN147	Upstream of 150th Ave, 2 mi. W of Raymond	fair	poor
07020004-524, Unnamed creek, T119 R36W S4, north line to Hawk Cr	13.65	7	10MN089	Upstream of 140th Ave, 5 mi. NW of Raymond	fair	poor
07020004-508, Hawk Creek, T119 R35W S19, north line to T118 R37W S31, south line	27.11	7	10MN106	Downstream of Hwy 23, 2 mi. NE of Raymond	good	fair
07020004-524, Unnamed creek, T119 R36W S4, north line to Hawk Cr	13.65	7	10EM110	Upstream of 120th St NW, 1.5 mi. E of Pennock	fair	poor

AUID *Reach Name*, *Reach Description*	Reach Length (miles)	Use Class	Biological Station ID	Location of Biological Station	Fish IBI	Invert IBI
07020004-733, Unnamed ditch, Unnamed ditch to Hawk Cr	1.5	2B, 3C	10MN098	Downstream of 75th Ave, 2 mi. NE of Raymond	fair	poor
07020004-732, Unnamed ditch, Unnamed ditch to Hawk Cr	1.47	2B, 3C	10MN104	Upstream of Hwy 23, 1 mi. W of Raymond	poor	poor

Table 42. Minnesota Stream Habitat Assessment (MSHA): Upper Hawk Creek 10-HUC.

# Visits	Biological Station ID	Reach Name	Land Use (0-5)	Riparian (0-15)	Substrate (0-27)	Fish Cover (0-17)	Channel Morph. (0-36)	MSHA Score (0-100)	MSHA Rating
3	03MN007	Hawk Creek	0	10.16666667	15.25	11.66666667	10.66666667	47.75	fair
1	03MN016	Hawk Creek	0	7	20	7	14	48	fair
1	07MN047	Trib. to Hawk Creek	0	10	17.75	11	19	57.75	fair
1	10EM110	Unnamed creek	0	12	3.25	12	7	34.25	poor
1	10MN031	Hawk Creek	1	7	20.2	7	14	49.2	fair
1	10MN081	Hawk Creek	0	7	13.8	7	9	36.8	poor
1	10MN086	Unnamed ditch	2.75	7	16.05	13	19	57.8	fair
1	10MN089	Trib. to Hawk Creek	0	8	15.1	11	15	49.1	fair
1	10MN098	Trib. to Hawk Creek	0	7	18	1	10	36	poor
1	10MN104	Trib. to Hawk Creek	0	8.5	10	10	6	34.5	poor
1	10MN106	Hawk Creek	0	6	18	15	14	53	fair
1	10MN147	Hawk Creek	0	6	9	10	7	32	poor

Qualitative habitat ratings

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

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

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

Table 43. Channel Condition and Stability Assessment (CCSI): Upper Hawk Creek 10-HUC.

# Visits	Biological Station ID	Stream Name	Upper Banks (43-4)	Lower Banks (46-5)	Substrate (37-3)	Channel Evolution (11-1)	CCSI Score (137-13)	CCSI Rating
05-Aug-10	03MN007	Hawk Creek	25	12	6	5	48	moderately unstable
09-Aug-10	10EM110	Unnamed creek	26	12	19	3	60	moderately unstable
09-Aug-10	10MN081	Hawk Creek	34	16	19	7	76	moderately unstable
10-Aug-10	10MN086	Unnamed ditch	26	10	13	3	52	moderately unstable
05-Aug-10	10MN087	Trib. to Hawk Creek	13	4	17	1	35	fairly stable
09-Aug-10	10MN089	Trib. to Hawk Creek	31	14	19	3	67	moderately unstable
10-Aug-10	10MN098	Trib. to Hawk Creek	26	16	22	3	67	moderately unstable
05-Aug-10	10MN104	Trib. to Hawk Creek	24	4	17	1	46	moderately unstable
05-Aug-10	10MN106	Hawk Creek	27	16	7	1	51	moderately unstable
05-Aug-10	10MN133	Hawk Creek	31	14	22	7	74	moderately unstable
10-Aug-10	10MN147	Hawk Creek	37	14	23	7	81	severely unstable

Qualitative channel stability ratings

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

Table 44. Lake assessment data for the Upper Hawk Creek 10 HUC.

Lake ID	Lake Name	County	HUC-10	Ecoregion	Lake Area (ha)	Max Depth (m)	Mean Depth (m)	Watershed Area (ha)	% Littoral	Aquatic Recreation Use Support
34-0115-00	East Twin	Kandiyohi	0702000407	NCHF	65	2.3	1*	670	100	FS
34-0116-00	Henderson	Kandiyohi	0702000407	NCHF	37	17.4	6.3	104	37	FS
34-0117-00	West Twin	Kandiyohi	0702000407	NCHF	31	2.5	1*	847	100	FS
34-0171-00	Eagle	Kandiyohi	0702000407	NCHF	361	19.8	7.4	4,613	33.3	FS
34-0172-00	Ringo	Kandiyohi	0702000407	NCHF	313	2.1	1.3	1,767	100	NS
34-0180-00	Willmar	Kandiyohi	0702000407	WCBP	259	4.3	1.8	7,988	100	IF
34-0181-00	Foot	Kandiyohi	0702000407	WCBP	220	7.3	1.7	8,649	95.6	FS
34-0186-00	Swan	Kandiyohi	0702000407	WCBP	83	1.5	1*	5,426	100	NS
34-0192-00	Long	Kandiyohi	0702000407	NCHF	694	4.9	2.9	3,386	94.5	NS
34-0193-00	Point	Kandiyohi	0702000407	NCHF	30	9.8	3.1	190	75	FS
34-0194-00	Unnamed	Kandiyohi	0702000407	WCBP	20			137		IF
34-0196-00	Skataas	Kandiyohi	0702000407	WCBP	81	3.2	2.4	529	100	IF
34-0245-00	West Solomon	Kandiyohi	0702000407	WCBP	227	4.0	2.1	7,091	100	NS
34-0246-00	East Solomon	Kandiyohi	0702000407	WCBP	243	4.3	2.5	5,121	100	IF
34-0283-00	Saint Johns	Kandiyohi	0702000407	WCBP	78	2.0	1.3	8,013	100	NS
34-0294-00	Lindgren	Kandiyohi	0702000407	WCBP	25			544		IF
34-0297-00	West Lindgren	Kandiyohi	0702000407	WCBP	26			259		IF

* **Estimated mean depth**

Summary

The Upper Hawk Creek watershed unit has the highest density of lakes in the Minnesota River - Granite Falls HUC-8 watershed. This region is very diverse, with a mixture of deep and shallow lakes in both urban and agricultural areas. Eleven lakes in the Upper Hawk Creek watershed unit had sufficient data for aquatic recreation use assessment. East and West Twin, Henderson, Eagle, Foot, and Point Lakes were found to be fully supporting for aquatic recreation use. Eagle and Henderson lakes are both deep and have the ability to sequester phosphorus in the bottom sediments. Eagle Lake is highly developed and has a watershed dominated by pasture and cropland. Limiting urban and rural phosphorus inputs will be vital to maintaining good water quality. Henderson Lake has a very small watershed consisting of mostly forest with a mixture of cropland. Water quality in Henderson Lake should remain good with a small contributing watershed. Residents of the lake should use best land management practices to reduce any possible inputs of phosphorus from lawn care products, septic systems, or other localized sources. Foot and Point Lakes are moderately deep and have small watersheds. Both lakes' watersheds have a mixture of residential, forest, and cropland. Maintaining forest and other natural lands within these lakes' watersheds will be critical in maintaining good water quality. East and West Twin Lakes are both shallow and have good water quality. Eliminating phosphorus inputs to these lakes is vital to maintaining good water quality because shallow lakes are unable to sequester phosphorous. Aquatic vegetation, which ties up phosphorous, should be managed and protected. Forested areas need to remain intact and any new development needs to use best land management practices. Five lakes, Ringo, Swan, Long, West Solomon, and St. Johns were found to be impaired for aquatic recreation use (excess nutrients) suggesting that during certain times of the year contact with lake water may not be suitable for recreation. Long, West Solomon, and Ringo are shallow lakes that have large surface areas and small watersheds. Wind mixing redistributes sediments throughout the water column which causes internal loading of phosphorous. Swan's and St. Johns' watersheds have a mixture of residential and cropland. Both of these lakes are relatively small and have simple shallow basins. Phosphorous inputs form the watershed must be reduced in order to improve water quality. Six additional lakes had water quality data available but the data sets were not large enough for an assessment decision to be made resulting in an insufficient information designation (Table 44).

Streams were not assessed in this watershed due to the extensive channelization and Class 7 designation. Fish IBI rating improved going downstream from poor to good based on the channelized rating. Invertebrate IBIs were generally fair to poor throughout this watershed. Habitat ratings were mainly fair to poor based on the high amount of channelization. Channel stability was fair, but excessive sediment was observed in many reaches in this watershed. Evidence of excessive nutrients was observed in this watershed due the high abundance of dense macrophytes and duck weed present in many of the stream reaches. Streams not assessed for aquatic life were deferred due to channelization. Of the 12 stations sampled in this watershed, seven received poor modified stream ratings, and five received fair ratings.

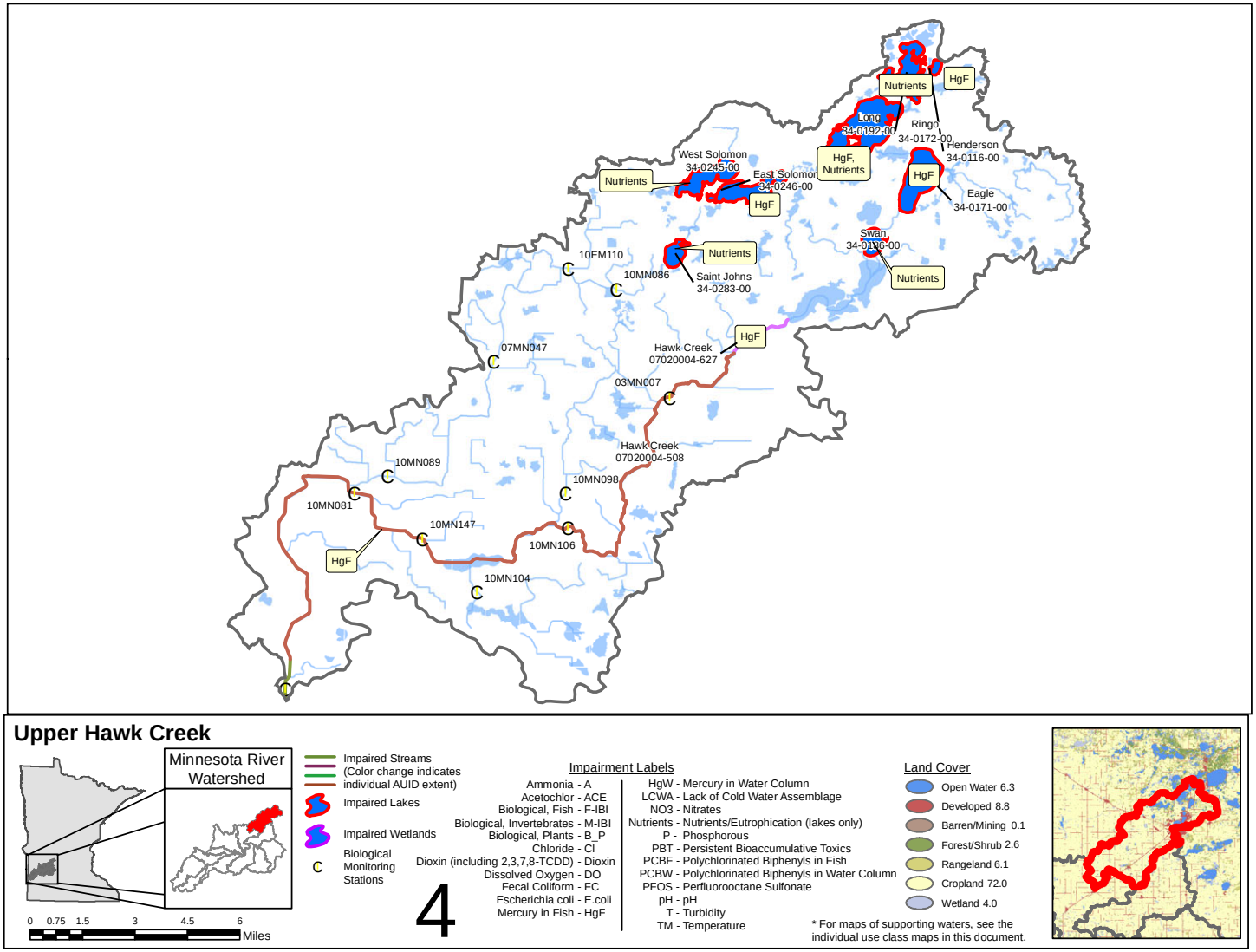

Figure 21. Currently listed impaired waters by parameter and land use characteristics in the Upper Hawk Creek Watershed Unit.

Chetomba Creek Watershed Unit HUC 0702000408

This watershed unit is a network of primarily channelized streams that flow into mainstem Chetomba Creek which flows to Hawk Creek. The subwatershed is located in the northeast part of the Minnesota River - Granite Falls HUC 8. This 158 square mile drainage area is comprised mainly of cropland and developed land. The towns of Ericson, Prinsburg, Holland, Roseland, Blomkest, and Whitefield are located in this subwatershed. The outlet site on Chetomba Creek (station 10MN016) was selected for intensive watershed monitoring in this subwatershed. The streams in this watershed include Chetomba Creek, Judicial Ditch 16, County Ditch 31, and Spring Creek, County Ditch 16, County Ditch 18, Judicial Ditch 1, County Ditch 8 and a few unnamed tributaries. One portion of Chetomba Creek in this watershed unit is designated as Class7. The remaining stream reaches are designated warmwater. Olson Lake is the only sampled lake in this subwatershed unit.

Table 45. Aquatic life and recreation assessments on stream reaches: Chetomba 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.**
					Fish IBI	Invert IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides			
07020004-623, Judicial Ditch 16, Headwaters to Chetomba Cr	8.17	2B, 3C	10MN101	Upstream of Kandi-Renville Line Rd SW, 3 mi. S of Prinsburg			--	IF		--	--			IF	NA

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

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

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

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

Table 46. Non-assessed biological stations on channelized AUIDs in the Chetomba Creek 10-HUC

AUID *Reach Name*, *Reach Description*	Reach Length (miles)	Use Class	Biological Station ID	Location of Biological Station	Fish IBI	Invert IBI
07020004-574, County Ditch 31 (Chetomba Creek), Unnamed cr to Chetomba Cr	1.74	2B, 3C	10MN083	Downstream of 75th St, 3 mi. NE of Prinsburg	poor	poor
07020004-588, Spring Creek, Unnamed ditch to Hawk Cr	0.84	2B, 3C	10MN016	Downstream of 880th Ave, 5 mi. SE of Maynard	poor	poor
07020004-522, Chetomba Creek, CD 8 to T117 R36W S10, west line	2.38	2C	10MN148	Upstream of 165th St SW, 3 mi. SE of Raymond	poor	poor
07020004-735, Unnamed ditch, Unnamed ditch to Unnamed ditch	1.7	2B, 3C	10MN084	Downstream of 60th St, 4 mi. E of Raymond	fair	fair
07020004-734, County Ditch 16, Unnamed ditch to CD 8	1.85	2B, 3C	10MN088	Upstream of CR 80, 3 mi. NE of Prinsburg	poor	poor
07020004-651, County Ditch 18, Unnamed ditch to CD 8	2.47	2B, 3C	91MN016	Downstream of 180th Ave SW, 3mi NE of Prinsburg	poor	poor
07020004-649, Judicial Ditch 1, Unnamed ditch to Chetomba Cr	6.95	2B, 3C	10MN082	Downstream of 150th St, 5 mi. SE of Maynard	fair	fair
07020004-571, Unnamed creek, Unnamed cr to Unnamed cr	3.1	2B, 3C	10MN085	Upstream of 105th Ave SW, 4.5 mi. E of Raymond	poor	fair
07020004-650, County Ditch 8, Unnamed ditch to CD 18	5.53	2B, 3C	10MN091	Downstream of 45th St, 4 mi. E of Prinsburg	poor	poor
07020004-728, Judicial Ditch 8, Unnamed ditch to Chetomba Cr	3.1	2B, 3C	10MN111	Upstream of 880th Ave, 4 mi. N of Renville	poor	poor
07020004-623, Judicial Ditch 16, Headwaters to Chetomba Cr	8.17	2B, 3C	10MN101	Upstream of Kandi-Renville Line Rd SW, 3 mi. S of Prinsburg	poor	poor

Table 47. Minnesota Stream Habitat Assessment (MSHA): Chetomba Creek 10-HUC.

# Visits	Biological Station ID	Reach Name	Land Use (0-5)	Riparian (0-15)	Substrate (0-27)	Fish Cover (0-17)	Channel Morph. (0-36)	MSHA Score (0-100)	MSHA Rating
1	07MN077	Chetamba Creek	0	9	20	7	8	44	poor
2	10EM046	Chetomba Creek	0	7.75	17.05	6.5	8.5	39.8	poor
1	10MN016	Chetomba Creek	0	7	18.2	7	14	46.2	fair
1	10MN082	Judicial Ditch 1	0	9.5	12.6	14	18	54.1	fair
1	10MN083	County Ditch 31	3	7	16	11	16	53	fair
3	10MN084	Trib. to County Ditch 31	0	8.2	13.9	11.7	8.7	42.4	fair
1	10MN085	Unnamed creek	0	11	9	13	10	43	poor
1	10MN088	County Ditch 16	0	8	8.5	13	10	39.5	poor
1	10MN091	County Ditch 8	0	7	8.5	13	7	35.5	poor
2	10MN101	Judicail Ditch 16	0	9.5	6.5	8.5	5.5	30	poor
1	10MN111	Judicial Ditch 8	0	8	9	1	4	22	poor
1	10MN124	Spring Creek	0	10	9	12	4	35	poor
1	10MN148	Chetomba Creek	0	9	14.8	9	15	47.8	fair
1	91MN016	Judicial Ditch 18	0	7.5	12	12	7	38.5	poor
1	97MN004	Chetomba Creek	0	7	16.4	8	14	45.4	fair

Qualitative habitat ratings

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

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

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

Table 48. Channel Condition and Stability Assessment (CCSI): Chetomba Creek 10 HUC

# Visits	Biological Station ID	Stream Name	Upper Banks (43-4)	Lower Banks (46-5)	Substrate (37-3)	Channel Evolution (11-1)	CCSI Score (137-13)	CCSI Rating
25-Aug-10	10EM046	Chetomba Creek	30	16	23	5	74	moderately unstable
04-Aug-10	10MN016	Chetomba Creek	34	13	14	3	64	moderately unstable
04-Aug-10	10MN082	Judicial Ditch 1	25	10	11	1	47	moderately unstable
11-Aug-10	10MN083	County Ditch 31	30	14	19	3	66	moderately unstable
10-Aug-10	10MN084	Trib. to County Ditch 31	30	10	26	3	69	moderately unstable
11-Aug-10	10MN088	County Ditch 16	31	10	30	3	74	moderately unstable
11-Aug-10	10MN091	County Ditch 8	26	14	27	7	74	moderately unstable
25-Aug-10	10MN101	Judicail Ditch 16	28	14	21	1	64	moderately unstable
12-Aug-10	10MN111	Judicial Ditch 8	30	12	17	3	62	moderately unstable
11-Aug-10	10MN148	Chetomba Creek	33	14	19	7	73	moderately unstable
11-Aug-10	91MN016	Judicial Ditch 18	28	10	21	3	62	moderately unstable
12-Aug-10	97MN004	Chetomba Creek	33	14	22	7	76	moderately unstable

Qualitative channel stability ratings

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

Table 49. Outlet water chemistry results for Chetomba Creek in the Chetomba Creek HUC 10

Station location:	**Chetomba Creek at 880th Ave. 5 mi. SE of Maynard**							
STORET/EQuIS ID:	**S002-152**							
Station #:	**10MN016**							
Parameter	**Units**	**# of Samples**	**Minimum**	**Maximum**	**Mean**	**Median**	**WQ Standard[1]**	**# of WQ Exceedances[2]**
Escherichia coli	MPN/100ml	0					1260.0	0
Ammonia-nitrogen	mg/l	10	0.16	0.16	0.16	0.16		
Inorganic nitrogen (nitrate and nitrite)	mg/l	10	0.20	19.00	10.90	10.80		
Kjeldahl nitrogen	mg/l	10	0.8	4.6	1.7	1.5		
Phosphorus	ug/l	10	30.0	248.0	118.9	114.0		
Orthophosphate	ug/l	0						
Total suspended solids	mg/l	10	4.0	36.0	18.0	15.5		
Total volatile solids	mg/l	10	2.0	8.0	4.4	4.5		
Hardness, carbonate	mg/l	10	429.0	784.0	646.4	665.0		
Calcium	mg/l	10	98.2	167.0	136.4	139.0		
Magnesium	mg/l	10	42.9	90.6	74.2	77.0		
Chloride	mg/l	10	16.8	39.4	31.5	33.4	230.0	0
Sulfate	mg/l	10	173.0	364.0	263.7	270.0		
Specific conductance	uS/cm	11	919.0	1386.0	1210.2	1239.0		
pH	--	11	8.1	8.8	8.3	8.2	6.5-9.0	0
Dissolved oxygen (DO)	mg/l	11	7.8	12.7	9.8	9.5	5.0	0
Temperature, water	deg C	11	9.7	26.7	19.9	21.5		
Turbidity	NTRU	16	4.6	90.9	28.3	21.2	25.0 NTU	6
Transparency, tube with disk	cm	16	7.0	100.0	36.5	25.5		

[1]Total suspended solids and transparency tube standards are surrogate standards derived from the turbidity standard of 25.
[2]Represents exceedances of individual maximum standard for E. coli (1260/100ml)

Table 50. Lake assessment data for lakes in the Chetomba Creek 10 HUC.

Lake ID	**Lake Name**	**County**	**HUC-10**	**Ecoregion**	**Lake Area (ha)**	**Max Depth (m)**	**Mean Depth (m)**	**Watershed Area (ha)**	**% Littoral**	**Aquatic Recreation Use Support**
34-0266-00	Olson	Kandiyohi	0702000408	WCBP	50	0.9	0.6	199	100	NS

Summary

Stream water quality data were available for Chetomba Creek from the headwaters to Hawk Creek. This AUID is approximately 1 mile long. Water chemistry data were collected approximately 3/4 mile upstream of the confluence with Hawk Creek. Chetomba Creek exceeded the standard for bacteria and was listed in 2010 and is considered impaired for aquatic recreation use. This impairment was based on three geometric mean exceedances and 19 individual samples exceeding the water quality standard of 1260 MPN/100ml. Levels of bacteria in this reach were high, suggesting that recreational use is not recommended. The same reach is considered impaired for aquatic life use based on an existing turbidity impairment from 2006. No biological assessments were made in this watershed due to extensive channelization. Fish and invertebrate IBIs on the channelized reaches were typically poor. Excessive macrophytes and duckweed were observed at many of the sample sites, especially in the headwaters. Stream stability scores were fair, based on channelized streams that are filled with excess sediment. A carp barrier at the outlet of Chetomba Creek is likely impeding fish and macro invertebrate movement upstream. Nitrate and phosphorus samples were above draft standards. Streams not assessed for aquatic life were deferred due to channelization. Of the 11 stations sampled in this subwatershed, seven received poor modified stream ratings, and four received fair ratings. Carp barriers present in this subwatershed may be impeding fish movement.

Lakes in this region are typically shallow and have watersheds that primarily consist of cropland and pasture. One lake in the Chetomba Creek Watershed Unit had sufficient data for aquatic recreation use assessment. Olson Lake was found to be impaired for aquatic recreation use (excess nutrients) suggesting that during certain times of the year the lake may not be suitable for recreation. Olson Lake had high concentrations of phosphorus, which in turn causes high Chl-a concentrations and nuisance algal blooms. Land use within Olson Lake's watershed is primarily contained within a federal Waterfowl Management Area and has a control structure on the outlet to control water levels. Best land management practices need to be implemented to limit nutrient inputs into the lake. Internal loading is likely a significant source of nutrients in Olson Lake and needs to be addressed.

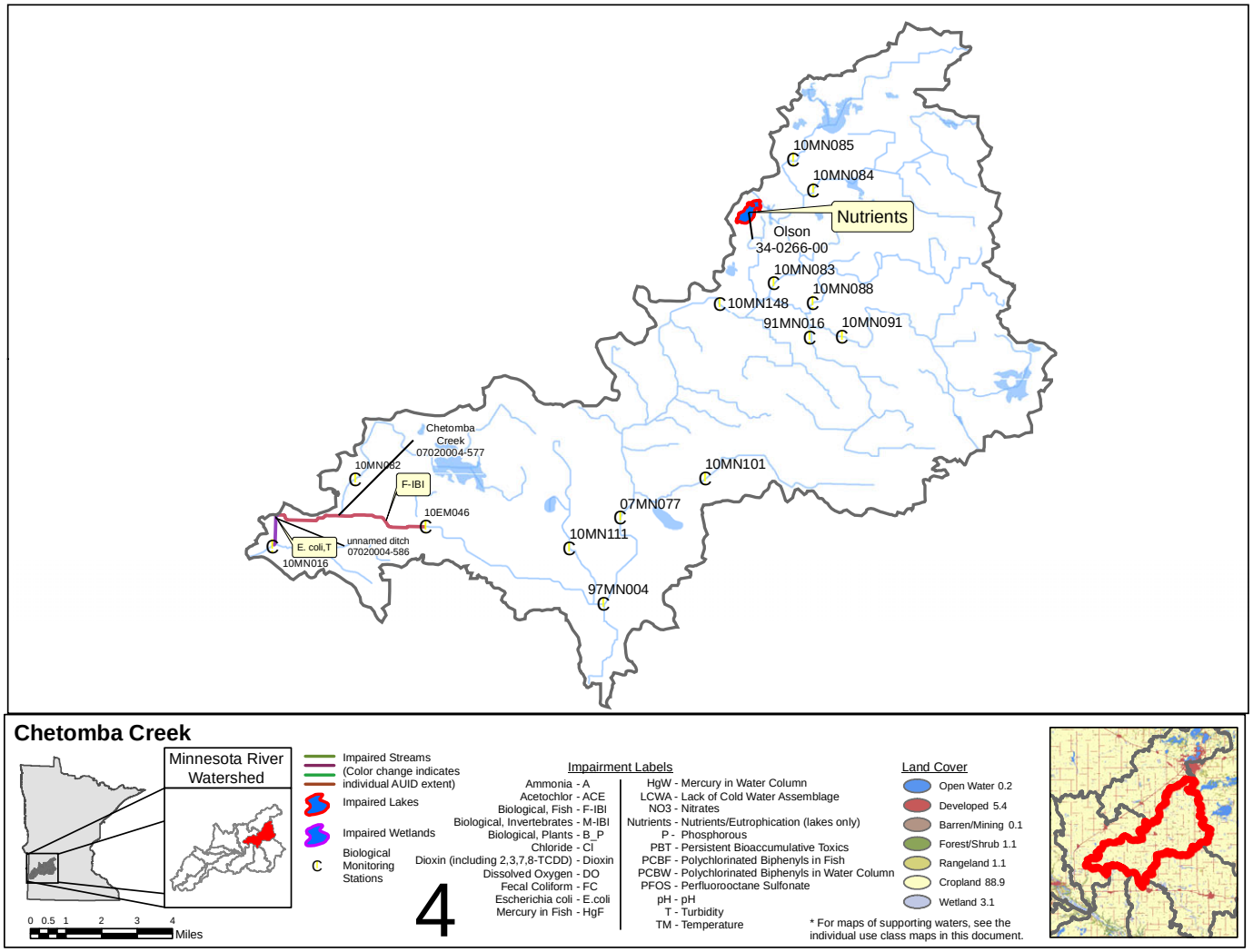

Figure 22. Currently listed impaired waters by parameter and land use characteristics in the Chetomba Creek Watershed Unit

Lower Hawk Creek Watershed Unit HUC 0702000409

This watershed unit is a flow through subwatershed of Hawk Creek. The stream reaches in this watershed consist of both channelized and natural stream reaches that flow into the Minnesota River. The subwatershed is located in the center of the Minnesota River - Granite Falls HUC 8. This 158 square mile drainage area is comprised mainly of cropland and developed land. The towns of Crate, Clara City, Rheiderland, Stoneham, and Wang are located in this subwatershed. There are two outlet sites that were sampled intensively for water chemistry. Two stations were selected for intensive watershed monitoring in this subwatershed on Hawk Creek. The first station (97MN006) was located upstream of the confluence of Chetomba Creek. The other station (10MN005) was located downstream of the confluence with Chetomba Creek, but before the confluence of the Minnesota River. In addition to Hawk Creek, this watershed includes County Ditch 36, County Ditch 37, Judicial Ditch 2, County Ditch 11, and a few unnamed tributaries. A monitoring site on Hawk Creek has been selected to be a part of the WPLMN program where intensive long-term stream chemistry monitoring will occur every year beginning in 2013. All stream reaches are designated as warmwater in this subwatershed unit. No lakes were sampled in this subwatershed unit.

Table 51. Aquatic life and recreation assessments on stream reaches: Lower Hawk Creek Watershed Unit.

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.
					Fish IBI	Invert IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides			
07020004-510, Hawk Creek, T117 R37W S6, north line to Chetomba Cr	10.45	2B, 3C	03MN016 10MN133 10MN031	1 mi. S.W. of Clara City, downstream of 100th St. S.E. Upstream of 40th St, in Clara City Downstream of CR 4 (Vardis St), at Lions Park, in Maynard			--	EXS		--	--			IF	NA
07020004-568, Hawk Creek, Unnamed cr to Unnamed cr	1.2	2B, 3C	97MN006	near Maynard, MN			IF	EXS	MTS	MTS	IF		EX	NS	NS
07020004-587, Hawk Creek, Spring Cr to Minnesota R	15.63	2B, 3C	10MN122 90MN017	Upstream of 840th Ave, 3 mi. E of Granite Falls Upstream of 822nd Ave, 4 mi west of Sacred Heart	MTS	MTS	IF	EXS	MTS	MTS	MTS		EX	NS	NS

07020004-716, County Ditch 36, Unnamed cr to Hawk Cr	1.41	2B, 3C	10MN144	Upstream of 110th St, 2 mi. E of Granite Falls	EXS	EXP	--	--		--				NS	NA
07020004-689, County Ditch 11, Unmnamed ditch to Hawk Cr	1.12	2B, 3C	10MN032	Upstream of CR 17, 0.5 mi. W of Maynard			IF	EXS		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: = existing impairment, listed prior to 2012 reporting cycle; = new impairment; = full support of designated use.

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

Table 52. Non-assessed biological stations on channelized AUIDs in the Lower Hawk Creek 10-HUC

AUID ***Reach Name,*** *Reach Description*	**Reach Length (miles)**	**Use Class**	**Biological Station ID**	**Location of Biological Station**	**Fish IBI**	**Invert IBI**
07020004-568, Hawk Creek, Unnamed cr to Unnamed cr	1.2	2B, 3C	97MN006	near Maynard, MN	good	poor
07020004-689, County Ditch 11, Unmnamed ditch to Hawk Cr	1.12	2B, 3C	10MN032	Upstream of CR 17, 0.5 mi. W of Maynard	good	poor
07020004-725, Unnamed ditch, Unnamed ditch to CD 11	0.13	2B, 3C	10MN138	Downstream of 70th St SE, W of CR 4, 1 mi. N of Maynard	poor	poor
07020004-731, Unnamed ditch, Unnamed ditch to JD 2	2.02	2B, 3C	10MN102	Upstream of 140th Ave, S of 40th St, 2 mi. E of Clara City	poor	poor
07020004-730, Judicial Ditch 2, Unnamed ditch to Unnamed ditch	3.64	2B, 3C	10MN103	Upstream of 140th Ave, N of 40th St, 2 mi. E of Clara City	poor	poor
07020004-724, County Ditch 37, Headwaters to Hawk Cr	4.68	2B, 3C	10MN137	Downstream of 90th St, 1 mi. SW of Maynard	fair	poor

Table 53. Minnesota Stream Habitat Assessment (MSHA): Lower Hawk Creek 10-HUC

# Visits	Biological Station ID	Reach Name	Land Use (0-5)	Riparian (0-15)	Substrate (0-27)	Fish Cover (0-17)	Channel Morph. (0-36)	MSHA Score (0-100)	MSHA Rating
2	10MN032	County Ditch 11	0	7.5	9.5	6	5.5	28.5	poor
1	10MN102	Trib. to Judicial Ditch 2	0	8	9	1	4	22	poor
1	10MN103	Judicial Ditch 2	0	8	9	12	7	36	poor
1	10MN133	Hawk Creek	0	8.5	18.2	6	12	44.7	poor
1	10MN137	County Ditch 37	0	9	8.5	13	7	37.5	poor
2	10MN138	Trib. to County Ditch 11	0	8	9	11	12	40	poor
1	10MN144	County Ditch 36	0	11.5	13.75	15	22	62.25	fair
1	97MN006	Hawk Creek	0	8	20.8	6	21	55.8	fair
1	90MN017	Hawk Creek	0	8	19	15	25	67	good
1	10MN122	Hawk Creek	0	9.5	18.4	10	20	57.9	fair

Qualitative habitat ratings

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

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

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

Table 54. Channel Condition and Stability Assessment (CCSI): Lower Hawk Creek 10- HUC.

# Visits	Biological Station ID	Stream Name	Upper Banks (43-4)	Lower Banks (46-5)	Substrate (37-3)	Channel Evolution (11-1)	CCSI Score (137-13)	CCSI Rating
04-Aug-10	10MN032	County Ditch 11	17	8	19	1	45	fairly stable
11-Aug-10	10MN102	Trib. to Judicial Ditch 2	21	12	28	3	64	moderately unstable
11-Aug-10	10MN103	Judicial Ditch 2	31	16	24	3	74	moderately unstable
02-Aug-10	10MN122	Hawk Creek	21	22	7	1	51	moderately unstable
04-Aug-10	10MN137	County Ditch 37	13	4	17	3	37	fairly stable
04-Aug-10	10MN138	Trib. to County Ditch 11	29	22	26	7	84	severely unstable
02-Aug-10	10MN144	County Ditch 36	16	6	11	3	36	fairly stable
10-Aug-10	90MN017	Hawk Creek	13	12	9	5	39	fairly stable
04-Aug-10	97MN006	Hawk Creek	24	18	9	7	58	moderately unstable

Qualitative channel stability ratings

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

Table 55. Outlet water chemistry results for Hawk Creek in the Lower Hawk Creek HUC 10

Station location:	**Hawk Creek at CR 52, 6.5 mi. SE of Granite Falls**							
STORET/EQuIS ID:	**S002-012**							
Station #:	**10MN005**							
Parameter	**Units**	**# of Samples**	**Minimum**	**Maximum**	**Mean**	**Median**	**WQ Standard[1]**	**# of WQ Exceedances[2]**
Escherichia coli	MPN/100ml	0					1260.0	0
Ammonia-nitrogen	mg/l	1	0.16	0.16	0.16	0.16		
Inorganic nitrogen (nitrate and nitrite)	mg/l	10	1.26	15.40	7.50	6.63		
Kjeldahl nitrogen	mg/l	10	0.8	3.4	1.7	1.7		
Phosphorus	ug/l	10	132.0	476.0	271.1	261.5		
Orthophosphate	ug/l	2	77.0	115.0	96.0	96.0		
Total suspended solids	mg/l	10	4.0	119.0	37.1	34.5		
Total volatile solids	mg/l	10	2.0	17.0	6.7	6.0		
Hardness, carbonate	mg/l	10	375.0	741.0	588.8	616.0		
Calcium	mg/l	10	84.3	154.0	123.3	124.5		
Magnesium	mg/l	10	39.9	88.6	68.2	71.4		
Chloride	mg/l	10	19.1	72.5	39.7	35.1	230.0	0
Sulfate	mg/l	10	137.0	325.0	238.4	253.0		
Specific conductance	uS/cm	16	736.0	1319.0	1069.4	1102.5		
pH	--	16	7.9	8.6	8.3	8.3	6.5-9.0	0
Dissolved oxygen (DO)	mg/l	16	8.0	13.5	10.0	9.2	5.0	0
Temperature, water	deg C	16	11.2	27.2	20.6	21.1		
Turbidity	NTRU	16	3.9	134.0	41.6	31.3	25.0 NTU	9
Transparency, tube with disk	cm	16	7.0	100.0	32.1	21.0		

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

Table 56. Outlet water chemistry results for Hawk Creek in the Lower Hawk Creek HUC 10

Station location:	**Hawk Creek at HWY 23, 2 mi. S of Maynard**							
STORET/EQuIS ID:	**S002-148**							
Station #:	**97MN006**							
Parameter	**Units**	**# of Samples**	**Minimum**	**Maximum**	**Mean**	**Median**	**WQ Standard[1]**	**# of WQ Exceedances[2]**
Escherichia coli	MPN/100ml	0					1260.0	0
Ammonia-nitrogen	mg/l	10	0.16	0.16	0.16	0.16		
Inorganic nitrogen (nitrate and nitrite)	mg/l	10	2.23	12.60	6.34	5.58		
Kjeldahl nitrogen	mg/l	10	0.9	4.3	1.8	1.7		
Phosphorus	ug/l	10	164	744	332	320		
Orthophosphate	ug/l	0						
Total suspended solids	mg/l	10	7	60	34	40		
Total volatile solids	mg/l	10	2	14	6	6		
Hardness, carbonate	mg/l	10	373	741	586	615		
Calcium	mg/l	10	82	152	121	127		
Magnesium	mg/l	10	41	88	69	71		
Chloride	mg/l	10	18	65	43	40	230.0	0
Sulfate	mg/l	10	134	316	232	240		
Specific conductance	uS/cm	16	713	1327	1075	1116		
pH	--	16	7.7	8.6	8.1	8.1	6.5-9.0	0
Dissolved oxygen (DO)	mg/l	16	6.1	13.1	9.0	8.6	5.0	0
Temperature, water	deg C	16	10.6	26.4	20.3	20.9		
Turbidity	NTRU	16	5.8	70.5	36.0	35.3	25.0 NTU	12
Transparency, tube with disk	cm	16	11	68	27	20		

[1]Total suspended solids and transparency tube standards are surrogate standards derived from the turbidity standard of 25.
[2]Represents exceedances of individual maximum standard for E. coli (1260/100ml)

Summary

Of the nine stations sampled for invertebrates in the subwatershed, only three were assessable. Two were on the Hawk Creek mainstem, and one on a small, mainstem tributary. These reaches were located in the lower portions of the subwatershed, near the confluence with the Minnesota River. Hawk Creek increases in gradient as it nears the Minnesota River, and the surrounding land use becomes increasingly forested. The two stations on Hawk Creek both had wooded riparian zones with high quality, diverse invertebrate habitat. These stations also had poor water quality conditions, including relatively high Total Suspended Solids, and nitrogen. Despite this, these stations had M-IBI scores above the warmwater threshold. The small tributary, County Ditch 36, scored below the threshold. The six non-assessable reaches in the upper half of the watershed all had M-IBI scores below the threshold, with poor modified stream ratings.

Stream water quality data were available for a reach of Hawk Creek from the headwaters to Chetomba Creek. This AUID is approximately one mile long. Water chemistry data were collected further upstream of site S002-012 in the Lower Hawk Creek watershed unit. Hawk Creek exceeded the standard for bacteria and was listed in 2006 and is considered impaired for aquatic recreation use. This impairment was based on five geometric mean exceedances and 15 individual samples that exceeded the water quality standard of 1260 MPN/100ml. Levels of bacteria in this reach were high, suggesting that recreational use is not recommended. The same reach is considered impaired for aquatic life use based on an existing turbidity impairment from 2006. Dissolved oxygen flux could be an issue as indicated by the maximum D.O. value being over 12 mg/L. Biology was not assessed in the upstream portion of the subwatershed due to extensive channelization. Fish IBIs in the channelized headwater reaches had poor ratings. Invertebrate IBs were also rated poor throughout the watershed. Habitat quality improved moving downstream and channel stability is fair throughout the subwatershed. Excess sediment, and dense macrophytes and duckweed are abundant at sites through the watershed.

Stream water quality data were available for Hawk Creek from Chetomba Creek to the Minnesota River. This AUID is approximately 16 miles long. Water chemistry data were collected approximately 3 miles upstream of the confluence with the Minnesota River. Hawk Creek exceeded the standard for bacteria and was listed in 2010 and is considered impaired for aquatic recreation use. This impairment was based on four geometric mean exceedances and 15 individual samples exceeded the water quality standard of 1260 MPN/100ml. Levels of bacteria in this reach were high, suggesting that recreational use is not recommended. The same reach is considered impaired for aquatic life use based on an existing turbidity impairment from 2004. Fish and invertebrates were in good condition in this farthest downstream portion of Hawk Creek. Habitat scores were also good in this downstream reach compared to the poor habitat conditions upstream.

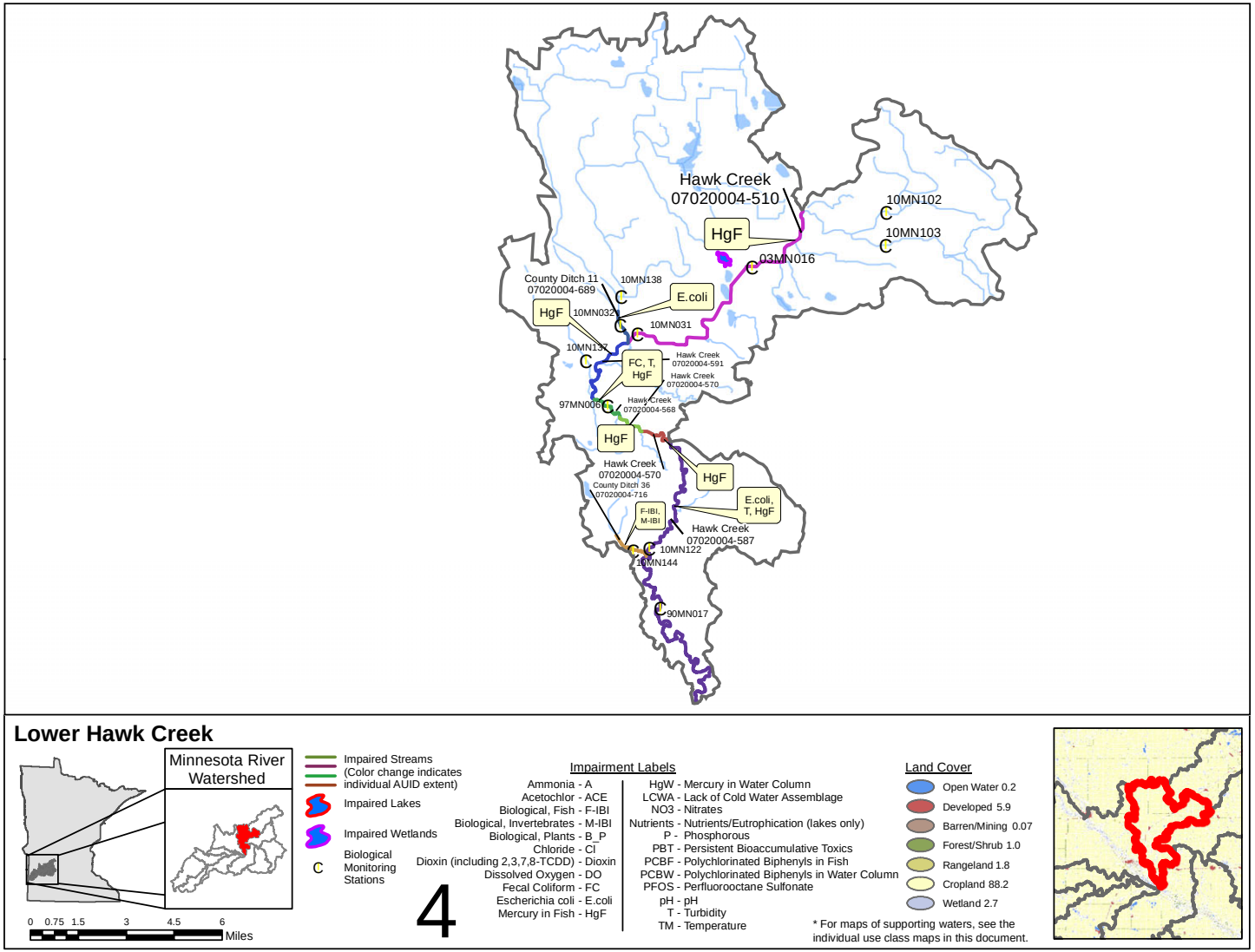

Figure 23. Currently listed impaired waters by parameter and land use characteristics in the Lower Hawk Creek Watershed Unit

Wood Lake Creek-Minnesota River Watershed Unit HUC 0702000410

This watershed unit is composed of smaller direct tributaries that flow into the Minnesota River. The streams in this subwatershed contain both channelized and natural stream reaches that flow from headwater lakes and wetlands into the Minnesota River. The subwatershed is located in the southern part of the Minnesota River - Granite Falls HUC 8. This 191 square mile drainage area is comprised mainly of cropland, wetland, and developed land. The towns of Wood Lake, Posen, Echo, Sioux Agency, Swedes Forest, Hawk Creek, and Sacred Heart are located in this subwatershed. Two stations (10MN013, Wood Lake Creek and 10MN008, Boiling Spring Creek) were selected for intensive watershed monitoring in this subwatershed. Additional streams in this subwatershed include County Ditch 119, County Ditch 116, County Ditch 2, Judicial Ditch 10, County Ditch 31, County Ditch 104 and a few unnamed tributaries. The upstream portions of Boiling Spring Creek are designated Class 7. The other stream reaches are designated warmwater in this subwatershed. Five lakes were sampled in this subwatershed.

Table 57. Aquatic life and recreation assessments on stream reaches: Wood Lake Creek-Minnesota 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.**
					Fish IBI	Invert IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides			
07020004-555, Boiling Spring Creek, T114 R37W S20, west line to Minnesota R	4.25	2C	10MN008	T114 R37W S20, west line to Minnesota R	MTS	MTS	IF	EXS	MTS	MTS	--		EX	IF	NS
07020004-566, Unnamed creek, Unnamed cr to Unnamed cr	2.96	2B, 3C	91MN050	Unnamed cr to Unnamed cr	EXS	EXS	--	--		--	--			NS	NA
07020004-684, County Ditch 116, Unnamed ditch to T115 R37W S8, east line	5.02	2B, 3C	10MN150	Unnamed ditch to T115 R37W S8, east line			--	IF		--				IF	NA
07020004-687, County Ditch 119, Unnamed ditch to Unnamed cr	2.85	2B, 3C	10MN140	Unnamed ditch to Unnamed cr	EXS	EXS	--	--		--				NS	NA

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.
					Fish IBI	Invert IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides			
07020004-717, County Ditch 2, Unnamed cr to Minnesota R	3	2B, 3C	10MN125	Unnamed cr to Minnesota R	EXS	MTS	--	--		--	--			NS	NA
07020004-718, Unnamed creek, Lone Tree Lk to Minnesota R	4.98	2B, 3C	10MN057	Lone Tree Lk to Minnesota R	EXS	EXP	--	--		--	--			NS	NA
07020004-547, Judicial Ditch 10 (Wood Lake Creek), Wood Lk outlet to Minnesota R	8.54	2C	10MN013 07MN069	Upstream of 600th St, 6 mi. N of Echo Downstream of 567th St, 3.5 mi NE of Wood Lake	EXS	EXS	IF	EXS	MTS	MTS	--		EX	NS	NS

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

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

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

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

Table 58. Non-assessed biological stations on channelized AUIDs in the Wood Lake Creek 10-HUC

AUID *Reach Name*, *Reach Description*	Reach Length (miles)	Use Class	Biological Station ID	Location of Biological Station	Fish IBI	Invert IBI
07020004-546, Judicial Ditch 10 (Wood Lake Creek), Timm Lk to Wood Lk outlet	15.45	2C	03MN049	@ Wood Lake (town)	poor	poor
07020004-547, Judicial Ditch 10 (Wood Lake Creek), Wood Lk outlet to	8.54	2C	07MN069	Downstream of 567th St, 3.5 mi NE of Wood Lake	poor	poor

AUID *Reach Name*, *Reach Description*	Reach Length (miles)	Use Class	Biological Station ID	Location of Biological Station	Fish IBI	Invert IBI
Minnesota R						
07020004-546, Judicial Ditch 10 (Wood Lake Creek), Timm Lk to Wood Lk outlet	15.45	2C	10MN126	Upstream of 567th St, 1 mi. NE of Wood Lake	poor	poor
07020004-737, County Ditch 31, Headwaters to JD 10	5.27	2B, 3C	10MN128	Upstream of 170th Ave, 1.5 mi. E of Woodlake	fair	poor
07020004-719, Unnamed creek, Unnamed cr to Minnesota R	6.05	2B, 3C	10MN139	Downstream of 180th St, 8 mi. N of Belview	good	fair
07020004-614, County Ditch 104, T115 R37W S7, west line to Minnesota R	7.79	7	10MN141	Upstream of 800th Ave, 3 mi. S of Sacred Heart	fair	poor
07020004-684, County Ditch 116, Unnamed ditch to T115 R37W S8, east line	5.02	2B, 3C	10MN150	Upstream of CR 9, 0.25 mi. SE of Sacred Heart	poor	poor
07020004-620, Boiling Spring Creek, Headwaters to T113 R38W S7, east line	1.55	2C	10MN151	Upstream of CSAH 1, 2 mi. W of Echo	poor	poor
07020004-546, Judicial Ditch 10 (Wood Lake Creek), Timm Lk to Wood Lk outlet	15.45	2C	10MN056	Downstream of 540th St, 2 mi. SW of Wood Lake	poor	poor
07020004-518, Judicial Ditch 10, Headwaters to Wood Lake Cr	3.5	2B, 3C	10MN129	Upstream of 530th St, 2 mi. SW of Wood Lake	poor	poor
07020004-554, Boiling Spring Creek, Unnamed lateral ditch to T114 R37W S19, east line	9.43	7	10MN146	Downstream of CR 1, 1.5 mi. W of Echo	poor	fair

Table 59. Minnesota Stream Habitat Assessment (MSHA): Wood Lake Creek 10-HUC.

# Visits	Biological Station ID	Reach Name	Land Use (0-5)	Riparian (0-15)	Substrate (0-27)	Fish Cover (0-17)	Channel Morph. (0-36)	MSHA Score (0-100)	MSHA Rating
2	03MN049	Judicial Ditch 10	0	8	12	14.5	10.5	45	fair
1	07MN069	Wood Lake Creek	0	9	14	6	11	40	poor
1	10MN008	Boiling Spring Creek	1.25	4	15.3	8	24	52.55	fair
2	10MN013	Judicial Ditch 10	0	6.75	18.6	13	22.5	60.85	fair
1	10MN056	Judicial Ditch 10	0	6.5	4	13	7	30.5	poor
2	10MN057	Trib. to Minnesota River	0	3	12.85	11	10.5	37.35	poor
1	10MN125	County Ditch 2	2.5	12	19.1	13	29	75.6	good
1	10MN126	Judicial Ditch 10	0	3	9	6	10	28	poor
1	10MN128	County Ditch 31	0	8	14	14	12	47.75	fair
1	10MN129	Judicial Ditch 10	0	7.5	4	12	7	30.5	poor
2	10MN139	Trib. to Minnesota River	0	8.25	13.25	14	19.5	55	fair

# Visits	Biological Station ID	Reach Name	Land Use (0-5)	Riparian (0-15)	Substrate (0-27)	Fish Cover (0-17)	Channel Morph. (0-36)	MSHA Score (0-100)	MSHA Rating
1	10MN140	County Ditch 119	0	10.5	12.9	16	16	55.4	fair
1	10MN141	County Ditch 104	0	12	18.4	14	24	68.4	good
2	10MN146	Boiling Spring Creek	0	7	3.5	8	4	22.5	poor
1	10MN150	County Ditch 104	0	8	7	10	4	29	poor
1	10MN151	Boiling Spring Creek	0	8	4	6	4	22	poor
2	91MN050	Trib. to Minnesota River	0	10.5	13.425	11.5	19.5	54.925	fair

Qualitative habitat ratings

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

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

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

Table 60. Channel Condition and Stability Assessment (CCSI): Wood Lake Creek 10-HUC.

# Visits	Biological Station ID	Stream Name	Upper Banks (43-4)	Lower Banks (46-5)	Substrate (37-3)	Channel Evolution (11-1)	CCSI Score (137-13)	CCSI Rating
11-Aug-10	10MN008	Boiling Spring Creek	19	14	13	5	51	moderately unstable
05-Aug-10	10MN013	Judicial Ditch 10	28	24	16	11	79	moderately unstable
03-Aug-10	10MN056	Judicial Ditch 10	36	22	11	3	72	moderately unstable
10-Aug-10	10MN057	Trib. to Minnesota River	18	10	18	3	49	moderately unstable
05-Aug-10	10MN125	County Ditch 2	24	28	21	11	84	severely unstable

# Visits	Biological Station ID	Stream Name	Upper Banks (43-4)	Lower Banks (46-5)	Substrate (37-3)	Channel Evolution (11-1)	CCSI Score (137-13)	CCSI Rating
05-Aug-10	10MN126	Judicial Ditch 10	32	20	15	5	72	moderately unstable
05-Aug-10	10MN128	County Ditch 31	32	14	12	7	65	moderately unstable
03-Aug-10	10MN129	Judicial Ditch 10	29	12	13	3	57	moderately unstable
11-Aug-10	10MN139	Trib. to Minnesota River	25	18	9	5	57	moderately unstable
11-Aug-10	10MN140	County Ditch 119	16	8	11	4	39	fairly stable
10-Aug-10	10MN141	County Ditch 104	18	10	8	3	39	fairly stable
10-Aug-10	10MN146	Boiling Spring Creek	13	6	22	3	44	fairly stable
02-Aug-10	10MN150	County Ditch 104	26	5	26	3	60	moderately unstable
10-Aug-10	10MN151	Boiling Spring Creek	13	6	22	3	44	fairly stable
02-Aug-10	91MN050	Trib. to Minnesota River	16	17	26	3	62	moderately unstable

Qualitative channel stability ratings

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

Table 61. Outlet water chemistry results for Judicial Ditch 10 (Wood Lake Creek) in the Wood Lake Creek HUC 10

Station location:	**Judicial Ditch 10 (Wood Lake Creek) at 600th St. 6 mi. N of Echo**
STORET/EQuIS ID:	**S006-161**
Station #:	**10MN013**

Parameter	Units	# of Samples	Minimum	Maximum	Mean	Median	WQ Standard[1]	# of WQ Exceedances[2]
Escherichia coli	MPN/100ml	15	48.1	2419.6	384.8	162.4	1260.0	1
Ammonia-nitrogen	mg/l	10	0.16	0.16	0.16	0.16		
Inorganic nitrogen (nitrate and nitrite)	mg/l	10	3.35	16.20	11.12	11.45		
Kjeldahl nitrogen	mg/l	10	0.5	2.8	1.7	1.7		
Phosphorus	ug/l	10	54.0	336.0	171.0	179.5		

Station location:	Judicial Ditch 10 (Wood Lake Creek) at 600th St. 6 mi. N of Echo							
STORET/EQuIS ID:	S006-161							
Station #:	10MN013							
Parameter	**Units**	**# of Samples**	**Minimum**	**Maximum**	**Mean**	**Median**	**WQ Standard[1]**	**# of WQ Exceedances[2]**
Orthophosphate	ug/l	2	5.0	29.0	17.0	17.0		
Total suspended solids	mg/l	10	5.0	57.0	19.2	15.0		
Total volatile solids	mg/l	10	2.0	11.0	5.5	4.5		
Hardness, carbonate	mg/l	10	563.0	822.0	664.3	646.5		
Calcium	mg/l	10	116.0	168.0	134.6	131.0		
Magnesium	mg/l	10	65.2	97.7	79.7	78.9		
Chloride	mg/l	10	20.1	55.5	30.9	29.1	230.0	0
Sulfate	mg/l	10	258.0	391.0	323.8	316.5		
Specific conductance	uS/cm	19	1095.0	1500.0	1263.1	1263.0		
pH	--	19	7.9	8.4	8.1	8.2	6.5-9.0	0
Dissolved oxygen (DO)	mg/l	19	7.9	13.8	10.1	9.4	5.0	0
Temperature, water	deg C	19	9.4	25.9	19.5	20.4		
Turbidity	NTRU	19	3.8	40.0	15.7	11.8	25.0 NTU	4
Transparency, tube with disk	cm	19	20.0	92.0	49.1	45.0		

[1]Total suspended solids and transparency tube standards are surrogate standards derived from the turbidity standard of 25.
[2]Represents exceedances of individual maximum standard for E. coli (1260/100ml)

Table 62. Outlet water chemistry results for Boiling Spring Creek in the Wood Lake Creek HUC 10

Station location:	Boiling Spring Creek at Grandview Ave. 4.5 mi. N of Belview							
STORET/EQuIS ID:	S004-345							
Station #:	10MN008							
Parameter	**Units**	**# of Samples**	**Minimum**	**Maximum**	**Mean**	**Median**	**WQ Standard[1]**	**# of WQ Exceedances[2]**
Escherichia coli	MPN/100ml	15	146.7	1299.7	498.4	325.5	1260.0	1
Ammonia-nitrogen	mg/l	10	0.16	0.16	0.16	0.16		
Inorganic nitrogen (nitrate and nitrite)	mg/l	10	0.61	14.60	5.57	4.42		
Kjeldahl nitrogen	mg/l	10	1.0	5.5	2.2	1.9		
Phosphorus	ug/l	10	60.0	406.0	243.7	235.0		

Station location:	Boiling Spring Creek at Grandview Ave. 4.5 mi. N of Belview							
STORET/EQuIS ID:	S004-345							
Station #:	10MN008							
Parameter	**Units**	**# of Samples**	**Minimum**	**Maximum**	**Mean**	**Median**	**WQ Standard[1]**	**# of WQ Exceedances[2]**
Orthophosphate	ug/l	2	5.0	9.0	7.0	7.0		
Total suspended solids	mg/l	10	6.0	60.0	18.6	12.5		
Total volatile solids	mg/l	10	2.0	41.0	9.5	5.0		
Hardness, carbonate	mg/l	10	446.0	611.0	512.9	526.5		
Calcium	mg/l	10	71.9	137.0	102.6	108.5		
Magnesium	mg/l	10	59.1	68.4	62.4	61.8		
Chloride	mg/l	10	19.2	27.5	24.7	24.9	230.0	0
Sulfate	mg/l	10	180.0	304.0	229.8	225.5		
Specific conductance	uS/cm	19	921.0	1156.0	1019.7	1028.0		
pH	--	19	8.2	8.5	8.3	8.3	6.5-9.0	0
Dissolved oxygen (DO)	mg/l	19	8.8	13.2	10.1	9.8	5.0	0
Temperature, water	deg C	19	9.7	23.4	17.9	17.9		
Turbidity	NTRU	19	6.0	77.0	25.2	13.4	25.0 NTU	3
Transparency, tube with disk	cm	19	11.0	81.0	41.8	47.0		

[1]Total suspended solids and transparency tube standards are surrogate standards derived from the turbidity standard of 25.
[2]Represents exceedances of individual maximum standard for E. coli (1260/100ml)

Table 63. Lake assessment data for the Wood Lake Creek 10 HUC.

Lake ID	Lake Name	County	HUC-10	Ecoregion	Lake Area (ha)	Max Depth (m)	Mean Depth (m)	Watershed Area (ha)	% Littoral	Aquatic Recreation Use Support
42-0020-00	Lady Slipper	Lyon	0702000410	WCBP	106	2.7	1.4	599	100	NS
87-0016-00	Curtis	Yellow Medicine	0702000410	WCBP	178	1.8	1.1	2,453	100	NS
87-0017-00	Timm	Yellow Medicine	0702000410	WCBP	105	0.6	1*	795	100	IF
87-0019-00	Tyson	Yellow Medicine	0702000410	WCBP	73	2.3	1*	301	100	IF
87-0030-00	Wood	Yellow Medicine	0702000410	WCBP	196	2.6	1.9	2,469	100	NS

*Estimated mean depth

Summary

Similar to other subwatersheds in this region, the headwater streams above the river valley are predominately low gradient and have been highly channelized. Most of the riparian areas have been removed along these smaller headwater streams, and the in-stream habitat is very limited. These streams have not been assessed, but nonetheless every channelized stream in this subwatershed fell below the warmwater M-IBI threshold, and most of them had poor modified stream ratings. Most of these streams have very limited macroinvertebrate communities that appear similar to wetland communities. The preponderance of highly impaired headwater streams typically has an impact on downstream reaches, which was the case with some streams in this subwatershed. Of the 11 unassessable channelized stations in this watershed, nine had poor modified stream ratings, and two had fair ratings.

Stream reaches closer to the Minnesota River Valley tended to be higher gradient, with forested riparian areas, and more diverse in-stream habitats. The uppermost reach of Wood Lake Creek, as well as its headwaters, Judicial Ditch 10, was comprised of channelized streams. The lowermost reach has an intact riparian zone and diverse in-stream habitat, but it failed to meet the warmwater threshold due primarily to a highly agricultural upstream land use contributing high nutrients and excess sediment. Other reaches failing to meet warmwater criteria were also located primarily in the river valley, and had similar circumstances of highly modified and impaired headwaters contributing high nutrients and sediment.

The two streams in the subwatershed that were assessable and met warmwater criteria were also located in the more highly wooded area of the river valley, close to the Minnesota River. These streams also had impaired headwaters, but their high gradient nature, great instream habitat, and forested riparian areas were able to compensate for the poor contributing source water. Stream water quality data were available for a reach of Judicial Ditch 10 (Wood Lake Creek) from the Wood Lake Outlet to the Minnesota River. This AUID is approximately 9 miles long. Water chemistry data were collected approximately 2.5 miles upstream of the Minnesota River confluence. Judicial Ditch 10 exceeded the standard for bacteria and is considered impaired for aquatic recreation use. This impairment was based on three geometric mean exceedances and two individual samples exceeded the water quality standard of 1260 MPN/100ml. The same reach is considered impaired for aquatic life use based on both fish and invertebrates being impaired in the assessed portion of Judicial Ditch 10. Ratings in the upstream channelized sites for fish and invertebrates are poor. Habitat ratings are also poor. Channel stability is fair but there are signs excess sediment and eroding banks.

Stream water quality data were available for Boiling Spring Creek from T114 R37W S20, west line to the Minnesota River. This AUID is approximately four miles long. Water chemistry data were collected approximately 1 mile upstream of the Minnesota River confluence. Boiling Spring Creek exceeded the standard for bacteria and is considered impaired for aquatic recreation use. This impairment was based on three geometric mean exceedances and one individual sample exceeded the water quality standard of 1260 MPN/100ml. Fish and invertebrate IBIs in the assessable reach of Boiling Spring Creek were in support of aquatic life. Upstream portions of the reach are designated Class 7 where fish and invertebrates rated poor. Channel stability is good upstream and becomes less stable downstream. Turbidity is also an issue throughout this stream.

The remaining small direct tributaries to the Minnesota River are non-supporting for fish or invertebrates. The majority of the channelized reaches also rated poorly for fish and invertebrates. Excess nutrients, turbidity and E. coli are also problems in these smaller systems. Channel stability is fairly stable in these channelized systems. Habitat ranged from fair to poor.

Lakes in this region are typically shallow with watersheds that are dominated by cropland and pasture. Three lakes in the Wood Lake Creek watershed unit had sufficient data for aquatic recreation use assessment. Lady Slipper, Curtis, and Wood lakes were found to be impaired for aquatic recreation use (excess nutrients) suggesting that during certain times of the year the lakes may not be suitable for recreation. All three lakes had high concentrations of phosphorus, which in turn causes high Chl-a concentrations and nuisance algal blooms. Land use within these lakes' watersheds is almost entirely cropland. Best land management practices need to be implemented to limit nutrient inputs into these lakes. All three lakes are shallow and have significant internal loading of phosphorous which needs to be addressed. Two additional lakes had water quality data available but the data sets were not large enough for an assessment decision to be made resulting in an insufficient information designation (Table 63).

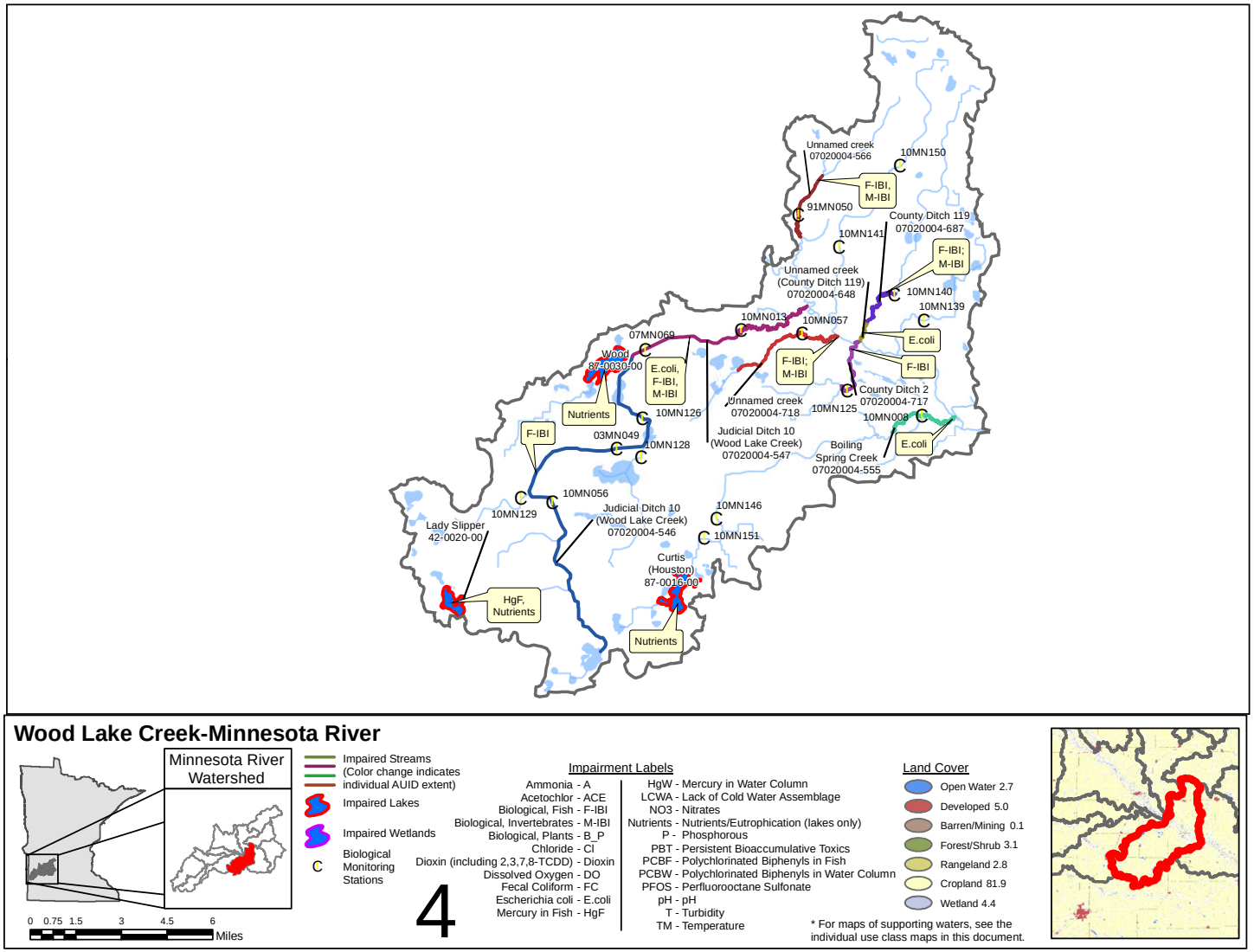

Figure 24. Currently listed impaired waters by parameter and land use characteristics in the Wood Lake Creek Watershed Unit

Beaver Creek Watershed Unit HUC 0702000411

This watershed unit is composed of tributaries that flow into Beaver Creek, which is a direct tributary to the Minnesota River. The headwater stream reaches in this subwatershed are mainly channelized and transition to natural stream before Beaver Creek flows to the Minnesota River. The subwatershed is located in the southeastern part of the Minnesota River - Granite Falls HUC 8. This 198 square mile drainage area is comprised mainly of cropland and developed land. The towns of Crooks, Winfield, Kingman, Bird Island, Olivia, Troy, Danube, Henryville, and Beaver Falls are located in this subwatershed. Three stations were selected for intensive watershed monitoring in this subwatershed. Two stations (10MN006, East fork Beaver Creek and 10MN152, West Fork Beaver Creek) were located upstream of where they combine to form Beaver Creek. The outlet of Beaver Creek (Station 92MN052) was located just upstream of the Minnesota River confluence. Tributary streams to West Fork Beaver Creek include County Ditch 37 (1), County Ditch 59 and County Ditch 17A. The only tributary to East Fork Beaver Creek is County Ditch 63. The upstream portions of East Fork Beaver Creek including County Ditch 63 are designated as Class7. The other stream reaches are designated as warmwater in this subwatershed. There were no sampled lakes in this subwatershed unit. Beaver Creek has been selected to be a part of the WPLMN program where intensive long-term stream chemistry monitoring will occur every year beginning in 2013.

Table 64. Aquatic life and recreation assessments on stream reaches: Beaver 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.
					Fish IBI	Invert IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides			
07020004-528, Beaver Creek, E Fk Beaver Cr to Minnesota R	13.29	2B, 3C	92MN052	Upstream of CR 2, in Beaver Falls	MTS	MTS	MTS	EXS	MTS	MTS	MTS		EX	NS	NS
07020004-530, Beaver Creek, West Fork, Headwaters to E Fk Beaver Cr	29.42	2B, 3C	10MN152	Downstream of 320th St, 3.5 mi. NE of Bechyn			EXS	EXS	MTS	MTS	MTS		EX	IF	NS
			03MN018	8 mi. N. of Morton on CR 4, upstream of bridge											
			10MN033	Downstream of CR 59, 2 mi. NW of Danube											
			10MN107	Upstream of Hwy 71, 4 mi. NE of Danube											

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.
					Fish IBI	Invert IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides			
07020004-531, County Ditch 37 (1), Headwaters to W Fk Beaver Cr	4.1	2B, 3C	03MN017	Downstream of North/South road, 2.5 mi. E of Renville			EXS	MTS		MTS				IF	NA
07020004-677, County Ditch 59, Unnamed cr to W Fk Beaver Cr	5.17	2B, 3C	10MN113	Upstream of 280th St, 1 mi. NW of Danube			EXS	IF		--	--			IF	NA
07020004-678, County Ditch 17A, Unnamed ditch to W Fk Beaver Cr	1.61	2B, 3C	10MN110	Upstream of CR 11, 4 mi. NE of Renville			--	IF		--				IF	NA
07020004-586, Beaver Creek, East Fork, T115 R35W S35, north line to W Fk Beaver Cr	8.4	2B, 3C	10MN115 10MN020 10MN006	Upstream of CR 62 (770th Ave), 10 mi. N of Morton Downstream of CR 17, 3 mi. S of Olivia Upstream of CR 4, 6.5 mi. S of Olivia	EXP	EXS	IF	EXS	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: = existing impairment, listed prior to 2012 reporting cycle; = new impairment; = full support of designated use.

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

Table 65. Non-assessed biological stations on channelized AUIDs in the Beaver Creek 10-HUC

AUID ***Reach Name,*** *Reach Description*	Reach Length (miles)	Use Class	Biological Station ID	Location of Biological Station	Fish IBI	Invert IBI
07020004-530, Beaver Creek, West Fork, Headwaters to E Fk Beaver Cr	29.42	2B, 3C	03MN018	8 mi. N. of Morton on CR 4, upstream of bridge	fair	fair
07020004-586, Beaver Creek, East Fork, T115 R35W S35, north line to W Fk Beaver Cr	8.4	2B, 3C	10MN020	Downstream of CR 17, 3 mi. S of Olivia	poor	poor
07020004-530, Beaver Creek, West Fork, Headwaters to E Fk Beaver Cr	29.42	2B, 3C	10MN033	Downstream of CR 59, 2 mi. NW of Danube	fair	poor
07020004-678, County Ditch 17A, Unnamed ditch to W Fk Beaver Cr	1.61	2B, 3C	10MN110	Upstream of CR 11, 4 mi. NE of Renville	fair	poor
07020004-677, County Ditch 59, Unnamed cr to W Fk Beaver Cr	5.17	2B, 3C	10MN113	Upstream of 280th St, 1 mi. NW of Danube	fair	poor
07020004-721, County Ditch 110, Unnamed ditch to W Fk Beaver Cr	1.91	2B, 3C	10MN093	Downstream of CR 13, 3.5 mi. NE of Bechyn	fair	fair
07020004-530, Beaver Creek, West Fork, Headwaters to E Fk Beaver Cr	29.42	2B, 3C	10MN107	Upstream of Hwy 71, 4 mi. NE of Danube	poor	fair
07020004-531, County Ditch 37 (1), Headwaters to W Fk Beaver Cr	4.1	2B, 3C	03MN017	Downstream of North/South road, 2.5 mi. E of Renville	poor	poor

Table 66. Minnesota Stream Habitat Assessment (MSHA): Beaver Creek 10-HUC.

# Visits	Biological Station ID	Reach Name	Land Use (0-5)	Riparian (0-15)	Substrate (0-27)	Fish Cover (0-17)	Channel Morph. (0-36)	MSHA Score (0-100)	MSHA Rating
2	03MN017	County Ditch 37	1.125	7.25	5.5	5	7	25.875	poor
1	03MN018	Beaver Creek, West Fork	0	11	1	3	10	25	poor
1	07MN076	Beaver Creek, East Fork	0	8	15.1	11	15	49.1	fair
1	10MN006	Beaver Creek, East Fork	0	8.5	20.55	15	26	70.05	good
1	10MN019	Beaver Creek, East Fork	0	7.5	17.3	14	13	51.8	fair
1	10MN020	Beaver Creek, East Fork	0	7.5	18	11	17	53.5	fair
1	10MN033	Beaver Creek, West Fork	2	8.5	8	10	10	38.5	poor
1	10MN093	County Ditch 110	0	10.5	13.8	12	16	52.3	fair
1	10MN095	County Ditch 117	0	12.5	16	13	9	50.5	fair
1	10MN099	County Ditch 63	0	7	4	9	5	25	poor
1	10MN105	County Ditch 31	0	8	7	14	4	33	poor

# Visits	Biological Station ID	Reach Name	Land Use (0-5)	Riparian (0-15)	Substrate (0-27)	Fish Cover (0-17)	Channel Morph. (0-36)	MSHA Score (0-100)	MSHA Rating
1	10MN107	Beaver Creek, West Fork	0	7	19.75	10	22	58.75	fair
1	10MN110	County Ditch 17, Branch A	0	7	9	1	4	21	poor
1	10MN113	County Ditch 59	0	9.5	7	3	7	26.5	poor
1	10MN115	Beaver Creek, East Fork	0	7.5	9	6	4	26.5	poor
1	10MN152	Beaver Creek, West Fork	0	7.5	15	8	9	39.5	poor
2	92MN052	Beaver Creek	1	9.75	19.45	12	24	66.2	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 67. Channel Condition and Stability Assessment (CCSI): Beaver Creek 10 HUC.

# Visits	Biological Station ID	Stream Name	Upper Banks (43-4)	Lower Banks (46-5)	Substrate (37-3)	Channel Evolution (11-1)	CCSI Score (137-13)	CCSI Rating
24-Aug-10	10MN006	Beaver Creek, East Fork	17	16	8	4	45	moderately unstable
12-Aug-10	10MN019	Beaver Creek, East Fork	31	12	13	3	59	moderately unstable
12-Aug-10	10MN020	Beaver Creek, East Fork	33	14	16	3	66	moderately unstable
12-Aug-10	10MN033	Beaver Creek, West Fork	31	16	26	3	76	moderately unstable
25-Aug-10	10MN093	County Ditch 110	21	4	16	3	44	fairly stable

# Visits	Biological Station ID	Stream Name	Upper Banks (43-4)	Lower Banks (46-5)	Substrate (37-3)	Channel Evolution (11-1)	CCSI Score (137-13)	CCSI Rating
26-Aug-10	10MN099	County Ditch 63	24	12	19	1	56	moderately unstable
25-Aug-10	10MN105	County Ditch 31	26	14	22	3	65	moderately unstable
26-Aug-10	10MN107	Beaver Creek, West Fork	21	4	11	2	38	fairly stable
12-Aug-10	10MN110	County Ditch 17, Branch A	31	11	26	3	71	moderately unstable
25-Aug-10	10MN113	County Ditch 59	24	10	20	3	57	moderately unstable
09-Aug-10	92MN052	Beaver Creek	11	9	9	5	34	fairly stable

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

Table 68. Outlet water chemistry results for East Fork Beaver Creek in the Beaver Creek HUC 10

Station location:	**East Fork Beaver Creek at CR 4, 6.5 mi. S of Olivia**
STORET/EQuIS ID:	**S000-404**
Station #:	**10MN006**

Parameter	Units	# of Samples	Minimum	Maximum	Mean	Median	WQ Standard[1]	# of WQ Exceedances[2]
Escherichia coli	MPN/100ml	15	54.8	1046.2	305.7	248.1	1260.0	0
Ammonia-nitrogen	mg/l	10	0.16	0.16	0.16	0.16		
Inorganic nitrogen (nitrate and nitrite)	mg/l	10	2.54	16.50	7.55	5.68		
Kjeldahl nitrogen	mg/l	10	0.5	2.9	1.4	1.4		
Phosphorus	ug/l	10	87.0	342.0	194.3	198.0		
Orthophosphate	ug/l	2	32.0	61.0	46.5	46.5		
Total suspended solids	mg/l	10	2.0	29.0	14.1	15.0		
Total volatile solids	mg/l	10	2.0	6.0	3.7	3.5		
Hardness, carbonate	mg/l	10	357.0	660.0	534.0	521.5		
Calcium	mg/l	10	90.0	153.0	124.4	122.0		
Magnesium	mg/l	10	32.0	71.4	54.2	54.9		
Chloride	mg/l	10	14.8	39.0	31.1	32.3	230.0	0
Sulfate	mg/l	10	99.0	231.0	178.2	186.0		

Station location:	East Fork Beaver Creek at CR 4, 6.5 mi. S of Olivia							
STORET/EQuIS ID:	S000-404							
Station #:	10MN006							
Parameter	**Units**	**# of Samples**	**Minimum**	**Maximum**	**Mean**	**Median**	**WQ Standard[1]**	**# of WQ Exceedances[2]**
Specific conductance	uS/cm	19	722.0	1227.0	1023.8	1038.0		
pH	--	19	7.8	8.2	7.9	8.0	6.5-9.0	0
Dissolved oxygen (DO)	mg/l	19	6.6	14.6	9.0	8.4	5.0	0
Temperature, water	deg C	19	10.0	23.4	18.0	18.8		
Turbidity	NTRU	19	3.5	111.0	22.1	14.6	25.0 NTU	2
Transparency, tube with disk	cm	19	8.0	100.0	44.6	39.0		

[1]Total suspended solids and transparency tube standards are surrogate standards derived from the turbidity standard of 25.
[2]Represents exceedances of individual maximum standard for E. coli (1260/100ml)

Table 69. Outlet water chemistry results for West Fork Beaver Creek in the Beaver Creek HUC 10

Station location:	West Fork Beaver Creek at 320th St. 3.5 mi. NE of Bechyn							
STORET/EQuIS ID:	S006-138							
Station #:	10MN152							
Parameter	**Units**	**# of Samples**	**Minimum**	**Maximum**	**Mean**	**Median**	**WQ Standard[1]**	**# of WQ Exceedances[2]**
Escherichia coli	MPN/100ml	10	360.9	2419.6	803.6	461.8	1260.0	2
Ammonia-nitrogen	mg/l	10	0.16	0.16	0.16	0.16		
Inorganic nitrogen (nitrate and nitrite)	mg/l	10	2.09	14.20	7.22	6.64		
Kjeldahl nitrogen	mg/l	10	0.8	2.9	1.5	1.4		
Phosphorus	ug/l	10	59.0	346.0	207.7	206.0		
Orthophosphate	ug/l	0						
Total suspended solids	mg/l	10	8.0	62.0	32.9	36.0		
Total volatile solids	mg/l	10	2.0	13.0	6.2	4.5		
Hardness, carbonate	mg/l	10	382.0	640.0	557.8	578.0		
Calcium	mg/l	10	92.3	147.0	127.4	132.5		
Magnesium	mg/l	10	36.8	68.0	58.4	62.1		
Chloride	mg/l	10	15.1	38.9	30.2	31.2	230.0	0
Sulfate	mg/l	10	134.0	266.0	203.0	206.0		

Station location:	West Fork Beaver Creek at 320th St. 3.5 mi. NE of Bechyn							
STORET/EQuIS ID:	S006-138							
Station #:	10MN152							
Parameter	**Units**	**# of Samples**	**Minimum**	**Maximum**	**Mean**	**Median**	**WQ Standard[1]**	**# of WQ Exceedances[2]**
Specific conductance	uS/cm	17	768.0	1218.0	1086.8	1103.0		
pH	--	17	7.7	8.3	8.0	8.0	6.5-9.0	0
Dissolved oxygen (DO)	mg/l	17	5.4	12.4	8.4	7.8	5.0	0
Temperature, water	deg C	17	9.3	24.0	18.7	19.1		
Turbidity	NTRU	17	5.4	52.4	26.8	29.5	25.0 NTU	6
Transparency, tube with disk	cm	17	12.0	73.0	30.1	20.0		

[1]Total suspended solids and transparency tube standards are surrogate standards derived from the turbidity standard of 25.
[2]Represents exceedances of individual maximum standard for E. coli (1260/100ml)

Table 70. Outlet water chemistry results for Beaver Creek in the Beaver Creek HUC 10

Station location:	Beaver Creek at CR 2 in Beaver Falls							
STORET/EQuIS ID:	S000-666							
Station #:	92MN052							
Parameter	**Units**	**# of Samples**	**Minimum**	**Maximum**	**Mean**	**Median**	**WQ Standard[1]**	**# of WQ Exceedances[2]**
Escherichia coli	MPN/100ml	0					1260.0	0
Ammonia-nitrogen	mg/l	10	0.16	0.16	0.16	0.16		
Inorganic nitrogen (nitrate and nitrite)	mg/l	10	2.95	15.60	7.65	6.47		
Kjeldahl nitrogen	mg/l	10	0.5	3.0	1.3	1.2		
Phosphorus	ug/l	10	38.0	375.0	182.4	170.5		
Orthophosphate	ug/l	0						
Total suspended solids	mg/l	10	2.0	64.0	26.6	16.5		
Total volatile solids	mg/l	10	2.0	10.0	5.5	5.5		
Hardness, carbonate	mg/l	10	350.0	661.0	543.1	553.0		
Calcium	mg/l	10	86.6	147.0	124.0	125.5		
Magnesium	mg/l	10	32.6	71.5	56.7	58.2		
Chloride	mg/l	10	14.0	35.1	28.7	30.1	230.0	0
Sulfate	mg/l	10	110.0	231.0	179.5	182.5		

Station location:	Beaver Creek at CR 2 in Beaver Falls							
STORET/EQuIS ID:	S000-666							
Station #:	92MN052							
Parameter	**Units**	**# of Samples**	**Minimum**	**Maximum**	**Mean**	**Median**	**WQ Standard[1]**	**# of WQ Exceedances[2]**
Specific conductance	uS/cm	15	704.0	1171.0	1001.5	994.0		
pH	--	16	8.1	8.3	8.2	8.2	6.5-9.0	0
Dissolved oxygen (DO)	mg/l	16	8.4	12.2	9.7	9.5	5.0	0
Temperature, water	deg C	16	11.2	24.2	19.3	19.7		
Turbidity	NTRU	16	2.7	85.6	25.4	23.4	25.0 NTU	7
Transparency, tube with disk	cm	16	7.0	100.0	42.7	23.0		

[1]Total suspended solids and transparency tube standards are surrogate standards derived from the turbidity standard of 25.
[2]Represents exceedances of individual maximum standard for E. coli (1260/100ml)

Summary

The majority of stations in this subwatershed are channelized and non-assessable. Two stations had natural channels and were assessable, both of which were further down in the subwatershed. Site 10MN006, on the East Fork Beaver Creek near the confluence with the Beaver Creek mainstem, had an M-IBI score well below the threshold and lower confidence interval. The station had high gradient with relatively good habitat, yet had an invertebrate community dominated by tolerant caddisflies and mayflies, commonly found in high gradient reaches with high upstream agricultural land uses and high nutrients.

The lowermost station in this subwatershed on the mainstem of Beaver Creek (92MN052) had an MIBI score above the threshold and upper confidence interval. It is located near the confluence with the Minnesota River, in a high gradient, forested area of the Minnesota River Valley. The excellent in-stream habitat and wooded riparian area was extensive enough to create a recovery zone that allowed the invertebrate community to thrive despite the influence of upstream stressors.

Stream water quality data were available for the East Fork of Beaver Creek from T115 R35W S35, north line to the West Fork of Beaver Creek. This AUID is approximately 8 miles long. Water chemistry data were collected approximately 2 miles upstream of the Beaver Creek confluence. The East Fork of Beaver Creek exceeded the standard for bacteria and is considered impaired for aquatic recreation use. This impairment was based on six geometric mean exceedances and 27 individual samples exceeding the water quality standard of 1260 MPN/100ml. Levels of bacteria in this reach were high, suggesting that recreational use is not recommended. The same reach is considered impaired for aquatic life use based on invertebrates. Fish IBIs were meeting thresholds in the assessable reach of the East Fork of Beaver Creek. Upstream channelized reaches showed poor invertebrate ratings. Dense macrophytes and algae in the upstream reaches indicate nutrient issues in the subwatershed. Dissolved oxygen flux could be an issue as indicated by the maximum D.O. value being over 12 mg/L. Channel stability is moderately unstable throughout the subwatershed. Habitat condition is poor in the upstream channelized reach, but improved to good condition downstream where the stream channel is natural. Biology in East Fork Beaver Creek seems to follow the pattern of improved biology as habitat improves.

Stream water quality data were available for the West Fork of Beaver Creek from the headwaters to the East Fork of Beaver Creek. This AUID is approximately 29 miles long. Water chemistry data were collected approximately 2.75 miles upstream of the Beaver Creek confluence. The West Fork of Beaver Creek exceeded the standard for bacteria and was listed as impaired for aquatic recreation use in 2006. This impairment was based on six geometric mean exceedances and 27 individual samples exceeding the observed water quality standard of 1260 MPN/100ml. Levels of bacteria in this reach were high, suggesting that recreational use is not recommended. The same reach is considered impaired for aquatic life use based on low dissolved oxygen levels and an existing turbidity impairment from 2006. Dissolved oxygen flux could be an issue as indicated by the maximum D.O. value being over 12 mg/L. West Fork Beaver Creek was not assessed for biology due to channelization throughout the entire stream. Fish and invertebrate ratings for the channelized reaches were generally poor. Habitat is generally poor throughout the subwatershed. Channel stability was fair throughout the channelized stream. Excess sediment and nutrients also appear to be an issue in this part of the subwatershed.

Stream water quality data were available for Beaver Creek from the East Fork of Beaver Creek to the Minnesota River. This AUID is approximately 13 miles long. Water chemistry data were collected approximately two miles upstream of the Minnesota River confluence. Beaver Creek exceeded the standard for bacteria and was listed as impaired for aquatic recreation use in 2006. This impairment was based on five geometric mean exceedances and

21 individual samples exceeding the observed water quality standard of 1260 MPN/100ml. Levels of bacteria in this reach were high, suggesting that recreational use is not recommended. The same reach is considered impaired for aquatic life use based on an existing turbidity impairment from 2006. Dissolved oxygen flux could be an issue as indicated by the maximum D.O. value being over 12 mg/L. Both fish and invertebrates were in good condition in this natural stream reach. Channel stability and habitat were fair in this portion of the watershed. This stream reach is being impacted by the impaired and channelized tributary reaches upstream.

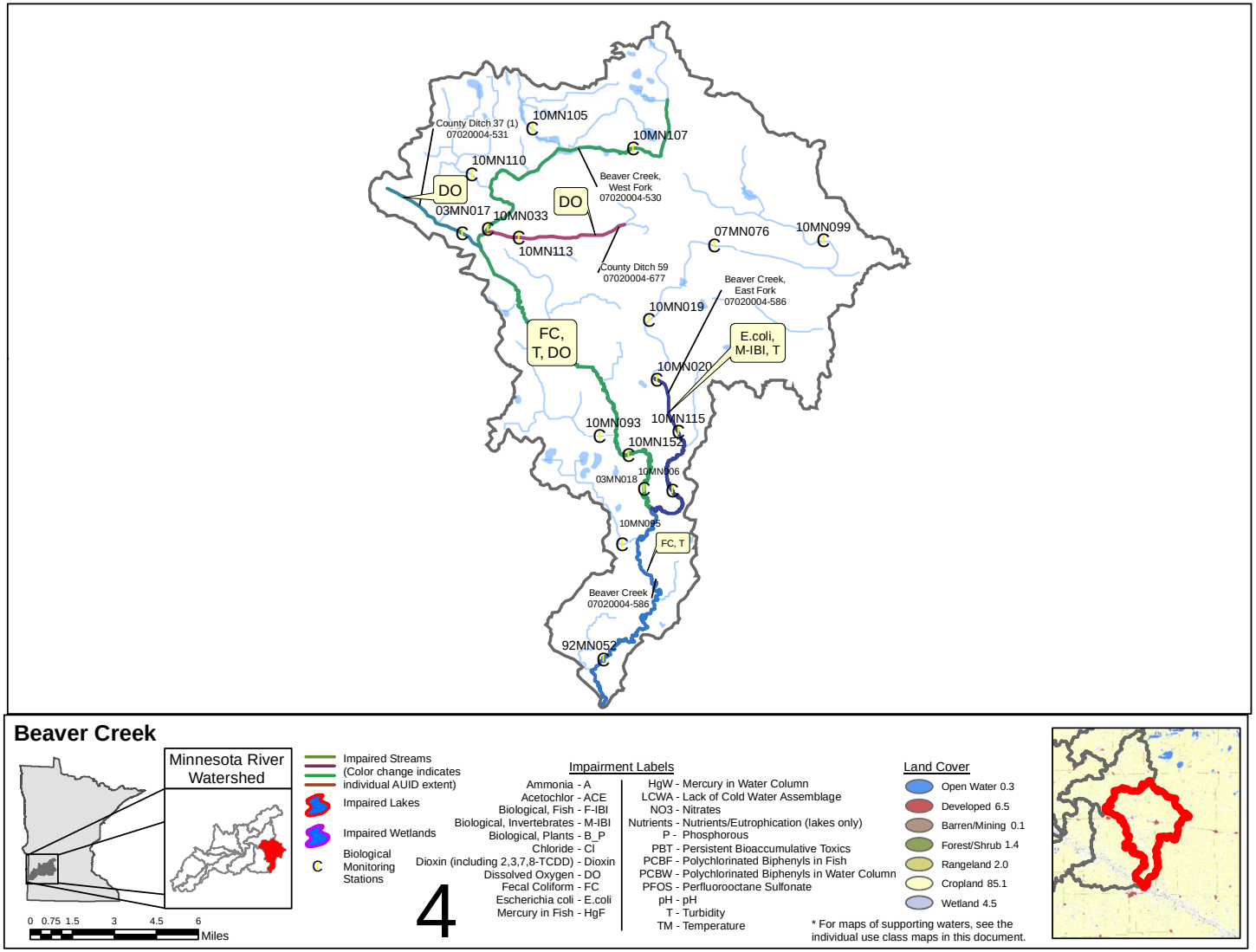

Figure 25. Currently listed impaired waters by parameter and land use characteristics in the Beaver Creek Watershed Unit

Sacred Heart Creek-Minnesota River Watershed Unit HUC 0702000412

This watershed unit is composed of smaller tributaries that flow directly to the Minnesota River. The headwater stream reaches in this watershed are a mix of channelized and natural streams that transition to natural streams before flowing into the Minnesota River. The subwatershed is located in the southeastern part of the Minnesota River - Granite Falls HUC 8. This 180 square mile drainage area is comprised mainly of cropland, but has a mix of wetland, forested and developed land. The towns of Renville, Emmet, Flora, Delhi, Kintire, and Belview are located in this subwatershed. The outlets of Timms Creek (station 10MN077), Sacred Heart Creek (station 10MN009) and County Ditch 12 (station 10MN018) were selected for intensive watershed monitoring in this subwatershed. County Ditch 45 is a tributary stream to Sacred Heart Creek. Other tributary streams to the Minnesota River in this subwatershed include County Ditch 12, Echo Creek, and Smith Creek. The upstream channelized portions of County Ditch 45 and County Ditch 12 are designated as Class7. The other stream reaches are designated as warmwater in this subwatershed. There were no sampled lakes in this subwatershed.

Table 71. Aquatic life and recreation assessments on stream reaches: Sacred Heart Creek-Minnesota 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.
					Fish IBI	Invert IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides			
07020004-525, Timms Creek, Headwaters to Minnesota R	16.33	2C	10MN077	Downstream of CR 15, 2.8 mi. NNE of Delhi	MTS	EXP	IF	EXS	MTS	MTS	MTS		EX	IF	NS
07020004-551, County Ditch 12, Headwaters to T113 R36W S8, north line	9.98	7	10MN135	Downstream of CR 9, 0.5 W of Delhi			IF		MTS	MTS	--		--		
07020004-552, County Ditch 12, T113 R36W S5, south line to Minnesota R	3.18	2B, 3C	10MN136	0.25 N of end of Justive Ave, 1 mi. NE of Delhi	EXP		--	--		--				FS	NA
07020004-604, Echo Creek, Unnamed cr to Minnesota R	6.52	2C	03MN057	1.5 mi. E of CR 19, 10 mi. NW of Redwood Falls	MTS		--	--		--	--			FS	NA

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.
					Fish IBI	Invert IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides			
07020004-617, Smith Creek (County Ditch 125A), T113 R35W S4, north line to Minnesota R	6.42	2C	10MN108	Upstream CR 15, 4 mi. NW of Beaver Falls	MTS	EXP	IF	MTS		MTS	--		EX	NS	NS
07020004-526, Sacred Heart Creek, Headwaters to Minnesota R	14.88	2B, 3C	10MN009 10MN021	Upstream of CR 15, 5.5 mi. N of Delhi Upstream of 770th Ave (CR 62), 6.5 mi. SW of Renville	EXP	EXP	EXS	EXS	MTS	MTS	MTS		EX	IF	NS
07020004-675, County Ditch 45, T114 R36W S7, north line to Sacred Heart Cr	3.69	2B, 3C	04MN003	0.5 mi. upstream of CSAH 15, 6 mi. N of Delhi	EXP	MTS	--	--	--	--				FS	NA
07020004-676, County Ditch 45, T115 R36W S7, east line to T114 R36W S6, south line	7.62	7	10MN092	Upstream of CR 62, 8 mi. N of Delhi			MTS		MTS	MTS	MTS		--		

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

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

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

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

Table 72. Non-assessed biological stations on channelized AUIDs in the Sacred Heart Creek 10-HUC

AUID ***Reach Name,*** *Reach Description*	Reach Length (miles)	Use Class	Biological Station ID	Location of Biological Station	Fish IBI	Invert IBI
07020004-676, County Ditch 45, T115 R36W S7, east line to T114 R36W S6, south line	7.62	7	10MN092	Upstream of CR 62, 8 mi. N of Delhi	good	fair
07020004-551, County Ditch 12, Headwaters to T113 R36W S8, north line	9.98	7	10MN135	Downstream of CR 9, 0.5 W of Delhi	good	fair

Table 73. Minnesota Stream Habitat Assessment (MSHA): Sacred Heart Creek-Minnesota River 10-HUC

# Visits	Biological Station ID	Reach Name	Land Use (0-5)	Riparian (0-15)	Substrate (0-27)	Fish Cover (0-17)	Channel Morph. (0-36)	MSHA Score (0-100)	MSHA Rating
3	03MN057	Echo Creek	3.3	13	18.6	11.7	25.3	71.9	fair
1	04MN003	County Ditch 45	5	14	19.8	12	28	78.8	good
1	10MN009	Sacred Heart Creek	2.5	15	21.8	13	30	82.3	good
1	10MN021	Sacred Heart Creek	1	4	22.8	15	30	72.8	good
1	10MN077	Timms Creek	5	11.5	17.4	10	32	75.9	good
1	10MN092	County Ditch 45	0	7.5	19.4	13	22	61.9	fair
1	10MN108	Smith Creek	2.5	10	16.7	11	20	60.2	fair
1	10MN135	County Ditch 12	0	8	4	12	7	31	poor
1	10MN136	County Ditch 12	0	5.5	21.5	7	24	58	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 74. Channel Condition and Stability Assessment (CCSI): Sacred Heart Creek 10 HUC

# Visits	Biological Station ID	Stream Name	Upper Banks (43-4)	Lower Banks (46-5)	Substrate (37-3)	Channel Evolution (11-1)	CCSI Score (137-13)	CCSI Rating
12-Aug-10	10MN009	Sacred Heart Creek	13	3	6	1	23	stable
12-Aug-10	10MN021	Sacred Heart Creek	11	10	13	3	37	fairly stable
11-Aug-10	10MN077	Timms Creek	13	4	4	1	22	stable
12-Aug-10	10MN092	County Ditch 45	25	12	13	3	53	moderately unstable
09-Aug-10	10MN108	Smith Creek	13	12	13	4	42	fairly stable
11-Aug-10	10MN135	County Ditch 12	15	10	13	3	41	fairly stable

■ = stable CCSI < 27; ■ = fairly stable 27 < CCSA < 45; ■ = moderately unstable 45 < CCSA < 80; ■ = severely unstable 80 < CCSI < 115; ■ = extremely unstable CCSI > 115

Table 75. Outlet water chemistry results for Sacred Heart Creek in the Sacred Heart Creek HUC 10

Station location:	**Sacred Heart Creek at CR 15, 5.5 mi. N of Delhi**
STORET/EQuIS ID:	**S001-341**
Station #:	**10MN009**

Parameter	Units	# of Samples	Minimum	Maximum	Mean	Median	WQ Standard[1]	# of WQ Exceedances[2]
Escherichia coli	MPN/100ml	0					1260.0	0
Ammonia-nitrogen	mg/l	8	0.16	0.16	0.16	0.16		
Inorganic nitrogen (nitrate and nitrite)	mg/l	10	1.18	11.70	6.45	6.25		
Kjeldahl nitrogen	mg/l	10	0.7	2.4	1.3	1.3		
Phosphorus	ug/l	10	197.0	1180.0	541.7	454.0		
Orthophosphate	ug/l	0						
Total suspended solids	mg/l	10	2.0	73.0	15.2	8.5		
Total volatile solids	mg/l	10	2.0	16.0	4.0	2.5		
Hardness, carbonate	mg/l	10	436.0	589.0	531.3	539.5		
Calcium	mg/l	10	97.2	129.0	115.3	117.5		
Magnesium	mg/l	10	47.5	75.8	59.1	58.6		

Station location:	Sacred Heart Creek at CR 15, 5.5 mi. N of Delhi							
STORET/EQuIS ID:	S001-341							
Station #:	10MN009							
Parameter	**Units**	**# of Samples**	**Minimum**	**Maximum**	**Mean**	**Median**	**WQ Standard[1]**	**# of WQ Exceedances[2]**
Chloride	mg/l	10	30.1	75.8	45.1	41.8	230.0	0
Sulfate	mg/l	10	106.0	190.0	150.8	152.5		
Specific conductance	uS/cm	16	833.0	1579.0	1056.3	1034.5		
pH	--	16	8.3	8.5	8.4	8.4	6.5-9.0	0
Dissolved oxygen (DO)	mg/l	16	9.4	13.5	10.4	10.1	5.0	0
Temperature, water	deg C	16	9.4	23.4	17.7	18.2		
Turbidity	NTRU	16	3.6	38.3	12.2	9.5	25.0 NTU	1
Transparency, tube with disk	cm	16	20.0	100.0	63.6	57.5		

[1]Total suspended solids and transparency tube standards are surrogate standards derived from the turbidity standard of 25.
[2]Represents exceedances of individual maximum standard for E. coli (1260/100ml)

Table 76. Outlet water chemistry results for Timms Creek in the Sacred Heart Creek HUC 10

Station location:	Timms Creek at CSAH 15, 2.8 mi. NNE of Delhi							
STORET/EQuIS ID:	S003-867							
Station #:	10MN077							
Parameter	**Units**	**# of Samples**	**Minimum**	**Maximum**	**Mean**	**Median**	**WQ Standard[1]**	**# of WQ Exceedances[2]**
Escherichia coli	MPN/100ml	0					1260.0	0
Ammonia-nitrogen	mg/l	10	0.16	0.16	0.16	0.16		
Inorganic nitrogen (nitrate and nitrite)	mg/l	10	0.58	21.50	12.98	16.05		
Kjeldahl nitrogen	mg/l	10	0.7	3.0	1.3	1.2		
Phosphorus	ug/l	10	16.0	164.0	81.3	87.5		
Orthophosphate	ug/l	0						
Total suspended solids	mg/l	10	3.0	26.0	8.7	5.0		
Total volatile solids	mg/l	10	2.0	4.0	2.5	2.0		
Hardness, carbonate	mg/l	10	524.0	715.0	606.7	590.5		
Calcium	mg/l	10	104.0	162.0	127.9	125.0		
Magnesium	mg/l	10	56.7	80.6	69.8	68.6		
Chloride	mg/l	10	24.2	37.4	31.4	31.1	230.0	0

Station location:	Timms Creek at CSAH 15, 2.8 mi. NNE of Delhi							
STORET/EQuIS ID:	S003-867							
Station #:	10MN077							
Parameter	**Units**	**# of Samples**	**Minimum**	**Maximum**	**Mean**	**Median**	**WQ Standard[1]**	**# of WQ Exceedances[2]**
Sulfate	mg/l	10	170.0	252.0	206.0	197.0		
Specific conductance	uS/cm	16	455.0	1312.0	1062.8	1078.5		
pH	--	16	8.3	8.6	8.4	8.4	6.5-9.0	0
Dissolved oxygen (DO)	mg/l	16	9.0	13.0	10.5	10.2	5.0	0
Temperature, water	deg C	16	9.4	23.0	16.9	17.4		
Turbidity	NTRU	16	1.4	24.8	9.6	7.0	25.0 NTU	0
Transparency, tube with disk	cm	16	20.0	100.0	69.6	65.5		

[1]Total suspended solids and transparency tube standards are surrogate standards derived from the turbidity standard of 25.
[2]Represents exceedances of individual maximum standard for E. coli (1260/100ml)

Table 77. Outlet water chemistry results for County Ditch 12 in the Sacred Heart Creek HUC 10

Station location:	County Ditch 12 at CR 6, 1 mi. N of Delhi							
STORET/EQuIS ID:	S006-160							
Station #:	10MN018							
Parameter	**Units**	**# of Samples**	**Minimum**	**Maximum**	**Mean**	**Median**	**WQ Standard[1]**	**# of WQ Exceedances[2]**
Escherichia coli	MPN/100ml	15	48.7	2419.6	471.2	285.1	1260.0	1
Ammonia-nitrogen	mg/l	10	0.16	0.16	0.16	0.16		
Inorganic nitrogen (nitrate and nitrite)	mg/l	10	0.88	16.60	10.46	13.60		
Kjeldahl nitrogen	mg/l	10	0.4	2.0	1.0	1.0		
Phosphorus	ug/l	10	39.0	696.0	196.0	116.5		
Orthophosphate	ug/l	2	12.0	73.0	42.5	42.5		
Total suspended solids	mg/l	10	2.0	11.0	5.4	5.5		
Total volatile solids	mg/l	10	2.0	5.0	2.6	2.0		
Hardness, carbonate	mg/l	10	482.0	576.0	511.6	499.5		
Calcium	mg/l	10	106.0	122.0	112.6	109.0		
Magnesium	mg/l	10	52.1	66.0	56.0	55.6		
Chloride	mg/l	10	25.7	89.1	36.0	28.6	230.0	0

Station location:	County Ditch 12 at CR 6, 1 mi. N of Delhi							
STORET/EQuIS ID:	S006-160							
Station #:	10MN018							
Parameter	**Units**	**# of Samples**	**Minimum**	**Maximum**	**Mean**	**Median**	**WQ Standard[1]**	**# of WQ Exceedances[2]**
Sulfate	mg/l	10	94.4	149.0	113.4	113.0		
Specific conductance	uS/cm	19	918.0	1204.0	1000.7	974.0		
pH	--	19	7.7	8.4	7.9	7.8	6.5-9.0	0
Dissolved oxygen (DO)	mg/l	19	5.3	14.2	9.0	9.4	5.0	0
Temperature, water	deg C	19	8.0	20.5	15.9	16.2		
Turbidity	NTRU	19	1.9	11.9	5.7	5.5	25.0 NTU	0
Transparency, tube with disk	cm	19	52.0	100.0	91.7	100.0		

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

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

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

Summary

The Sacred Heart Creek-Minnesota River subwatershed, much like other watersheds in this region, had healthier invertebrate communities and higher M-IBI scores in streams located in the higher gradient, wooded areas of the Minnesota River Valley. The lower reaches of Sacred Heart Creek (10MN009) and County Ditch 45 (04MN003) are adjacent to each other, and have excellent in-stream habitat with extensive wooded riparian areas. Both streams have relatively high diversity and abundance of moderately intolerant Ephemeroptera, Plecoptera and Trichoptera (EPT) taxa, despite having highly ditched and intensively farmed upstream watersheds. The upper station on Sacred Heart Creek (10MN021) was located at the top of wooded river valley, where the recovery zone contributing to the health 10MN009 begins. Just upstream of this reach the stream becomes channelized, with grazing and cropland adjacent to the stream; so despite being located in an a stream reach that appears healthy with good in-stream habitat and intact riparian zone, it is suffering from the impacts of the upstream land use, and is dominated by highly tolerant organisms common in low gradient streams or wetlands. Similar to 10MN021, Timm's Creek (10MN077) and Smith Creek (10MN108), were also both located in high gradient, wooded reaches of the River Valley, and they also had M-IBI scores below the threshold. These stations both had relatively healthy upstream wooded areas, but the majority of the upstream watersheds were channelized and contributing high levels of nutrients and sediment. Both sites were dominated by relatively tolerant Dipterans.

The upper reaches of this watershed were comprised of primarily non-assessable, channelized streams.

Stream water quality data were available for Sacred Heart Creek from the headwaters to the Minnesota River. This AUID is approximately 15 miles long. Water chemistry data were collected approximately 1/2 mile upstream of the Minnesota River confluence. Sacred Heart Creek exceeded the standard for bacteria and was listed as impaired for aquatic recreation use in 2010. This impairment was based on four geometric mean exceedances and nine

individual samples exceeded the observed water quality standard of 1260 MPN/100ml. Levels of bacteria in this reach were high, suggesting that recreational use is not recommended. The same reach is considered impaired for aquatic life use based on high turbidity and degraded invertebrate populations. Dissolved oxygen flux could be an issue as indicated by the maximum D.O. value being over 12 mg/L. Fish and invertebrates are impaired in Sacred Heart Creek, but impairment listing has been deferred due to channelization in the stream reach. Excess nutrients and the resulting algae are a problem. Fish sampled on County Ditch 45, a class 7 channelized reach, were found to have a good rating. Invertebrates were fair in County Ditch 45. Headwater areas of Sacred Heart Creek show reduced channel stability. The downstream portion of Sacred Heart Creek appears to be higher gradient and relatively stable. Habitat conditions were good in this subwatershed.

Stream water quality data were available for Timm's Creek from the headwaters to the Minnesota River. This AUID is approximately 16 miles long. Water chemistry data were collected approximately 1/2 mile upstream of the Minnesota River confluence. Timm's Creek exceeded the standard for bacteria and was listed as impaired for aquatic recreation use in 2010. This impairment was based on five geometric mean exceedances and 17 individual samples exceeded the observed water quality standard of 1260 MPN/100ml. Levels of bacteria in this reach were high, suggesting that recreational use is not recommended. The same reach is considered impaired for aquatic life use based on high turbidity and degraded invertebrate populations. Dissolved oxygen flux could be an issue as indicated by the maximum D.O. value being over 12 mg/L. Habitat measurements were good. Fish IBIs were in support of aquatic life. Stream channel stability was good in the sampled part of the stream as well, but upstream is extensively channelized.

Stream water quality data were available for County Ditch 12 from the headwaters to T113 R36W S8, north line. This AUID is approximately 10 miles long. Water chemistry data were collected approximately 3 miles upstream of the Minnesota River confluence. County Ditch 12 is a limited resource value water and indicates full support of the beneficial use; however, the final assessment for this stream segment is insufficient information (IF) at this time because of the limitations based on the designated use of this water. Fish IBI scores indicated support of aquatic life on the downstream non-class 7 portion of the stream. Habitat was poor to fair. Channel stability was fairly stable and was reflective of channelization upstream. Excess nutrients and sedimentation could be a problem at times. Dissolved oxygen flux could be an issue as indicated by the maximum D.O. value being over 12 mg/L. Upland areas appear to be heavily grazed pasture, and the stream has exposure to cattle trampling.

Smith Creek and Echo Creek are two smaller tributaries in this subwatershed. Fish IBI scores indicate support of aquatic life in both of these streams. Invertebrates IBI scores were not in support for aquatic life in Smith Creek and were not sampled in Echo Creek. Smith Creek is not always suitable for aquatic recreation as it is impaired due to E. coli; it is also channelized in the headwaters. Habitat is fair in each of these small streams. Channel stability was also fair.

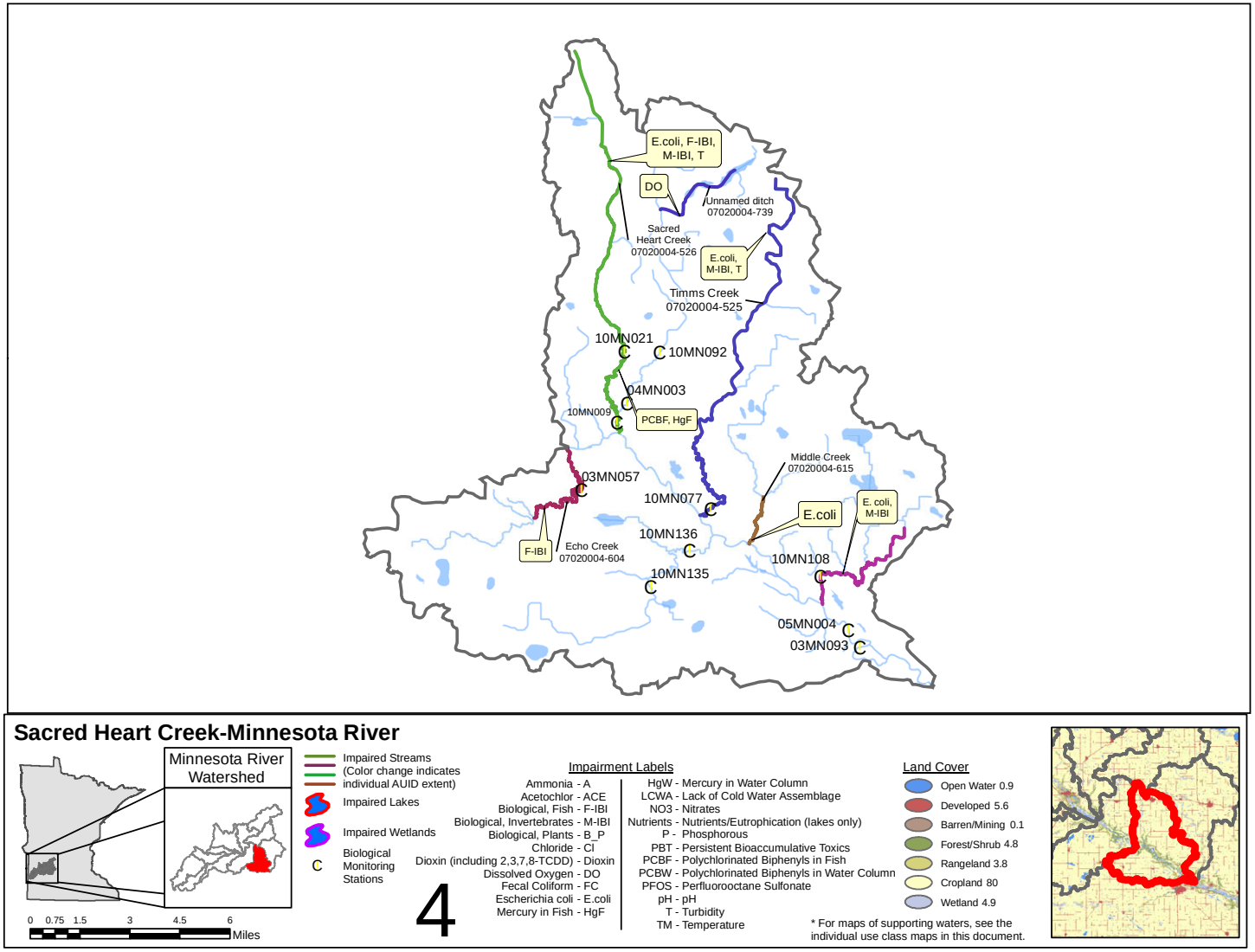

Figure 26. Currently listed impaired waters by parameter and land use characteristics in the Sacred Heart Creek Watershed Unit

VI. Watershed-wide results and discussion

Assessment results and data summaries are included below for the entire Minnesota River - Granite Falls Watershed, grouped by sample type. Summaries are provided for pollutant loads at two sites from major tributaries on either side of the Minnesota River (Yellow Medicine River near Granite Falls and Hawk Creek near Granite Falls), aquatic life and recreation uses in streams and lakes throughout the watershed, and for aquatic consumption results at select river and lake locations along the watershed.

Following the results are a series of graphics that provide an overall summary of assessment results by designated use, impaired waters, and fully supporting waters within the entire Minnesota River - Granite Falls Watershed.

Watershed pollutant load monitoring network

Hawk Creek near Granite Falls is monitored on County Road 52, approximately four river miles above the confluence with the Minnesota River. The Yellow Medicine River site is located on 560th Street, approximately eight river miles above the confluence with the Minnesota River. Many years of water quality data from throughout Minnesota, combined with previous analysis of Minnesota's ecoregion patterns, resulted in the development of three "River Nutrient Regions" (RNR), each with unique nutrient standards (MPCA, 2008). Of the state's three RNRs (North, Central, South), both of these monitoring stations are located within the South RNR.

Figures 27-30 display the annual flow weighed mean concentrations (FWMCs) for both sites, and compared to the RNR standards (only TP and TSS draft standards are available for the South RNR). It should be noted that while a FWMC exceeding given water quality standard is generally a good indicator that the water body is out of compliance with the RNR standard, the rule does not always hold true. Waters of the state are listed as impaired based on the percentage of individual samples exceeding the numeric standard, generally 10% and greater, over the most recent 10 year period and not based on comparisons with FWMCs (MPCA, 2012). A river with a FWMC above a water quality standard, for example, would not be listed as impaired if less than 10% of the individual samples collected over the assessment period were above the standard.

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

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

proportion of total annual runoff, concentrations of TSS and TP tend to be higher and DOP and nitrate-N concentrations tend to be lower. In contrast, during years with high snow melt runoff and less intense rainfall events, TSS levels tend to be lower while TP, DOP, and nitrate-N levels tend to be elevated.

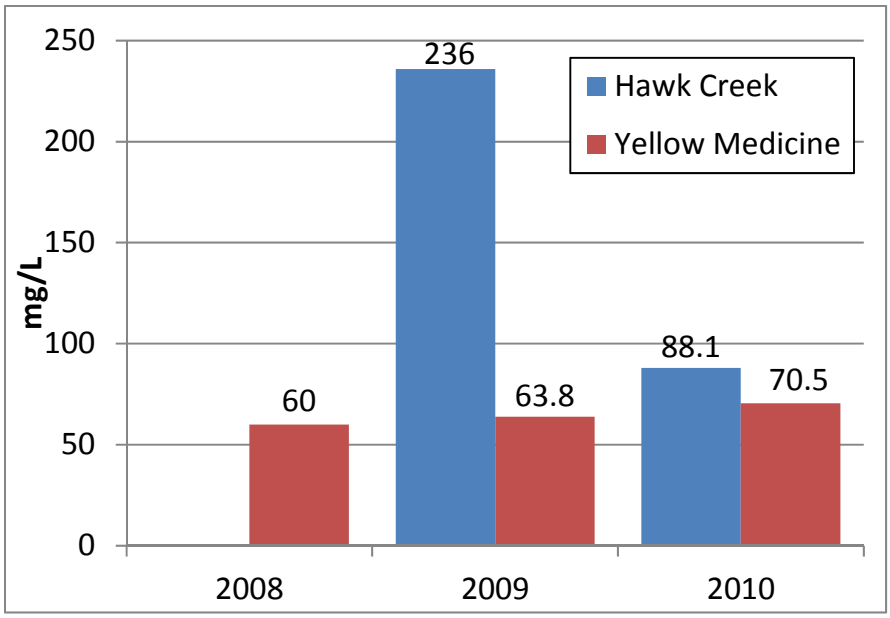

Figure 27. Total Suspended Solids (TSS) Flow Weighted Mean Concentrations

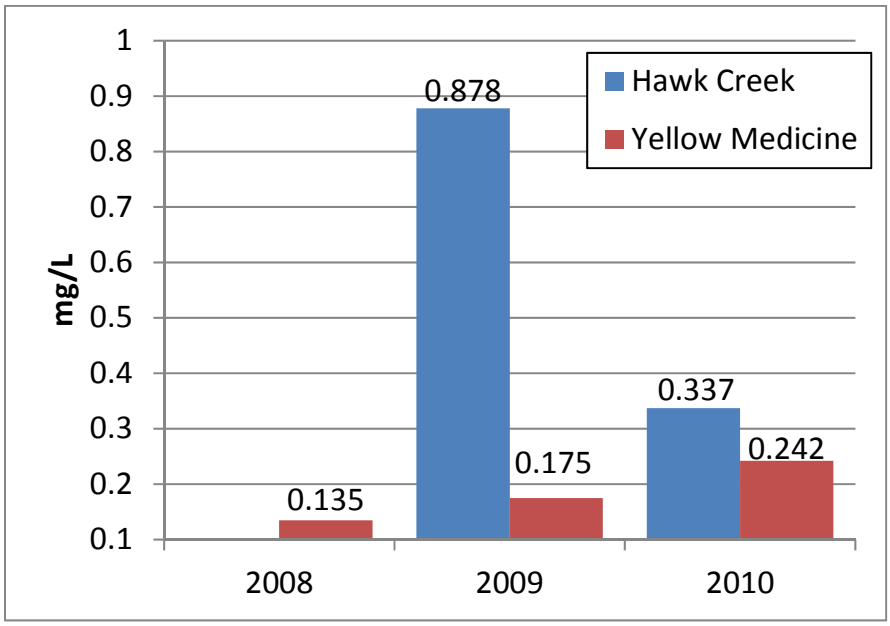

Figure 28. Total Phosphorus (TP) Flow Weighted Mean Concentrations

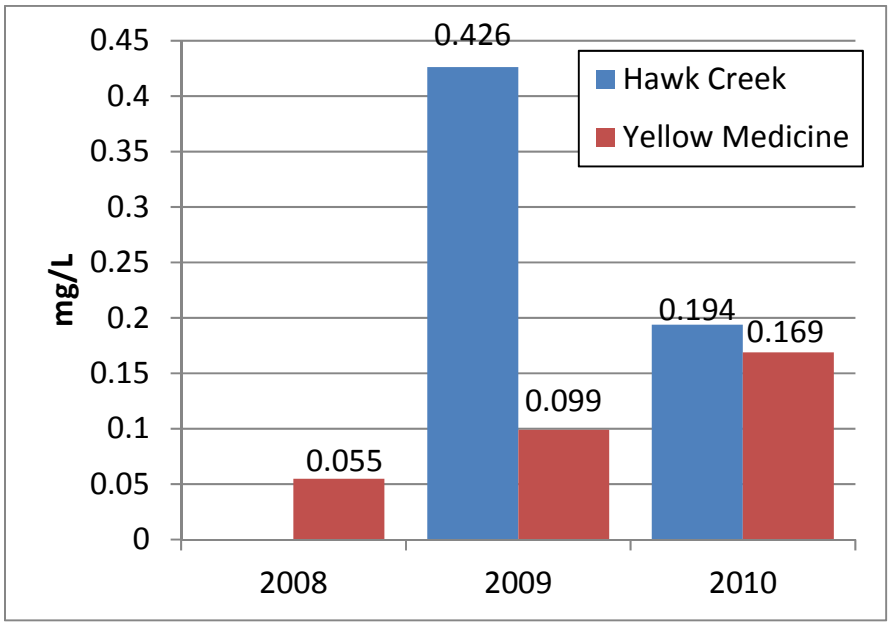

Figure 29. Dissolved Orthophosphate (DOP) Flow Weighted Mean

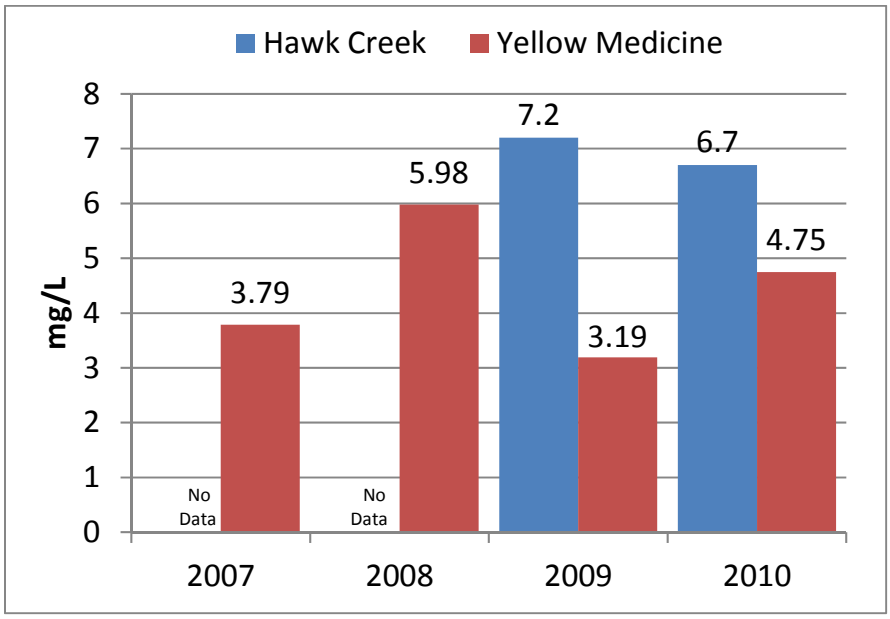

Figure 30. Nitrate + Nitrite Nitrogen (Nitrate-N) Flow Weighted Mean Concentrations

Table 78. Annual pollutant load mass (kg) by parameter

	2007		2008		2009		2010	
	Yellow Medicine River	Hawk Creek	Yellow Medicine River	Hawk Creek	Yellow Medicine River	Hawk Creek	Yellow Medicine River	Hawk Creek
TSS			7,494,896		5,352,815	26,040,970	43,212,043	41,983,550
TP			16,846		14,721	96,881	148,151	160,460
OP			6,953		8,312	47,030	103,598	92,520
Nitrate-N	628,527		746,839		267,628	794,626	2,911,279	3,193,372

Total Suspended Solids (TSS)

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

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

Currently, the state of Minnesota's TSS standards are considered to be draft standards until approved. Within the South RNR, the streams would be considered impaired when greater than 10% of the individual samples exceed the TSS draft standard of 65 mg/L. (MPCA, 2011). In 2009 and 2010, at the Hawk Creek site, 7.5% and 32% of the samples exceeded the 65 mg/L draft standard, respectively. In 2009, during snowmelt the Hawk Creek subwatershed received 1-3 inches of rain, causing severe overland runoff. The highest TSS concentration during this event was 1,010 mg/L. This single, extreme event was the only time that TSS concentrations exceeded the draft standard in 2009. In 2010, all of the TSS concentrations above 65 mg/L occurred in response to snowmelt and rainfall events throughout the season.

For the Yellow Medicine River, a similar trend was seen; 14% exceedances in 2008, 11% in 2009, and 39% in 2010. In 2008 and 2009, the computed annual FWMC did not exceed the 65 mg/L draft standard; there were only four and three samples, respectively, that exceeded the standard for the entire year. Alternatively, in 2010, there were several rain events for which 18 samples were above 65 mg/L, and in addition the FWMC exceeded the draft TSS standard. After a late June rainfall event, the TSS concentrations did not drop below the draft TSS standard for over one month. Table 72 displays the total annual loads which indicate TSS loads to be lowest in 2009, likely due to the lack of rainfall events.

Total Phosphorus

Nitrogen, phosphorus, and potassium are essential macronutrients and are required for growth by all animals and plants. Lack of sufficient nutrient levels in surface water often restricts the growth of aquatic plant species (University of Missouri Extension, 1999). In freshwaters such as lakes and streams, phosphorus is typically the nutrient limiting growth; increasing the amount of phosphorus entering a stream or lake will increase the growth of aquatic plants. Although phosphorus is a necessary nutrient, excessive levels overstimulate aquatic growth in lakes and

streams resulting in reduced water quality. The progressive deterioration of water quality from overstimulation of nutrients is called eutrophication where, as nutrient concentrations increase, the surface water quality is degraded (University of Missouri Extension, 1999). Elevated levels of phosphorus in rivers and streams can result in increased algae growth, reduced water clarity, reduced oxygen in the water, fish kills, altered fisheries, and toxins from cyanobacteria (blue green algae) which can affect human and animal health (University of Missouri Extension, 1999). In non-point source dominated watersheds, total phosphorus (TP) concentrations are strongly correlated with stream flow. During years of above average precipitation, TP loads are generally highest.

TP standards for Minnesota's rivers are considered draft standards until approved. Within the South RNR, the TP draft standard is 0.150 mg/L as a summer average. Summer average violations of one or more "response" variables (pH, biological oxygen demand, dissolved oxygen flux, chlorophyll-a) must also occur along with the numeric TP violation for the water to be listed. In 2009, all 40 samples collected on Hawk Creek were above 0.150 mg/L; this is likely to due to the city of Willmar wastewater facility discharging to Hawk Creek. In late 2009, a new wastewater facility became operational and by late 2010, total phosphorus concentrations dropped below the draft standard. For the Yellow Medicine River, during June through September, there were three exceedances in 2008 and no exceedances in 2009, but 100% of the samples (25) in 2010 exceeded the draft standard.

Figure 28 illustrates the FWMCs are greater than the draft standard at both sites for all years except at the Yellow Medicine River site in 2008. This dataset includes all data throughout the year (not just summer values). Table 72 shows annual loads, which exhibit similar traits as the FWMCs. It should be noted that the Yellow Medicine River saw a ten-fold increase in loads from 2009 to 2010, likely due to increased runoff volume (Figure 14).

Dissolved Orthophosphate

Dissolved Orthophosphate (DOP) is a water soluble form of phosphorus that is readily available for plant uptake (MPCA and MSUM, 2009). While orthophosphates occur naturally in the environment, river and stream concentrations may become elevated with additional inputs from wastewater treatment plants, noncompliant septic systems, and fertilizers in urban and agricultural runoff. At Hawk Creek, the DOP:TP ratio of FWMCs was 46% in 2009 and 57% in 2010. There were three DOP samples over 1 mg/L in 2009 and none in 2010. This may be related to flow volume; 2009 was a dry year compared to 2010 so the effects of the city of Willmar wastewater treatment facility were evident. At the Yellow Medicine River, the DOP:TP ratio was 41% in 2008, 57% in 2009 and 70% in 2010. Figure 29 and Table 72 show similar trends between years as seen in TP and TSS. This is not uncommon due to the relationship between DOP, TP and TSS.

Nitrate plus Nitrite - Nitrogen

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

contribute to hypoxia (low levels of dissolved oxygen) in the Gulf of Mexico. This occurs by nitrate-nitrogen stimulating the growth of algae which, through death and biological decomposition, consume large amounts of dissolved oxygen and thereby threaten aquatic life (MPCA and MSUM, 2009).

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

Figure 30 shows the nitrate-N FWMCs for Hawk Creek and the Yellow Medicine River. Both 2009 and 2010 nitrate-nitrogen FWMCs were above the draft chronic standard at Hawk Creek. The highest concentration collected was 19.0 mg/L on October 28, 2009 at Hawk Creek and 11.0 on June 13, 2010 at the Yellow Medicine River, both in response to rain events. For the Yellow Medicine River, only the 2008 FWMC was above the draft chronic standard nitrate-nitrogen. There were no exceedances of the draft acute standard at either site. Table 72 displays the annual loads which varied from year to year. From 2009 to 2010 at the Yellow Medicine River site, there was a 10-fold increase in nitrate-nitrogen. This may be related to the increase of runoff volume.

Stream water quality

Sixty-nine of the 143 stream AUIDs were assessed (**Table 51**); of the assessed streams only three stream AUIDs, all located on Stony Run Creek, were considered to be fully supporting of aquatic life. One stream AUID, located on the Lower Yellow Medicine River, was fully supporting of aquatic recreation. Twenty AUIDs were not assessed due to their classification as limited resource waters. Twenty-four AUIDS were not assessed for aquatic biology because greater than 50% of the AUID is channelized or the biological station fell on a channelized stream reach on the AUID. These AUIDs are currently deferred until Tiered Aquatic Life Use (TALU) criteria have been developed for assessment use on channelized .

Throughout the watersheds, 62 AUIDs are non-supporting of aquatic life, aquatic recreation, or both. Of those AUIDs, 40 are non-supporting of aquatic life and 50 are non-supporting of aquatic recreation. Four dissolved oxygen impairments were found throughout the watershed; however these impairments were located on channelized reaches and are deferred until TALU is implemented. No new turbidity impairments were found, however 10 turbidity impairments still exist from previous assessment prior to 2012.

Biological monitoring

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

Macroinvertebrates

The macroinvertebrate community in the Minnesota River - Granite Falls Watershed is largely reflective of the landscape surrounding each of the respective monitoring locations. Throughout the watershed, the presence of an intact riparian zone and diverse in-stream habitats had a significant, beneficial effect on the composition of the macroinvertebrate community. Most of the streams in the Minnesota River - Granite Falls Watershed flow through agricultural uplands, with sample stations being located in a mix of channelized and natural stream channels. The majority of stations sampled showed depressed M-IBI scores resulting from stresses related to a lack of riparian zone, dominant agricultural land use, and in-stream habitat alteration. Similar to other Minnesota watersheds containing large, mainstem rivers, small tributaries draining directly into the Minnesota River, as well as mainstem tributaries, show similar characteristics as they enter the Minnesota River Valley. As the gradient increase, the land becomes more difficult to farm, and artificial drainage and ditching become unnecessary, which leads to the presence of forested areas with predominately natural, meandering channels and higher quality in-stream habitats. The stations associated with these forested landscapes tended towards higher M-IBI scores, and were more likely to score above the impairment threshold. In some instances, despite the presence of high quality stream habitats and riparian conditions in the lower portions of the watershed, the upstream watersheds are so dominated by intense agricultural uses that the resulting hydrologic alterations and poor water quality conditions overwhelm the ability of the streams to recover, and poor M-IBI scores persist throughout.

The majority of streams sampled lacked sufficient flow and coarse substrates to be considered high-gradient, while the coarse substrate typical of high-gradient streams was present at one fourth of stations sampled. The lack of coarse substrate can have a significant effect on taxonomic composition, especially when substrates have been altered unnaturally due to habitat loss or sedimentation. Overall, 207 genera in 52 families of macroinvertebrates were collected in the Minnesota River - Granite Falls Watershed. The most commonly collected invertebrates in low gradient streams included snails in the genus Physa, mayflies in the genus Caenis, midges in the genera Thienemannimyia Gr. and Paratanytarsus, and sideswimmers, or scuds, in the genus Hyallela. Comparatively fewer in number, the taxa dominating the high gradient streams included midges in the genera Polypedilum and Cricotopus, caddisflies in the genus Cheumatopsyche, riffle beetles in the genera Dupiraphia and Stenelmis, and Physid snails.

Fish

Fish communities in the watershed are most heavily impacted in the warm headwaters branches of the Minnesota River - Granite Falls Watershed. These regions are commonly stressed by agricultural land use, homogenous in-stream habitat, channelization in the headwaters, and a lacking riparian zone. Invertebrate communities appear to show more acute sensitivity to stress

on the landscape within the Minnesota River - Granite Falls Watershed when compared to fish communities. This disparity in indicators is not a reason to put more stock in one indicator over another, rather it allows for a better understanding of whether impairments observed are a result of localized stress which fish are better equipped to flee from or if pollution is continuous in nature and limiting the establishment of a healthy fish community. High scores were seen in the sites least impacted by anthropogenic stress and in larger streams where habitat was available. Stations with the best F-IBI scores were observed in larger streams and rivers and direct tributaries to the Minnesota River where gradient is higher and the natural landscape has been less disturbed. These streams include subwatersheds including Sacred Heart Creek, Brafees Creek, Timms Creek, the South Branch and the mainstem of the Yellow Medicine River and Hawk Creek.

Historically, throughout the Minnesota River Basin, there have been 70 different species of fish sampled. Sixty-two of those species were sampled during monitoring efforts in the Minnesota River - Granite Falls Watershed. Some species were found at many sites in high densities, while other species were less dense and seen at few sites in limited quantities. The most commonly found fish species in the watershed was the creek chub, sampled at 69 sites, totaling 4,385 individuals. Other species that were commonly found in the watershed included central stonerollers and whitesucker, common shiners and johnny darters. A number of species were sampled at only one station and totaled only one individual: flathead catfish, pumpkin seed, sauger, and yellow bullhead. Additional game species captured included northern pike (28 stations), largemouth bass (20 stations), smallmouth bass (14 stations) and walleye (19 stations). A complete list of species sampled, quantities of stations they were observed at and total numbers of individuals sampled at each station can be found in Appendix 7.

Lake water quality

Forty-one lakes had water quality data available in the Minnesota River - Granite Falls Watershed. Seven lakes were found to be in full support of aquatic recreation, 14 were non-supporting, and 20 had insufficient data for aquatic recreations use assessment. The highest density of lakes in the Minnesota River - Granite Falls Watershed is in the headwaters of Upper Hawk Creek HUC-10. This region is very diverse with a mixture of deep and shallow lakes in both urban and agricultural areas. The rest of the Minnesota River - Granite Falls Watershed tends to have a low density of shallow lakes scattered though out. Land use tends to be predominantly agriculture. Geology, land use, lake morphology, and watershed size must all be considered in order to fully understand water quality for individual water bodies. The driving factors of lake water quality appear to be the contributing watershed size and land use. Lakes with small contributing watersheds and higher percentages of forest and rangeland have better water quality. However, many lakes are hydraulically connected to each other resulting in large watersheds which can increase nutrient loading to downstream lakes. The southern portion of the watershed has very few lakes; much of this area has been drained and is dominated by agriculture.

Bringing the watershed's lakes into compliance with water quality standards is an immense task when considering the scale and complexity of the problem. However, steps can be taken to protect lakes with good water quality and to improve lakes with poor water quality. Reductions in overland runoff and good land management practices can substantially reduce loading of phosphorus in lakes, resulting in water quality improvements.

Table 79. Assessment summary for stream water quality in the Minnesota River - Granite Falls Watershed

				Supporting		Non-supporting		
Watershed	**Area (square miles)**	**# Total AUIDs**	**# Assessed AUIDs**	**# Aquatic Life**	**# Aquatic Recreation**	**# Aquatic Life**	**# Aquatic Recreation**	**Insufficient Data**
Minnesota River Granite Falls **07020004**		**143**	**69**	**3**	**1**	**40**	**50**	**33**
County Ditch 9 0702000401	78	3	2	0	0	0	2	2
Stony Run Creek 0702000402	249	14	7	3	0	1	3	3
Upper Yellow Medicine River 0702000403	254	16	13	0	0	12	8	3
South Branch Yellow Medicine River 0702000404	124	14	11	0	0	10	11	1
Spring Creek 0702000405	129	5	3	0	0	0	3	3
Lower Yellow Medicine River 0702000406	169	11	6	0	1	5	5	1
Upper Hawk Creek 0702000407	195	10	0	0	0	0	0	0
Chetomba Creek 0702000408	158	15	0	0	0	0	0	1
Lower Hawk Creek 0702000409	153	12	5	0	0	4	4	4
Wood Lake Creek 0702000410	191	17	7	0	0	6	3	2
Beaver Creek 0702000411	198	17	8	0	0	1	8	10
Sacred Heart Creek 0702000412	180	9	7	0	0	1	3	3

Table 80. Assessment summary for lake water chemistry in the Minnesota River - Granite Falls Watershed

				Supporting		Non-supporting		
Watershed	Area square miles	Lakes >10 Acres	# Assessed Lakes	# Aquatic Life	# Aquatic Recreation	# Aquatic Life	# Aquatic Recreation	Insufficient Data
Minnesota River Granite Falls **07020004**		**135**	**41**	**NA**	**7**	**0**	**14**	**20**
County Ditch 9 0702000401	78	1	1	0	0	0	0	1
Stony Run Creek 0702000402	249	16	0	0	0	0	0	0
Upper Yellow Medicine River 0702000403	254	24	10	0	1	0	3	6
South Branch Yellow Medicine River 0702000404	124	11	3	0	0	0	1	2
Spring Creek 0702000405	129	6	1	0	0	0	0	1
Lower Yellow Medicine River 0702000406	169	6	3	0	0	0	1	2
Upper Hawk Creek 0702000407	195	53	17	0	6	0	5	6
Chetomba Creek 0702000408	158	3	1	0	0	0	1	0
Lower Hawk Creek 0702000409	153	2	0	0	0	0	0	0
Wood Lake Creek 0702000410	191	12	5	0	0	0	3	2
Beaver Creek 0702000411	198	1	0	0	0	0	0	0
Sacred Heart Creek 0702000412	180	0	0	0	0	0	0	0

Fish contaminant results, Minnesota River – Granite Falls Watershed

Fish species are identified by codes that are defined by their common and scientific names in Table 75. In this watershed, mercury has been measured in 12 fish species, PCBs in 9 species, and PFCs in two species. A total of 546 fish were tested.

Table 76 shows which waterways are impaired for aquatic consumption (i.e., fish contaminants). Hawk Creek, Yellow Medicine River, and seven lakes are impaired due to elevated levels of mercury (Hg) in fish tissue. Table 76 also shows the number of fish tested by species. Walleye (WE) was the most commonly tested species (37% of all fish tested), yellow perch (YP) was second (22%), and common carp (C) was third (12%). WE were tested in all but two of the lakes.

Table 77 is a summary of contaminant concentrations by waterway, fish species, and year. The table shows which contaminants, species, and years were sampled within a given lake. "Total Fish" and "Samples" are shown because many of the panfish, such as bluegill sunfish (BGS) and yellow perch (YP) were composite samples—multiple fish homogenized into a single sample. Sample years ranged from 1985 to 2009. Most of the samples were skin-on fillets (FILSK) or for fish without scales (catfish and bullheads), skin-off fillets (FILET). In several years, whole fish (WHORG) were tested as well as FILSK. Comparing mercury concentrations in FILSK and WHORG for the same species and year shows how the mercury is bound to the muscle tissue and homogenizing the whole fish causes a dilution of the mercury concentration.

Mercury was measured in 292 fish samples. The highest mercury concentration was 0.896 mg/kg in a NP collected from Henderson Lake (34011600) in 2004. The grand mean mercury concentration for all fish in the Yellow Medicine River watershed is 0.134 mg/kg. The impairment threshold for mercury in fish tissue is 0.2 mg mercury /kg fish tissue.

PCBs were measured in 14 fish samples from Hawk Creek, the Yellow Medicine River, and four lakes. Total PCB concentrations were generally below the detection limit. The maximum total PCBs concentration was 0.063 mg/kg in a common carp from Eagle Lake (34017100), collected in 1992. The impairment threshold for PCBs is 0.22 mg/kg.

PFOS was measured in select species from Foot (34018100) and Willmar (34018000) lakes. In Foot Lake, a composite of four black crappie (BKS) and three individual walleye (WE) were tested. In Willmar Lake, a composite of five BKS and three individual WE were tested. PFOS concentrations were low but detectable, ranging from 8.95 ng/g to 17.1 ng/g. These PFOS concentrations are well below the impairment threshold of 200 ng/g (ppb).

Overall, mercury in fish tissue remains a concern for the two streams and most of the lakes in this watershed. PCBs concentrations were mostly below the detection limits or very low concentrations. PFOS concentrations were detectable in the two lakes tested but at very low levels that would not cause a fish consumption advisory. Therefore, PCBs and PFOS are not a concern for the Minnesota River – Granite Falls Watershed.

Table 81. Fish species codes, common names, and scientific names

SPEC	Common Name	*Scientific Name*
BBU	Bigmouth buffalo	*Ictiobus Cyprinellus*
BGS	Bluegill sunfish	*Lepomis macrochirus*
BKB	Black bullhead	*Ictalurus melus*
BKS	Black crappie	*Pomoxis nigromaculatis*
C	Common Carp	*Cyprinus carpio*
CHC	Channel catfish	*Ictalurus punctatus*
LMB	Largemouth bass	*Micropterus salmoides*
NP	Northern pike	*Esox lucius*
SMB	Smallmouth bass	*Micropterus dolomieu*
WE	Walleye	*Sander vitreus*
WSU	White sucker	*Catostomus commersoni*
YP	Yellow perch	*Perca flavescens*

Table 82. Waterways having fish contaminant data, showing impairments caused by contaminants in fish tissue and number of fish tested by species

Waterway	AUID	Impaired	BBU	BGS	BKB	BKS	C	CHC	LMB	NP	SMB	WE	WSU	YP
HAWK CR.	07020004 - 510 - 568 - 569 -570 - 587 -591 - 627	Hg					8	3		2		5		
YELLOW MEDICINE R.	07020004 - 502 -513 - 541 -584 - 542 -503	Hg					9				7	9		
COTTONWOOD	42001400						4			5				10
EAGLE	34017100	Hg	8	10			3			3		20		
EAST SOLOMON	34024600	Hg				10	5					7		
FOOT	34018100					10	5					4		
HENDERSON	34011600	Hg								27				20
JOHN RES.	87018100					10	3		3	1		2		
LADY SLIPPER	42002000	Hg			8							5		10
LONG	34019200	Hg			2		13					27	1	
PERCH	41006700	Hg			8							6	3	7
RINGO	34017200					5	5					8		
SHAOKOTAN	41008900	Hg			7					1		97		72
WILLMAR	34018000			7		16	10					13	2	

Table 83. Waterways having fish contaminant data, showing impairments caused by contaminants in fish tissue and number of fish tested by species

							Length (in)			Mercury (mg/kg)				PCBs (mg/kg)				PFOS (µg/kg)		
Waterway	AUID	SPEC[1]	Year	Anat[2]	Total Fish	Samples	Mean	Min	Max	N	Mean	Min	Max	N	Mean	Min	Max	N	Mean	Max
HAWK	07020004	C	2003	FILSK	3	1	19.5	19.5	19.5	1	0.111	0.111	0.111	1	< 0.01					
	-510 - 568		2010	FILSK	5	5	23.8	19.4	26.0	5	0.117	0.024	0.185	2		< 0.025	0.046			
	-569 -570	CHC	2003	FILET	3	3	11.8	10.0	13.9	3	0.105	0.099	0.108	1	< 0.01					
	-587 -591	WE	2003	FILSK	5	5	11.7	10.1	12.5	5	0.209	0.162	0.254							
	-627	NP	2010	FILSK	2	2	23.6	20.5	26.7	2	0.092	0.074	0.109	2		< 0.025	< 0.025			
YELLOW	07020004	C	1990	FILSK	4	1	18.0	18.0	18.0	1	0.300	0.300	0.300	1	0.021					
	-502 -513		2010	FILSK	5	5	22.1	19.9	25.4	5	0.066	0.023	0.127	2		< 0.025	< 0.025			
	-541 -584	SMB	1990	FILSK	4	1	8.3	8.3	8.3	1	0.160	0.160	0.160	1	< 0.01					
	-542 -503		2010	FILSK	3	3	13.9	12.3	15.0	3	0.181	0.156	0.217	2		< 0.025	< 0.025			
		WE	1990	FILSK	2	1	12.3	12.3	12.3	1	0.180	0.180	0.180	1	< 0.01					
			2010	FILSK	7	7	15.2	12.8	17.8	7	0.227	0.178	0.321	2		< 0.025	< 0.025			
COTTONW	42001400	C	2002	FILSK	4	1	20.3			1	0.022									
		NP	2002	FILSK	5	5	18.6	17.3	19.7	5	0.078	0.061	0.106							
		YP	2002	FILSK	10	1	7.4			1	0.054									
EAGLE	34017100	BBU	1992	FILSK	8	1	16.6			1	0.088			1	0.038					
		BGS	1992	FILSK	10	1	5.9			1	0.056									
		C	1992	FILSK	3	2	28.2	23.2	33.2	2	0.028	0.028	0.028	2	0.0375	0.012	0.063			
		NP	1992	FILSK	3	2	26.9	19.8	34.0	2	0.330	0.220	0.440	1	0.027					

Waterway	AUID	SPEC[1]	Year	Anat[2]	Total Fish	Samples	Length (in)			Mercury (mg/kg)				PCBs (mg/kg)				PFOS (µg/kg)		
							Mean	Min	Max	N	Mean	Min	Max	N	Mean	Min	Max	N	Mean	Max
		WE	1992	FILSK	20	3	17.0	10.3	22.1	3	0.380	0.190	0.540	1	0.027					
EAST SOLO	34024600	BKS	2009	FILSK	10	2	8.5	8.2	8.8	2	0.029	0.027	0.030							
		C	2009	FILSK	5	1	21.4			1	0.031									
		WE	2009	FILSK	7	7	16.9	12.5	24.6	7	0.103	0.032	0.259							
FOOT	34018100	BKS	2009	FILSK	10	2	7.5	7.3	7.6	1	0.022							1	14.9	
		C	2009	FILSK	5	1	21.5			1	0.010									
		WE	2009	FILSK	4	4	15.2	9.4	17.7	4	0.079	0.033	0.099					3	13.4	17.1
HENDERSO	34011600	NP	1998	FILSK	5	5	25.9	23.0	27.7	5	0.368	0.270	0.610							
				WHORG	4	4	25.5	23.0	27.6	4	0.174	0.026	0.285							
			2004	FILSK	9	9	24.2	19.9	29.0	9	0.448	0.248	0.896							
			2009	FILSK	8	8	23.3	20.8	26.1	8	0.401	0.158	0.702							
		YP	1998	WHORG	10	10	5.6	5.3	6.1	10	0.094	0.046	0.140							
			2004	WHORG	10	2	5.7	5.5	5.8	2	0.093	0.085	0.100							
JOHN RES.	87018100	BKS	2008	FILSK	10	1	7.4			1	0.079									
		C	2008	FILSK	3	1	25.6			1	0.086									
		LMB	2008	FILSK	3	3	12.1	11.7	12.5	3	0.196	0.183	0.206							
		NP	2008	FILSK	1	1	27.1			1	0.134									
		WE	2008	FILSK	2	2	18.1	13.5	22.7	2	0.160	0.158	0.162							
LADY SLIPP	42002000	BKB	2002	FILET	8	1	10.0			1	0.099									

Waterway	AUID	SPEC[1]	Year	Anat[2]	Total Fish	Samples	Length (in)			Mercury (mg/kg)				PCBs (mg/kg)				PFOS (µg/kg)		
							Mean	Min	Max	N	Mean	Min	Max	N	Mean	Min	Max	N	Mean	Max
		WE	2002	FILSK	5	5	20.6	16.1	25.4	5	0.308	0.220	0.447							
		YP	2002	FILSK	10	1	7.6			1	0.076									
LONG	34019200	BKB	1991	FILET	2	1	13.0			1	0.260									
		C	1991	FILSK	8	2	16.2	9.5	22.9	2	0.097	0.074	0.120	1	0.01					
			2009	FILSK	5	1	23.2			1	0.127									
		WE	1991	FILSK	20	3	16.4	9.4	21.6	3	0.320	0.120	0.610	1	0.01					
			2009	FILSK	7	7	17.3	14.7	22.2	7	0.162	0.111	0.302							
		WSU	1991	FILSK	1	1	18.1			1	0.330			1	0.01					
PERCH	41006700	BKB	2000	FILET	8	1	9.8			1	0.040									
		WE	2000	FILSK	6	6	16.5	12.8	23.5	6	0.202	0.080	0.600							
		WSU	2000	FILSK	3	1	17.4			1	0.040									
		YP	2000	FILSK	7	1	10.7			1	0.050									
RINGO	34017200	BKS	2009	FILSK	5	1	8.8			1	0.052									
		C	2009	FILSK	5	1	15.0			1	0.025									
		WE	2009	FILSK	8	8	14.2	13.0	16.2	8	0.073	0.061	0.099							
SHAOKOTA	41008900	BKB	1993	FILET	7	1	12.4			1	0.068									
		NP	1999	FILSK	1	1	24.0			1	0.260									
		WE	1993	FILSK	12	3	17.1	14.3	19.9	3	0.179	0.096	0.250	1	0.01					
			1999	FILSK	22	22	17.0	11.4	20.0	22	0.203	0.130	0.270							

Waterway	AUID	SPEC[1]	Year	Anat[2]	Total Fish	Samples	Length (in)			Mercury (mg/kg)				PCBs (mg/kg)				PFOS (µg/kg)		
							Mean	Min	Max	N	Mean	Min	Max	N	Mean	Min	Max	N	Mean	Max
				WHORG	4	4	8.1	7.8	8.6	4	0.118	0.100	0.130							
			2000	FILSK	22	22	17.0	10.1	23.0	22	0.208	0.070	0.400							
			2004	FILSK	17	17	17.2	11.4	21.1	17	0.203	0.104	0.372							
			2008	FILSK	20	20	18.3	14.8	20.4	20	0.244	0.101	0.438							
		YP	1999	WHORG	36	12	7.3	6.6	8.5	12	0.056	0.050	0.060							
			2000	WHORG	20	20	7.8	6.1	10.0	20	0.068	0.040	0.130							
			2004	FILSK	1	1	10.2			1	0.046									
				WHORG	5	1	7.3			1	0.028									
			2008	WHORG	10	3	7.2	6.8	7.6	3	0.055	0.048	0.059							
WILL MAR	34018000	BGS	1985	FILSK	7	1	6.0			1	0.160			1	0.05					
		BKS	1985	FILSK	6	1	7.7			1	0.070			1	0.05					
			2009	FILSK	10	2	8.8	8.3	9.3	1	0.012							1	8.95	
		C	1985	FILSK	5	1	18.4			1	0.020			1	0.05					
			2009	FILSK	5	1	22.2			1	0.045									
		WE	1985	FILSK	5	1	15.6			1	0.090			1	0.05					
			2009	FILSK	8	8	16.3	10.6	18.5	5	0.053	0.038	0.061					3	13.9	15.3
		WSU	1985	FILSK	2	1	15.5			1	0.020			1	0.05					

1 **Species codes are defined in Table 75**

2 Anatomy codes: FILSK – fillet skin-on

Pollutant trends for the Minnesota River - Granite Falls Watershed

Water quality trends at long-term monitoring stations

Water chemistry data were analyzed for trends (Table 84) for the long term period of record (1967-2009) and near term period of record (1994-2009). There were significant increases in nitrite/nitrates and chloride during the long term period of record for the Yellow Medicine River, but not for the short term period for nitrite/nitrates. Conversely, there were significant decreases in total suspended solids, total phosphorus, and biological oxygen demand for the long term and short term periods of record.

Table 84. Trends in the Minnesota River - Granite Falls Watershed

	Total Suspended Solids	Total Phosphorus	Nitrite/ Nitrate	Ammonia	Biochemical Oxygen Demand	Chloride
Yellow Medicine River at MN-67 Bridge 7 mi. SE of Granite Falls (S000-159)(YM-0.5) (period of record 1967 - 2009)						
overall trend	**decrease**	**decrease**	**increase**	**decrease**	**decrease**	**increase**
estimated average annual change	-1.8%	-2.4%	0.8%	-2.6%	-1.9%	3.3%
estimated total change	-52%	-63%	29%	-53%	-56%	292%
1994 - 2009 trend	**decrease**	**decrease**	**no trend**	**no trend**	**decrease**	little data
estimated average annual change	-10.6%	-5.1%			-4.7%	0.0%
estimated total change	-83%	-57%			-53%	0%
median concentrations first 10 years	65	0.2	0.3	0.13	5.1	13
median concentrations most recent 10 years	26	0.1	0.3	<0.03	1.6	18

(Analysis was performed using the Seasonal Kendall Test for Trends. Trends shown are significant at the 90% confidence level. Percentage changes are statistical estimates based on the available data. Actual changes could be higher or lower. A designation of "no trend" means that a statistically significant trend has not been found; this may simply be the result of insufficient data.)
(Concentrations are median summer (Jun-Aug) values, except for chlorides, which are median year-round values. All concentrations are in mg/L.)

Water clarity trends at citizen monitoring sites

Citizen volunteer monitoring occurred at 114 stream sampling locations within the watershed. Water clarity has shown a weak increasing trend at two sampling locations; S002-148 and S002-246. No trend was found on 17 stream sampling locations and 95 sampling locations had insufficient information for calculating trends.

Citizen volunteer monitoring occurred at seven lakes within the watershed. Water clarity has shown an increasing trend on one lake; Lake George 34-0142. No trend was found in six other lakes with water clarity information.

Table 85. Water clarity trends at citizen stream monitoring sites.

MN River - Yellow Medicine HUC 07020004	Citizen Stream Monitoring Program	Citizen Lake Monitoring Program
number of sites w/ increasing trend	2	1
number of sites w/ decreasing trend	0	0
number of sites w/ no trend	17	6

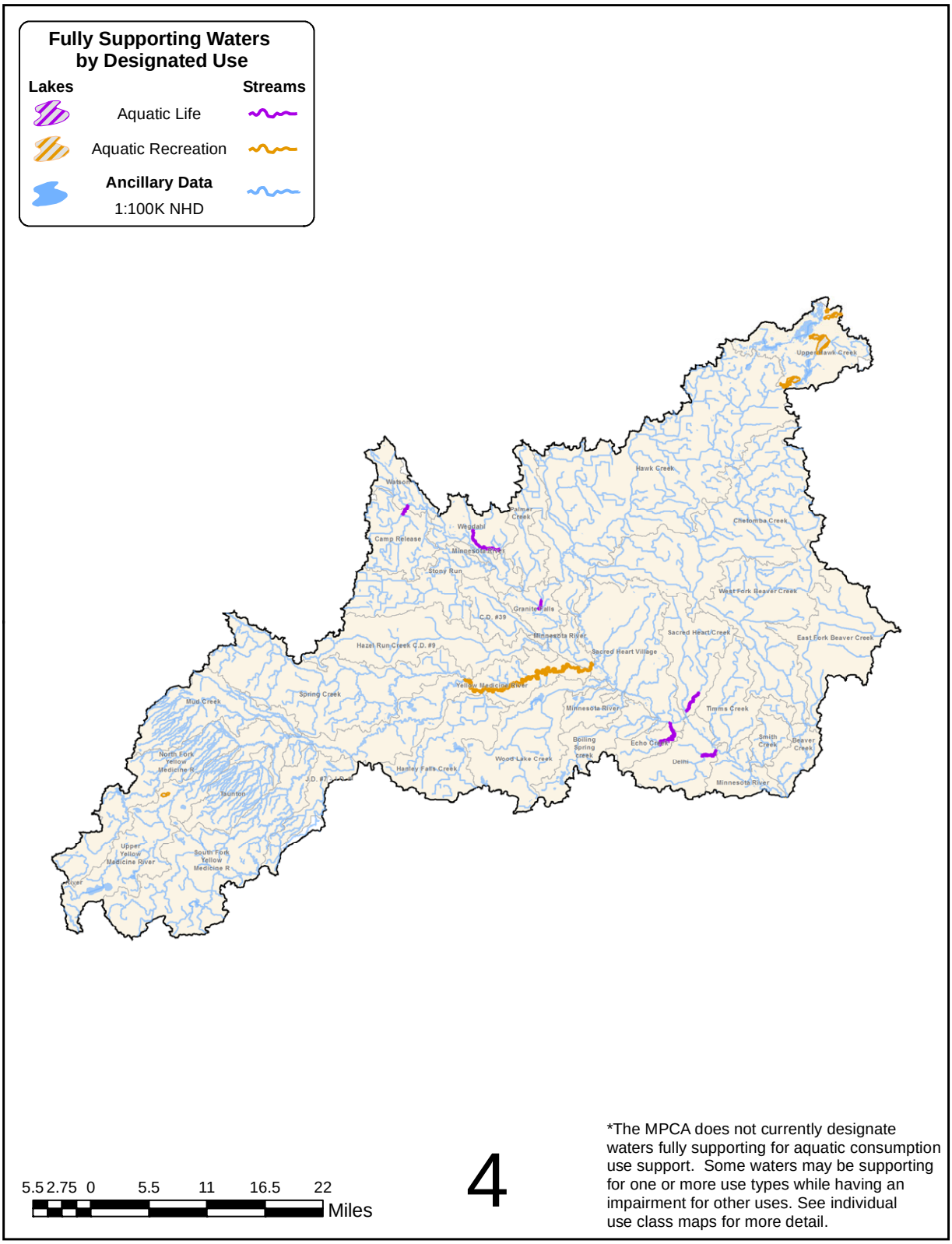

Figure 31. Fully supporting waters by designated use in the Minnesota River - Granite Falls Watershed

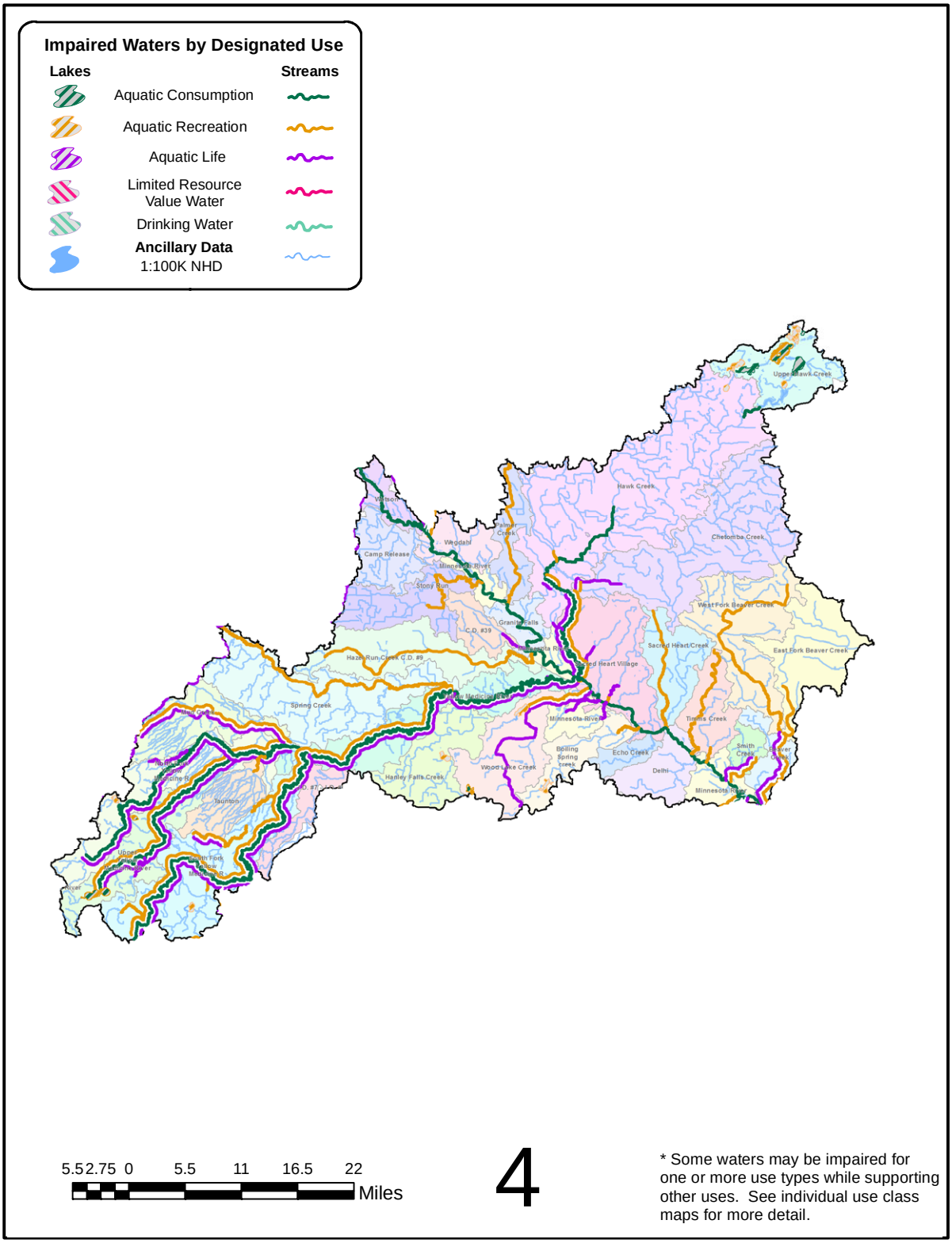

Figure 32. Impaired waters by designated use in the Minnesota River - Granite Falls Watershed

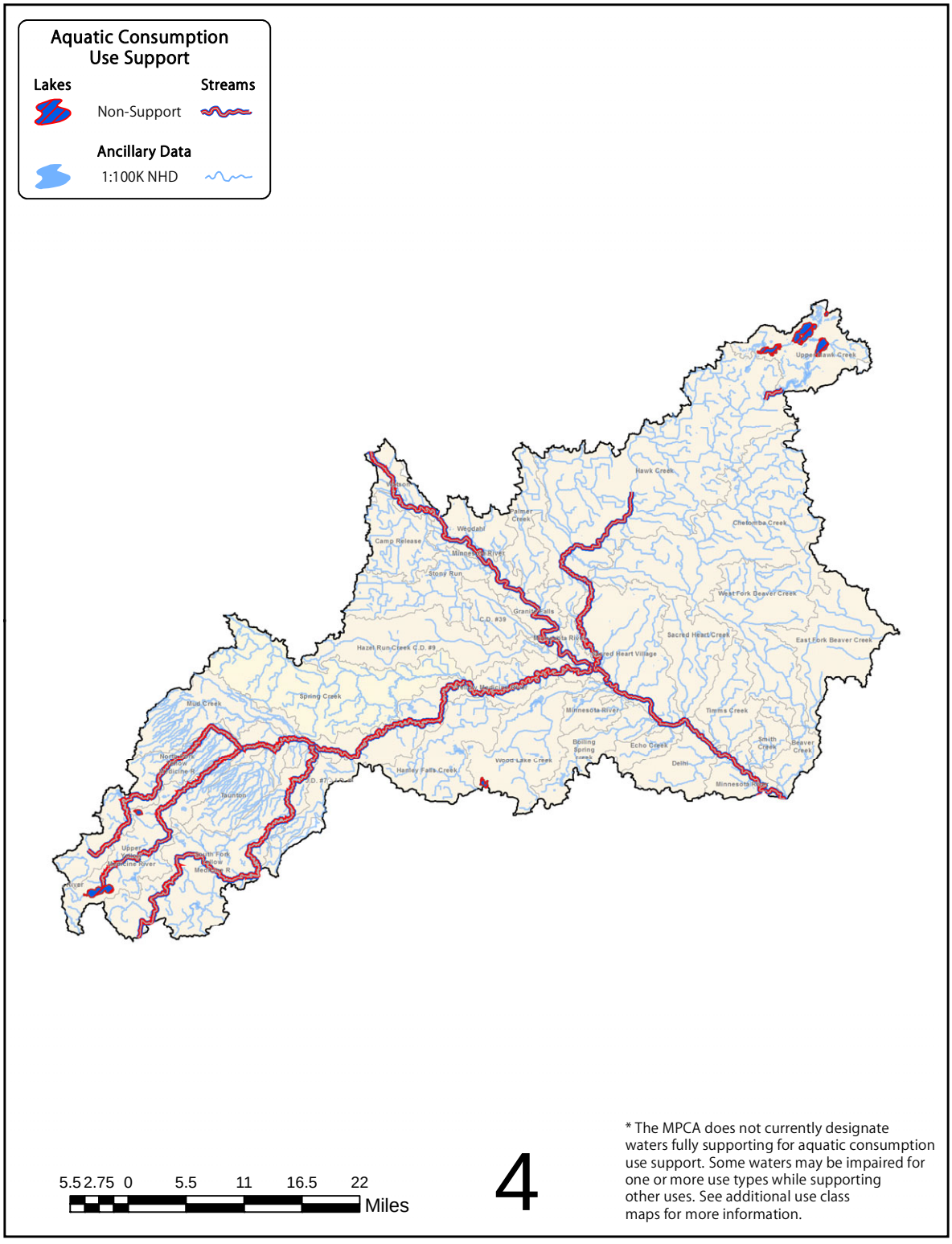

Figure 33. Aquatic consumption use support in the Minnesota River - Granite Falls Watershed

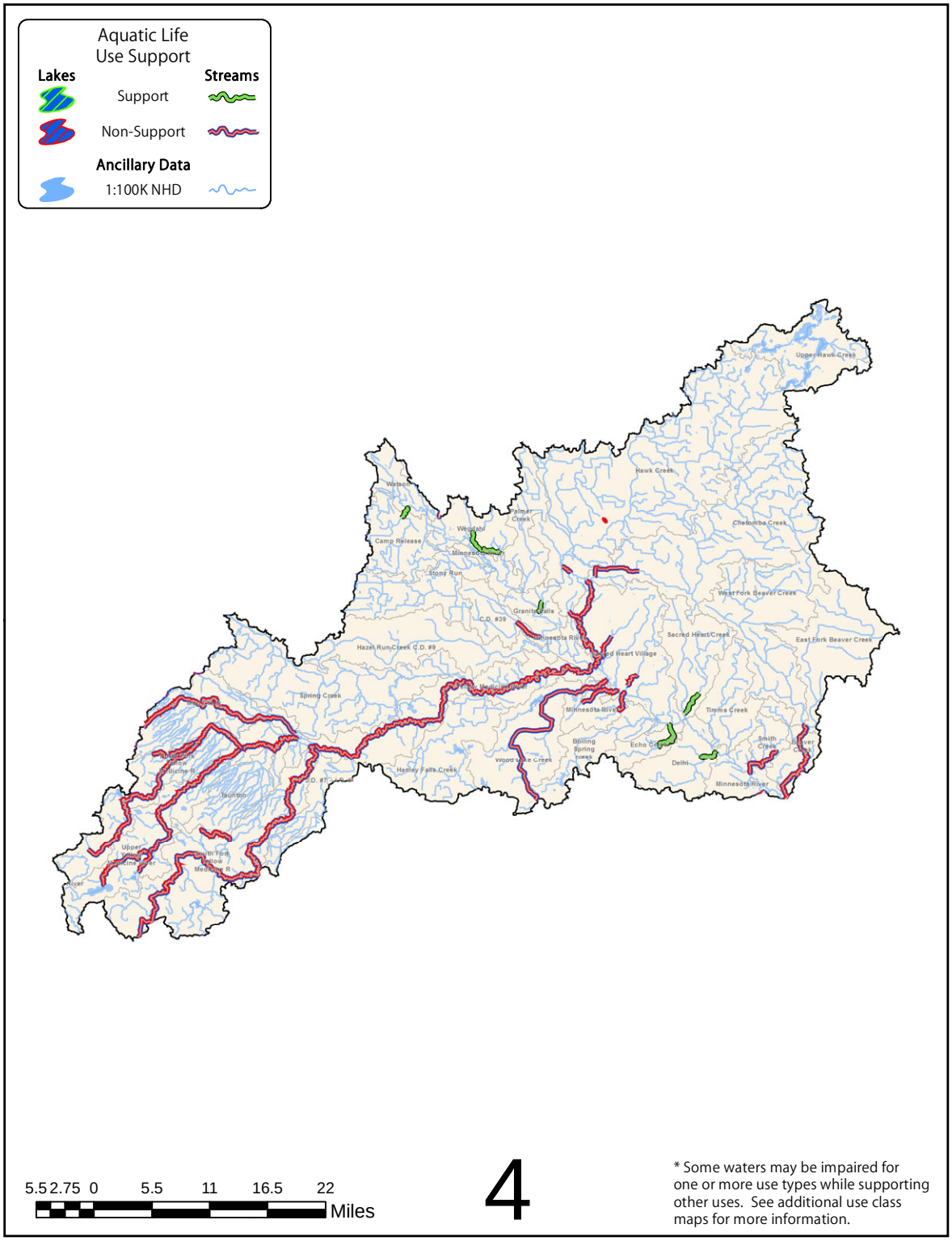

Figure 34. Aquatic life use support in the Minnesota River - Granite Falls Watershed

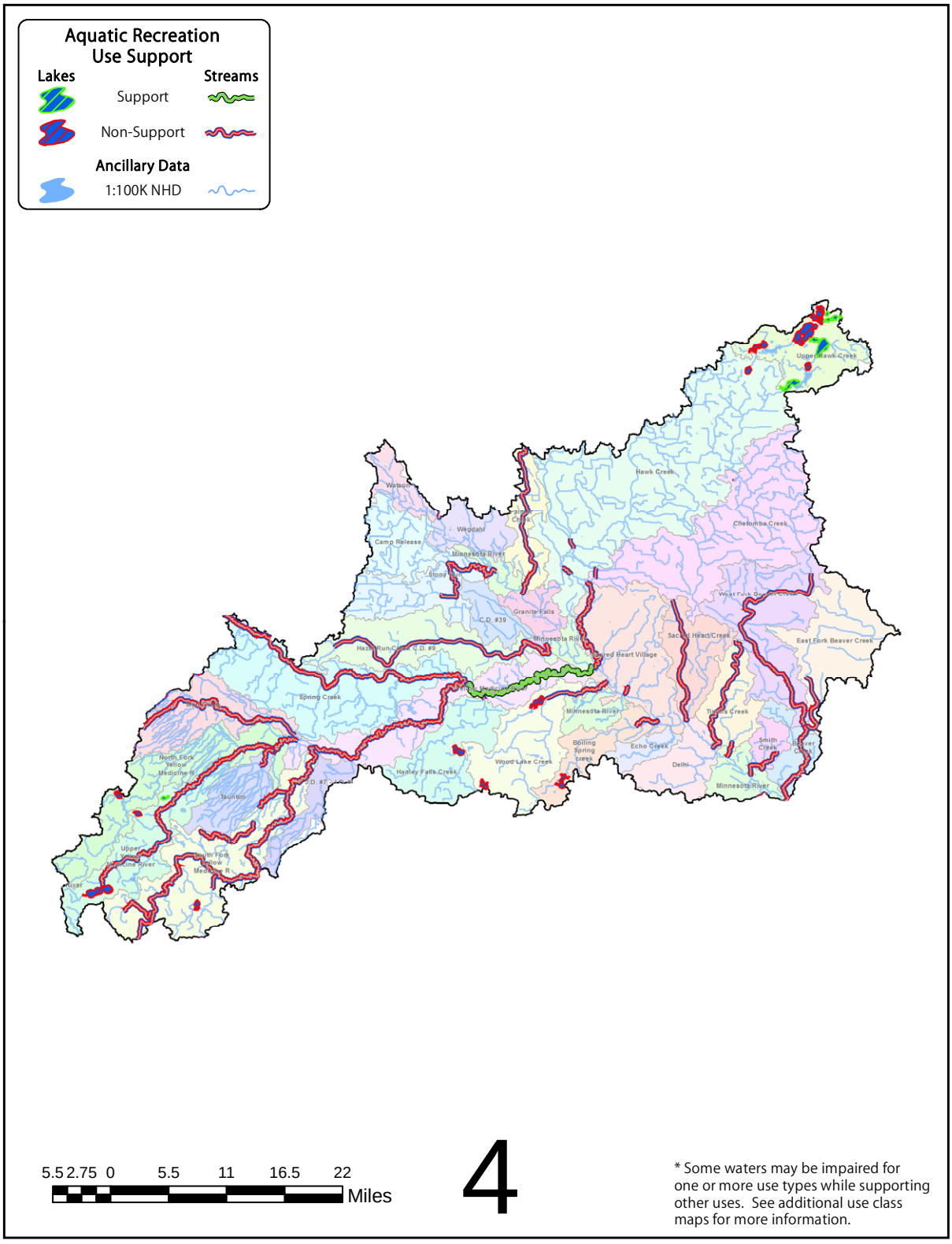

Figure 35. Aquatic recreation use support in the Minnesota River - Granite Falls Watershed

VII. Summary and recommendations

While measures have been taken to reduce legacy land use impacts in the watershed, streams are still recovering from land use practices implemented during watershed settlement and continuing today. The Minnesota River - Granite Falls Watershed is located in a heavily agricultural area of Minnesota. Most of the upland areas have been extensively modified, while the downstream portions of many of the streams retain their natural state and wooded buffer corridors. Nonpoint source pollution from agricultural land use is likely negatively impacting immediate and downstream water quality uses for aquatic life, recreation, and drinking water. Sixty-nine of the 143 stream AUIDs were assessed for aquatic life and/or aquatic recreation (Table 79). Those not assessessed were either classified as limited resource value waters or channelized. Of the assessed streams, only three AUIDs were considered to be fully supporting aquatic life and one stream AUID was fully supporting aquatic recreation. There were a total of 90 non-supporting assessments for aquatic life and/or recreation in the Minnesota River - Granite Falls Watershed.

Impairment of aquatic recreation is widespread across the watershed. The abundance of permitted feedlots in the watershed may correlate with this finding. High bacteria levels could also be attributed to failing septic systems which are not well quantified across the watershed. The Upper Hawk Creek and Chetomba Creek watersheds did not have any aquatic recreation impairments because the majority of these subwatersheds are class 7 limited resource waters and are not assessed for aquatic recreation.

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

Turbidity concerns are widespread, but are not as universal as impairment due to E. coli. As improvements have been made in the watershed to significantly reduce overland erosion by implementing soil conservation efforts and restoring natural vegetation along bluff slopes and in riparian zones, high levels of turbidity are likely stemming from stream bank erosion as streams cut into banks of alluvial sediment historically deposited from the watershed's uplands. Increased volumes of water entering streams from artificial drainage may exacerbate this condition. Poor habitat conditions observed across many biological stations may be linked to turbidity and sedimentation issues, as well as poor riparian land use.

Overall, mercury in fish tissue remains a concern for the two streams listed as impaired and most of the lakes in this watershed. Continuation of monitoring is recommended to see if conditions improve over time.

While impairment is prevalent across the watershed, efforts to restore water quality and bring surface waters into attainment for designated uses is not futile. Future efforts to control sediment should include measures to hold more water in upland areas and stabilize stream bank channels. Based on the large number of impairments that are likely influenced by the intensive agriculture practices and development in the watershed, stressors to be examined should include: nutrients, turbidity, low dissolved oxygen, decreased habitat, and altered hydrology. Addressing nonpoint source pollution would benefit from a targeted approach to BMP placement, identifying areas in the watershed that are likely more prone to be sources and pathways of contamination and working with those landowners to protect and restore those sensitive areas. Collaborating with landowners will help the agricultural economy of the region to move forward in a sustainable way that does not neglect water quality.

Literature cited

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

Genet, J. A. 2012. Status and Trends of wetland s in Minnesota: Depressional Wetland Quality Baseline. Minnesota Pollution Control Agency, Biological Monitoring Program, St. Paul, Minnesota. 80 pp. http://www.pca.state.mn.us/index.php/view-document.html?gid=17741

Genet, J.A. and A.R. Olson. 2008. Assessing depressional wetland quantity and quality using a probabilistic sampling design in the Redwood River Watershed, Minnesota, and USA. Wetlands 28(2): 3224-335.

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

Meyer, R. W. 1991. Everyone's Country Estate: A History of Minnesota's State Parks. Minnesota Historical Society Press: St. Paul, Minnesota.

Midwest Regional Climate Center. Climate Summaries. Historical Climate Data. Precipitation Summary. Station: 210355 Austin 3 S, MN. 1971-2000 NCDC Normals. http://mrcc.isws.illinois.edu/climate_midwest/historical/precip/mn/210075_psum.html

Minnesota Conservation Department (MCD). 1959. Hydrologic Atlas of Minnesota. Division of Waters, Minnesota Conservation Department, St. Paul, Minnesota.

Minnesota Department of Agriculture (MDA). 2010. 2010 Water Quality Monitoring Report. Pesticide and Fertilizer Management Division, Minnesota Department of Agriculture, St. Paul, Minnesota. http://www.mda.state.mn.us/chemicals/pesticides/~/media/Files/chemicals/maace/2010wqmreport.ashx.

Minnesota Department of Agriculture (MDA). 2009. 2009 Water Quality Monitoring Report. Pesticide and Fertilizer Management Division, Minnesota Department of Agriculture, St. Paul, Minnesota. http://www.mda.state.mn.us/~/media/Files/chemicals/reports/2009waterqualitymonrpt.ashx

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

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

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

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

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

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

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

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

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

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

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

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

National Resource Conservation Service (NRCS). 2007. Rapid Watershed Assessment: [XXXXXX] (MN/IA) HUC: XXXXXXXX. NRCS. USDA. http://www.mn.nrcs.usda.gov/technical/rwa/Assessments/reports/upper_cedar.pdf.

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

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

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

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

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

Appendix 1 - Water chemistry definitions

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

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

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

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

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

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

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

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

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

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

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

Total Suspended Volatile Solids (TSVS) - Volatile solids are solids lost during ignition (heating to 500 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 (NH_3) - 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 watershed monitoring water chemistry stations in the Minnesota River - Granite Falls Watershed

Biological Station ID	STORET/ EQuIS ID	Waterbody Name	Location	10-digit HUC
10MN014	S006-172	Hazel Creek	At Hwy 274, 3 mi. S of Granite Falls	702000401
10MN007	S002-136	Palmer Creek	At 15th Ave. 2 mi. N of Granite Falls	702000402
10MN015	S006-171	Stony Run Creek	Hwy 212, 4 mi. NW of Granite Falls	702000402
10MN002	S002-323	Yellow Medicine River	At Lyon Lincoln Rd, 1/4 MI E CSAH-8, 2 MI W TAUNTON	702000403
10MN010	S002-321	Mud Creek	MUD CK JUST SO. OF CSAH-27 ON UNN ST, 5 1/2 MI N OF MINNEOTA	702000403
10MN011	S006-173	Yellow Medicine River	At CR 3, 3.5 mi. N of Minneota	702000403
10MN017	S006-170	Trib. to Yellow Medicine River	CR 26, 1 mi. NE of Taunton	702000403
10MN003	S002-320	Yellow Medicine River, South Branch	At CR 26, 2 mi. N of Minneota	702000404
10MN001	S002-316	Yellow Medicine River	560th St, 5.25 mi. NE of Hanley Falls	702000406
10MN012	S002-319	Judicial Ditch 17	CR 18, 1 mi. W of Hanley Falls	702000406
10MN016	S002-152	Chetomba Creek	880th Ave, 5 mi. SE of Maynard	702000408
10MN005	S002-012	Hawk Creek	At CR 52, 6.5 mi. SE of Granite Falls	702000409
97MN006	S002-148	Hawk Creek	Hwy 23, 2 mi. S of Maynard	702000409
10MN008	S004-345	Boiling Spring Creek	At Grandview Ave, 4.5 mi. N of Belview	702000410
10MN013	S006-161	Judicial Ditch 10	600th St, 6 mi. N of Echo	702000410
10MN006	S000-404	Beaver Creek, East Fork	At CR 4, 6.5 mi. S of Olivia	702000411
10MN152	S006-138	Beaver Creek, West Fork	Downstream of 320th St, 3.5 mi. NE of Bechyn	702000411
92MN052	S000-666	Beaver Creek	At CR 2 in Beaver Falls	702000411
10MN009	S001-341	Sacred Heart Creek	At CR 15, 5.5 mi. N of Delhi	702000412
10MN018	S006-160	County Ditch 12	CR 6, 1 mi. N of Delhi	702000412
10MN077	S003-867	Timms Creek	TIMMS CK AT CSAH-15, 2.8 MI NNE OF DELHI, MINNESOTA	702000412

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

AUID DESCRIPTIONS				USES							Aquatic Life Indicators								
National Hydrography Dataset (NHD) Assessment Segment AUID	Stream Segment Name	Segment Description	Reach Length (Miles)	Use Class	Aquatic Life	Aquatic Recreation	Aquatic Consumption	Class 7	303d list impairments		Fish IBI	Invert IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides	Bacteria (Aq. Recreation)
HUC 10: 0702000401 (County Ditch 9)																			
07020004-536	Hazel Creek	Unnamed cr to Minnesota R	30.37	2C	IF	NS			E.coli, B_I		MTS	EXP	IF	MTS	MTS	MTS	--		EX
07020004-707	Unnamed creek	Headwaters to CD 9	2.86	2B, 3C									--	--		--	--		
HUC 10: 0702000402 (Stony Run Creek-Minnesota River)																			
07020004-534	Palmer Creek (County Ditch 68)	Headwaters to Minnesota R	17.76	2C	IF	NS			E.coli		MTS	MTS	IF	EXS	MTS	MTS	MTS		EX
07020004-535	Stony Run Creek	T116 R40W S30, west line to Minnesota R	13.54	2C	IF	NS			E.coli				IF	MTS	MTS	MTS	--		EX
07020004-580	Stony Run Creek	Headwaters to T116 R41W S25, east line	9.59	2B, 3C									--	--		--	--		
07020004-610	Brafees Creek	T116 R40W S1, north line to Minnesota R	2.82	2C	FS	NA					MTS	MTS	--	MTS		--			
07020004-673	Judicial Ditch 23	Unnamed ditch to Unnamed cr	4.55	2B, 3C									--	--		--	--		
07020004-674	Judicial Ditch 23	Unnamed cr to Minnesota R	2	2B, 3C	FS	NA					MTS	MTS	--	--		--	--		
07020004-680	County Ditch 36A	Unnamed cr to Unnamed cr	0.8	2B, 3C										--					

AUID DESCRIPTIONS				USES							Aquatic Life Indicators								
National Hydrography Dataset (NHD) Assessment Segment AUID	Stream Segment Name	Segment Description	Reach Length (Miles)	Use Class	Aquatic Life	Aquatic Recreation	Aquatic Consumption	Class 7	303d list impairments		Fish IBI	Invert IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides	Bacteria (Aq. Recreation)
07020004-682	County Ditch 36A	Unnamed cr to Minnesota R	2.34	2B, 3C	FS	NA					MTS		--	IF		--			
07020004-708	County Ditch 36	Unnamed ditch to JD 21	1.12	2B, 3C									--	--		--	--		
07020004-709	Unnamed ditch	Unnamed ditch to JD 21	2.82	2B, 3C									--	--		--			
HUC 10: 0702000403 (Upper Yellow Medicine River)																			
07020004-542	Yellow Medicine River, North Branch	CD 8 to Yellow Medicine R	39.9	2C, 3C	NS	IF	NS		T, HGF B_I		EXP	EXS	IF	EXS		--	--		IF
07020004-543	Mud Creek	Headwaters to T114 R43W S35, south line	29.2	2C	NS	NS			T E.coli, B_I		MTS	EXP	EXS	EXS	MTS	MTS	--		EX
07020004-545	Unnamed creek	Headwaters to Yellow Medicine R	3.05	2B, 3C	NA	NS			E.coli				--	--	MTS	--			EX
07020004-564	Unnamed creek	Unnamed cr to Unnamed cr	4.38	2B, 3C	NS	NA			B_I		MTS	EXP	--	--		--	--		
07020004-584	Yellow Medicine River	Headwaters to Mud Cr	44.65	2B, 3C	NS	NS	NS		T, HGF E.coli		EXP	MTS	IF	EXS	MTS	MTS	--		EX
07020004-592	Unnamed creek	Headwaters to Unnamed cr	1.56	2B, 3C	NA								--	--		--			
07020004-593	Unnamed creek	Headwaters to Unnamed cr	2.13	2B, 3C										--					
07020004-630	Unnamed	Headwaters	0.64	2B, 3C										--					

AUID DESCRIPTIONS				USES							Aquatic Life Indicators								
National Hydrography Dataset (NHD) Assessment Segment AUID	Stream Segment Name	Segment Description	Reach Length (Miles)	Use Class	Aquatic Life	Aquatic Recreation	Aquatic Consumption	Class 7	303d list impairments		Fish IBI	Invert IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides	Bacteria (Aq. Recreation)
	creek	to Lk Shaokatan																	
07020004-631	Unnamed creek	Headwaters to Lk Shaokatan	0.01	2B, 3C										--					
07020004-694	Unnamed creek	Ash Lk to Yellow Medicine R	2.76	2B, 3C	NS	NA			B_F, B_I		EXS	EXP	--	--		--			
07020004-695	Unnamed creek	Unnamed cr to Unnamed cr	5.98	2B, 3C									--	--		--			
07020004-900	Unnamed creek	Unnamed ditch to Unnamed cr	0.7	2B, 3C										--					
07020004-902	Unnamed creek (Lake Shaokatan Inlet)	Headwaters to Lk Shaokatan	0.78	2B, 3C										--					
07020004-910	Unnamed ditch	Driveway intersecting CSAH 1 to Unnamed cr	0.52	2B, 3C										--					
07020004-912	County Ditch 8	Biggs Lk (41-0084-00) to N Br Yellow Medicine R	0.94	2C, 3B									--	--		--			
HUC 10: 0702000404 (South Branch Yellow Medicine River)																			

AUID DESCRIPTIONS				USES							Aquatic Life Indicators								
National Hydrography Dataset (NHD) Assessment Segment AUID	Stream Segment Name	Segment Description	Reach Length (Miles)	Use Class	Aquatic Life	Aquatic Recreation	Aquatic Consumption	Class 7	303d list impairments		Fish IBI	Invert IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides	Bacteria (Aq. Recreation)
07020004-503	Yellow Medicine River, South Branch (County Ditch 35)	Headwaters to Yellow Medicine R	62.65	2B, 3C	NS	NS	NS		T, HGF, FC		MTS	MTS	IF	EXS	MTS	MTS	MTS		EX
07020004-549	Judicial Ditch 29	T111 R44W S33, east line to T111 R44W S21, north line	4.2	7									--			--	--		
07020004-550	Judicial Ditch 29	T111 R44W S16, south line to S Br Yellow Medicine R	1.73	2B, 3C	IF	NS			FC				IF	MTS		MTS	--		EX
07020004-595	Unnamed creek	Headwaters to Unnamed cr	4.74	2B, 3C	NS	NS			E.coli, B_F		EXS	EXP	IF	MTS		MTS			EX
07020004-597	Unnamed creek	Unnamed cr to Unnamed cr	5.15	2B, 3C	IF	NS			FC				IF	MTS		MTS			EX
07020004-599	Unnamed creek	Unnamed cr to S Br Yellow Medicine R	5.56	2B, 3C	IF	NS			FC				IF	EXS		MTS			EX
07020004-600	Unnamed creek	CD 34 to CD 35	5.19	2B, 3C					FC				--	--		--	--		
HUC 10: 0702000405 (Spring Creek)																			
07020004-538	Spring Creek	Headwaters to Yellow	41.24	2B, 3C	IF	NS			B_F E.coli,				EXS	EXS		--	--		EX

AUID DESCRIPTIONS				USES							Aquatic Life Indicators								
National Hydrography Dataset (NHD) Assessment Segment AUID	Stream Segment Name	Segment Description	Reach Length (Miles)	Use Class	Aquatic Life	Aquatic Recreation	Aquatic Consumption	Class 7	303d list impairments		Fish IBI	Invert IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides	Bacteria (Aq. Recreation)
		Medicine R							DO										
07020004-539	Unnamed ditch	Unnamed cr to Spring Cr	3.85	2B, 3C									--	--		--	--		
07020004-607	Judicial Ditch 20	Unnamed ditch to Unnamed cr	5.2	2B, 3C															
07020004-697	County Ditch 48	Unnamed cr to Unnamed cr	1.89	2B, 3C									--	--		--	--		
HUC 10: 0702000406 (Lower Yellow Medicine River)																			
07020004-502	Yellow Medicine River	Spring Cr to Minnesota R	27.82	2B, 3C	NS	FS	NS		T, HGF		MTS	MTS	MTS	EXS	MTS	MTS	MTS	IF	MTS
07020004-513	Yellow Medicine River	S Br Yellow Medicine R to Spring Cr	33.62	2B, 3C	NS	NS	NS		T, HGF E.coli		EXP	EXP	IF	EXS		MTS	MTS		EX
07020004-622	Judicial Ditch 17	CD 3 to Yellow Medicine R	1.03	2B, 3C	IF	NS			E.coli				IF	MTS	MTS	MTS	--		EX
07020004-634	County Ditch 37	Unnamed cr to Unnamed cr	2.69	2B, 3C									--	--		--			
07020004-636	Judicial Ditch 7	Unnamed ditch to Yellow Medicine R	3.13	2B, 3C									--	--		--	--		
07020004-663	County Ditch 4	Headwaters to CD 55	4.79	2B, 3C									--	--		--			
07020004-670	Judicial Ditch 24	Unnamed ditch to JD 17	6.18	2B, 3C									--	--		--	--		

AUID DESCRIPTIONS				USES							Aquatic Life Indicators								
National Hydrography Dataset (NHD) Assessment Segment AUID	Stream Segment Name	Segment Description	Reach Length (Miles)	Use Class	Aquatic Life	Aquatic Recreation	Aquatic Consumption	Class 7	303d list impairments		Fish IBI	Invert IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides	Bacteria (Aq. Recreation)
07020004-703	Unnamed creek	Unnamed ditch to Unnamed ditch	2.48	2B, 3C									--	--		--			
HUC 10: 0702000407 (Upper Hawk Creek)																			
07020004-508	Hawk Creek	T119 R35W S19, north line to T118 R37W S31, south line	27.11	7			NS	IF	HGF				--			MTS	MTS		--
07020004-524	Unnamed creek	T119 R36W S4, north line to Hawk Cr	13.65	7				IF					IF			MTS	--		--
07020004-578	Unnamed creek	Headwaters to Unnamed cr	4.16	7									--			--	--		
07020004-602	Unnamed creek (Eagle Lake Inlet)	Unnamed cr to Eagle Lk	0.16	2B, 3C	NA	NA								EXS					--
07020004-627	Hawk Creek	Headwaters (Foot Lk 34-0181-00) to T119 R35W S18, south line	2.37	2B, 3C			NS		HGF					--					
07020004-640	Unnamed creek (Hawk Creek)	Eagle Lk to Swan Lk	1.11	2B, 3C	NA	NA								IF					
07020004-642	Unnamed	Swan Lk to	0.28	2B, 3C	NA	NA								IF					

AUID DESCRIPTIONS				USES							Aquatic Life Indicators								
National Hydrography Dataset (NHD) Assessment Segment AUID	Stream Segment Name	Segment Description	Reach Length (Miles)	Use Class	Aquatic Life	Aquatic Recreation	Aquatic Consumption	Class 7	303d list impairments		Fish IBI	Invert IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides	Bacteria (Aq. Recreation)
	creek (Hawk Creek)	Willmar Lk																	
07020004-653	Unnamed creek	Unnamed lk (34-0131-00) to Unnamed cr	1.59	2B, 3C	IF	NA								IF					--
07020004-654	Unnamed creek	Unnamed cr to Unnamed cr	3.2	2B, 3C	IF	NA								IF					--
07020004-656	Unnamed creek	Headwaters to Unnamed cr	2.14	2B, 3C	IF	NA								IF					--
07020004-657	Unnamed creek	Unnamed cr to Eagle Lk	0.43	2B, 3C	NA	NA								IF					--
07020004-662	Unnamed creek	Long Lk to East Solomon Lk	1.64	2B, 3C										--					
07020004-679	Unnamed creek	Unnamed lk (34-0408-00) to Long Lk	0.13	2B, 3C	IF	NA							--	--	NA	--			
07020004-732	Unnamed ditch	Unnamed ditch to Hawk Cr	1.47	2B, 3C									--	--		--	--		
07020004-733	Unnamed ditch	Unnamed ditch to Hawk Cr	1.5	2B, 3C									--	--		--	--		
07020004-736	Unnamed ditch	Unnamed creek to Hawk Cr	0.57	2B, 3C									--	--		--			
HUC 10: 0702000408 (Chetomba Creek)																			

AUID DESCRIPTIONS				USES							Aquatic Life Indicators								
National Hydrography Dataset (NHD) Assessment Segment AUID	Stream Segment Name	Segment Description	Reach Length (Miles)	Use Class	Aquatic Life	Aquatic Recreation	Aquatic Consumption	Class 7	303d list impairments		Fish IBI	Invert IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides	Bacteria (Aq. Recreation)
07020004-522	Chetomba Creek	CD 8 to T117 R36W S10, west line	2.38	2C									--	--		--	--		
07020004-571	Unnamed creek	Unnamed cr to Unnamed cr	3.1	2B, 3C									--	--		--			
07020004-572	Unnamed creek	Unnamed cr to CD 31	1.39	2B, 3C	IF	NA								MTS					
07020004-574	County Ditch 31 (Chetomba Creek)	Unnamed cr to Chetomba Cr	1.74	2B, 3C									--	--		--	--		
07020004-576	Chetomba Creek	T117 R36W S9, east line to T116 R37W S8, west line	17.57	7				IF					--		MTS	MTS	MTS		
07020004-588	Spring Creek	Unnamed ditch to Hawk Cr	0.84	2B, 3C									--	--		--	--		
07020004-589	Unnamed ditch	Chetomba Cr to Spring Cr	0.87	2B, 3C	NS	NS			T, E.coli				IF	EXS	MTS	MTS	MTS		EX
07020004-608	Unnamed ditch	Unnamed ditch to Chetomba Cr	2.09	2B, 3C	IF	NA								MTS					
07020004-623	Judicial Ditch 16	Headwaters to Chetomba Cr	8.17	2B, 3C	IF	NA							--	IF		--	--		
07020004-649	Judicial Ditch 1	Unnamed ditch to Chetomba	6.95	2B, 3C									--	--		--	--		

AUID DESCRIPTIONS				USES							Aquatic Life Indicators								
National Hydrography Dataset (NHD) Assessment Segment AUID	Stream Segment Name	Segment Description	Reach Length (Miles)	Use Class	Aquatic Life	Aquatic Recreation	Aquatic Consumption	Class 7	303d list impairments		Fish IBI	Invert IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides	Bacteria (Aq. Recreation)
		Cr																	
07020004-650	County Ditch 8	Unnamed ditch to CD 18	5.53	2B, 3C									--	--		--	--		
07020004-651	County Ditch 18	Unnamed ditch to CD 8	2.47	2B, 3C									--	--		--	--		
07020004-652	County Ditch 8	CD 18 to CD 31	1.57	2B, 3C										--					
07020004-683	Spring Creek	Unnamed cr to Unnamed ditch	1.66	2B, 3C									--	--		--			
07020004-728	Judicial Ditch 8	Unnamed ditch to Chetomba Cr	3.1	2B, 3C									--	--		--			
07020004-734	County Ditch 16	Unnamed ditch to CD 8	1.85	2B, 3C									--	--		--	--		
07020004-735	Unnamed ditch	Unnamed ditch to Unnamed ditch	1.7	2B, 3C									--	--		--	--		
HUC 10: 0702000409 (Lower Hawk Creek)																			
07020004-510	Hawk Creek	T117 R37W S6, north line to Chetomba Cr	10.45	2B, 3C	IF	NA	NS		HGF				--	EXS		--	--		
07020004-568	Hawk Creek	Unnamed cr to Unnamed cr	1.2	2B, 3C	NS	NS	NS		T, HGF, FC				IF	EXS	MTS	MTS	IF		EX

AUID DESCRIPTIONS				USES							Aquatic Life Indicators								
National Hydrography Dataset (NHD) Assessment Segment AUID	Stream Segment Name	Segment Description	Reach Length (Miles)	Use Class	Aquatic Life	Aquatic Recreation	Aquatic Consumption	Class 7	303d list impairments		Fish IBI	Invert IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides	Bacteria (Aq. Recreation)
07020004-587	Hawk Creek	Spring Cr to Minnesota R	15.63	2B, 3C	NS	NS	NS		T, HGF, E.coli		MTS	MTS	IF	EXS	MTS	MTS	MTS		EX
07020004-591	Hawk Creek	Chetomba Cr to Unnamed cr	2.94	2B, 3C	IF	NA	NS		HGF							MTS			
07020004-689	County Ditch 11	Unmnamed ditch to Hawk Cr	1.12	2B, 3C	IF	NS			E.coli				IF	EXS		MTS	--		EX
07020004-716	County Ditch 36	Unnamed cr to Hawk Cr	1.41	2B, 3C	NS	NA			B_F, B_I		EXS	EXP	--	--		--			
07020004-724	County Ditch 37	Headwaters to Hawk Cr	4.68	2B, 3C									--	--		--			
07020004-725	Unnamed ditch	Unnamed ditch to CD 11	0.13	2B, 3C									--	--		--	--		
07020004-730	Judicial Ditch 2	Unnamed ditch to Unnamed ditch	3.64	2B, 3C									--	--		--	--		
07020004-731	Unnamed ditch	Unnamed ditch to JD 2	2.02	2B, 3C									--	--		--	--		
HUC 10: 0702000410 (Wood Lake Creek-Minnesota River)																			
07020004-518	Judicial Ditch 10	Headwaters to Wood Lake Cr	3.5	2B, 3C									--	--		--	--		
07020004-546	Judicial Ditch 10 (Wood Lake	Timm Lk to Wood Lk outlet	15.45	2C					B_F				--	--		--	--		

AUID DESCRIPTIONS				USES							Aquatic Life Indicators								
National Hydrography Dataset (NHD) Assessment Segment AUID	Stream Segment Name	Segment Description	Reach Length (Miles)	Use Class	Aquatic Life	Aquatic Recreation	Aquatic Consumption	Class 7	303d list impairments		Fish IBI	Invert IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides	Bacteria (Aq. Recreation)
	Creek)																		
07020004-547	Judicial Ditch 10 (Wood Lake Creek)	Wood Lk outlet to Minnesota R	8.54	2C	NS	NS			E.coli, B_F, B_I		EXS	EXS	IF	EXS	MTS	MTS	--		EX
07020004-554	Boiling Spring Creek	Unnamed lateral ditch to T114 R37W S19, east line	9.43	7									--			--	--		
07020004-555	Boiling Spring Creek	T114 R37W S20, west line to Minnesota R	4.25	2C	IF	NS			E.coli		MTS	MTS	IF	EXS	MTS	MTS	--		EX
07020004-566	Unnamed creek	Unnamed cr to Unnamed cr	2.96	2B, 3C	NS	NA			B_F B_I		EXS	EXS	--	--		--	--		
07020004-614	County Ditch 104	T115 R37W S7, west line to Minnesota R	7.79	7									--			--			
07020004-620	Boiling Spring Creek	Headwaters to T113 R38W S7, east line	1.55	2C									--	--		--			
07020004-648	Unnamed creek (County Ditch 119)	Unnamed cr to Minnesota R	1.17	2B, 3C	IF	NS			E.coli				IF	EXS		MTS	MTS		EX
07020004-684	County Ditch 116	Unnamed ditch to T115 R37W S8, east line	5.02	2B, 3C	IF	NA							--	IF		--			
07020004-685	County	Headwaters	4.23	2B, 3C	IF	NA								IF					

AUID DESCRIPTIONS				USES							Aquatic Life Indicators								
National Hydrography Dataset (NHD) Assessment Segment AUID	Stream Segment Name	Segment Description	Reach Length (Miles)	Use Class	Aquatic Life	Aquatic Recreation	Aquatic Consumption	Class 7	303d list impairments		Fish IBI	Invert IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides	Bacteria (Aq. Recreation)
	Ditch 119	to Unnamed ditch																	
07020004-686	County Ditch 119	Unnamed ditch to Unnamed ditch	4.67	2B, 3C										--					
07020004-687	County Ditch 119	Unnamed ditch to Unnamed cr	2.85	2B, 3C	NS	NA			B_F, B_I		EXS	EXS	--	--		--			
07020004-717	County Ditch 2	Unnamed cr to Minnesota R	3	2B, 3C	NS	NA			B_F		EXS	MTS	--	--		--	--		
07020004-718	Unnamed creek	Lone Tree Lk to Minnesota R	4.98	2B, 3C	NS	NA			B_F, B_I		EXS	EXP	--	--		--	--		
07020004-719	Unnamed creek	Unnamed cr to Minnesota R	6.05	2B, 3C									--	--		--	--		
07020004-737	County Ditch 31	Headwaters to JD 10	5.27	2B, 3C									--	--		--	--		
HUC 10: 0702000411 (Beaver Creek)																			
07020004-528	Beaver Creek	E Fk Beaver Cr to Minnesota R	13.29	2B, 3C	NS	NS			T, FC		MTS	MTS	MTS	EXS	MTS	MTS	MTS		EX
07020004-530	Beaver Creek, West Fork	Headwaters to E Fk Beaver Cr	29.42	2B, 3C	IF	NS			T, FC DO				EXS	EXS	MTS	MTS	MTS		EX
07020004-531	County Ditch 37 (1)	Headwaters to W Fk Beaver Cr	4.1	2B, 3C	IF	NA			DO				EXS	MTS		MTS			
07020004-532	County Ditch 37 (2)	Headwaters to W Fk Beaver Cr	4.99	2B, 3C	IF	NA								MTS					

AUID DESCRIPTIONS				USES							Aquatic Life Indicators								
National Hydrography Dataset (NHD) Assessment Segment AUID	Stream Segment Name	Segment Description	Reach Length (Miles)	Use Class	Aquatic Life	Aquatic Recreation	Aquatic Consumption	Class 7	303d list impairments		Fish IBI	Invert IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides	Bacteria (Aq. Recreation)
07020004-585	Beaver Creek, East Fork	Unnamed ditch to T115 R35W S26, south line	11.61	7									--			--	--		
07020004-586	Beaver Creek, East Fork	T115 R35W S35, north line to W Fk Beaver Cr	8.4	2B, 3C	IF	NS			E.coli, B_I		EXP	EXS	IF	EXS	MTS	MTS	--		EX
07020004-618	Unnamed creek	Headwaters to Beaver Cr	4.21	2B, 3C									--	--					
07020004-621	County Ditch 63 (East Fork Beaver Creek)	Unnamed ditch to Unnamed ditch	4.24	7									--			--			
07020004-677	County Ditch 59	Unnamed cr to W Fk Beaver Cr	5.17	2B, 3C	IF	NA			DO				EXS	IF		--	--		
07020004-678	County Ditch 17A	Unnamed ditch to W Fk Beaver Cr	1.61	2B, 3C	IF	NA							--	IF		--			
07020004-721	County Ditch 110	Unnamed ditch to W Fk Beaver Cr	1.91	2B, 3C									--	--		--	--		
07020004-722	County Ditch 117	Unnamed ditch to Beaver Cr	4.4	2B, 3C									--	--		--			
07020004-727	County Ditch 31	Unnamed ditch to W Fk Beaver Cr	2.55	2B, 3C									--	--		--			
HUC 10: 0702000412 (Sacred Heart Creek-																			

AUID DESCRIPTIONS				USES							Aquatic Life Indicators								
National Hydrography Dataset (NHD) Assessment Segment AUID	Stream Segment Name	Segment Description	Reach Length (Miles)	Use Class	Aquatic Life	Aquatic Recreation	Aquatic Consumption	Class 7	303d list impairments		Fish IBI	Invert IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides	Bacteria (Aq. Recreation)
Minnesota River)																			
07020004-525	Timms Creek	Headwaters to Minnesota R	16.33	2C	IF	NS			E.coli T, B_I		MTS	EXP	IF	EXS	MTS	MTS	MTS		EX
07020004-526	Sacred Heart Creek	Headwaters to Minnesota R	14.88	2B, 3C	IF	NS			E.coli B_F, T, B_I		EXP	EXP	EXS	EXS	MTS	MTS	MTS		EX
07020004-551	County Ditch 12	Headwaters to T113 R36W S8, north line	9.98	7				IF					IF		MTS	MTS	--		--
07020004-552	County Ditch 12	T113 R36W S5, south line to Minnesota R	3.18	2B, 3C	FS	NA					EXP		--	--		--			
07020004-604	Echo Creek	Unnamed cr to Minnesota R	6.52	2C	FS	NA			B_F		MTS		--	--		--	--		
07020004-615	Middle Creek	CD 120 to Minnesota R	1.92	2C	IF	NS			E.coli				IF	IF		MTS			EX
07020004-617	Smith Creek (County Ditch 125A)	T113 R35W S4, north line to Minnesota R	6.42	2C	NS	NS			E.coli, B_I		MTS	EXP	IF	MTS		MTS	--		EX
07020004-647	Camp Pope Creek	Headwaters to Minnesota R	3.12	2B, 3C									--	--		--			
07020004-675	County Ditch 45	T114 R36W S7, north line to Sacred Heart Cr	3.69	2B, 3C	FS	NA					EXP	MTS	--	--	--	--			
07020004-676	County	T115 R36W	7.62	7				IF					MTS		MTS	MTS	MTS		--

AUID DESCRIPTIONS				USES							Aquatic Life Indicators								
National Hydrography Dataset (NHD) Assessment Segment AUID	Stream Segment Name	Segment Description	Reach Length (Miles)	Use Class	Aquatic Life	Aquatic Recreation	Aquatic Consumption	Class 7	303d list impairments		Fish IBI	Invert IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides	Bacteria (Aq. Recreation)
	Ditch 45	S7, east line to T114 R36W S6, south line																	
07020004-739	Unnamed ditch	Unnamed ditch to CD 45	3.13	2B, 3C	IF	NA			DO				EXS		MTS	MTS	--		

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

Appendix 3.2 - Assessment results for lakes in the Minnesota River - Granite Falls Watershed

Lake ID	Lake Name	County	HUC-10	Ecoregion	Lake Area (ha)	Max Depth (m)	Mean Depth (m)	Watershed Area (ha)	% Littoral	Aquatic Recreation Use Support
87-0067-00	Stokke	Yellow Medicine	0702000401	WCBP	33			82		IF
41-0054-00	Anderson	Lincoln	0702000403	NGP	138			5,866		IF
41-0055-00	North Ash	Lincoln	0702000403	NGP	38	1.0	1*	1,064	100	IF
41-0057-00	South Ash	Lincoln	0702000403	NGP	61	1.5	1*	809	100	IF
41-0062-00	Oak	Lincoln	0702000403	NGP	43	3.0	1*	293	100	FS
41-0067-00	Perch	Lincoln	0702000403	NGP	83	2.7	1.5	339	100	NS
41-0082-00	Steep Bank	Lincoln	0702000403	NGP	84	2.0	1*	726	100	NS
41-0084-00	Biggs	Lincoln	0702000403	NGP	52			2,457		IF
41-0089-00	Shaokotan	Lincoln	0702000403	NGP	422	3.7	2.0	3,568	100	NS
41-0096-00	Widmark Marsh	Lincoln	0702000403	NGP	9			84	100	IF
42-0099-00	Conger's Slough	Lyon	0702000403	WCBP	31			361	100	IF
41-0024-00	Gislason	Lincoln	0702000404	NGP	49			423		IF
41-0034-00	Stay	Lincoln	0702000404	NGP	89	1.8	1*	2,444	100	NS
41-0045-00	Hawksnest	Lincoln	0702000404	NGP	109	0.7	1*	380	100	IF
87-0098-00	Unnamed	Yellow Medicine	0702000405	WCBP	12			124		IF
42-0014-00	Cottonwood	Lyon	0702000406	WCBP	155	2.4	1*	5,262	100	NS
87-0060-00	Spellman	Yellow Medicine	0702000406	WCBP	121	1.5	1*	638	100	IF
87-0061-00	Miedd	Yellow Medicine	0702000406	WCBP	59			106		IF
34-0115-00	East Twin	Kandiyohi	0702000407	NCHF	65	2.3	1*	670	100	FS
34-0116-00	Henderson	Kandiyohi	0702000407	NCHF	37	17.4	6.3	104	37	FS
34-0117-00	West Twin	Kandiyohi	0702000407	NCHF	31	2.5	1*	847	100	FS
34-0171-00	Eagle	Kandiyohi	0702000407	NCHF	361	19.8	7.4	4,613	33.3	FS
34-0172-00	Ringo	Kandiyohi	0702000407	NCHF	313	2.1	1.3	1,767	100	NS
34-0180-00	Willmar	Kandiyohi	0702000407	WCBP	259	4.3	1.8	7,988	100	IF
34-0181-00	Foot	Kandiyohi	0702000407	WCBP	220	7.3	1.7	8,649	95.6	FS
34-0186-00	Swan	Kandiyohi	0702000407	WCBP	83	1.5	1*	5,426	100	NS

Lake ID	Lake Name	County	HUC-10	Ecoregion	Lake Area (ha)	Max Depth (m)	Mean Depth (m)	Watershed Area (ha)	% Littoral	Aquatic Recreation Use Support
34-0192-00	Long	Kandiyohi	0702000407	NCHF	694	4.9	2.9	3,386	94.5	NS
34-0193-00	Point	Kandiyohi	0702000407	NCHF	30	9.8	3.1	190	75	FS
34-0194-00	Unnamed	Kandiyohi	0702000407	WCBP	20			137		IF
34-0196-00	Skataas	Kandiyohi	0702000407	WCBP	81	3.2	2.4	529	100	IF
34-0245-00	West Solomon	Kandiyohi	0702000407	WCBP	227	4.0	2.1	7,091	100	NS
34-0246-00	East Solomon	Kandiyohi	0702000407	WCBP	243	4.3	2.5	5,121	100	IF
34-0283-00	Saint Johns	Kandiyohi	0702000407	WCBP	78	2.0	1.3	8,013	100	NS
34-0294-00	Lindgren	Kandiyohi	0702000407	WCBP	25			544		IF
34-0297-00	West Lindgren	Kandiyohi	0702000407	WCBP	26			259		IF
34-0266-00	Olson	Kandiyohi	0702000408	WCBP	50	0.9	0.6	199	100	NS
42-0020-00	Lady Slipper	Lyon	0702000410	WCBP	106	2.7	1.4	599	100	NS
87-0016-00	Curtis	Yellow Medicine	0702000410	WCBP	178	1.8	1.1	2,453	100	NS
87-0017-00	Timm	Yellow Medicine	0702000410	WCBP	105	0.6	1*	795	100	IF
87-0019-00	Tyson	Yellow Medicine	0702000410	WCBP	73	2.3	1*	301	100	IF
87-0030-00	Wood	Yellow Medicine	0702000410	WCBP	196	2.6	1.9	2,469	100	NS

Abbreviations:

FS – Full Support
NS – Non-Support
IF – Insufficient Information
N/A – Not Assessed

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

*These depths were created by MPCA Staff.

Appendix 4.1 - Minnesota statewide IBI thresholds and confidence limits

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

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

HUC_10	WID	FieldNum	NAME	DrainSqMi	FishClass	FishIBI	Threshold	VisitDate
0702000401	07020004-536	10MN014	Hazel Creek	75.32	2	67	45	28-Jul-10
0702000402	07020004-534	10MN007	Palmer Creek (County Ditch 68)	33.28	2	53	45	28-Jul-10
0702000402	07020004-713	10MN051	County Ditch 39	21.90	3	40	51	12-Aug-10
0702000402	07020004-610	10MN076	Brafees Creek	6.38	3	68	51	07-Jul-10
0702000402	07020004-682	10MN116	County Ditch 36A	8.54	3	65	51	07-Jul-10
0702000402	07020004-674	10MN121	Judicial Ditch 23	22.30	3	66	51	22-Jul-10
0702000403	07020004-542	03MN042	Yellow Medicine River, North Branch	41.42	2	44	45	05-Aug-03
0702000403	07020004-542	10EM016	Yellow Medicine River, North Branch	40.80	2	51	45	24-Aug-10
0702000403	07020004-543	10EM126	Mud Creek	35.97	2	54	45	23-Aug-10
0702000403	07020004-584	10MN002	Yellow Medicine River	70.18	2	42	45	04-Aug-10
0702000403	07020004-584	10MN011	Yellow Medicine River	191.03	2	66	45	10-Aug-10
0702000403	07020004-543	10MN075	Mud Creek	39.97	2	59	45	03-Aug-10
0702000403	07020004-694	10MN059	Unnamed creek	5.60	3	32	51	08-Jun-10
0702000403	07020004-564	10MN065	Unnamed creek	8.03	3	68	51	03-Aug-10
0702000404	07020004-503	03MN038	Yellow Medicine River, South Branch (County Ditch 35)	75.74	2	61	45	26-Jun-03
0702000404	07020004-503	03MN039	Yellow Medicine River, South Branch (County Ditch 35)	84.62	2	47	45	26-Jun-03
0702000404	07020004-503	10EM062	Yellow Medicine River, South Branch (County Ditch 35)	74.92	2	61	45	18-Aug-10
0702000404	07020004-503	10MN003	Yellow Medicine River, South Branch (County Ditch 35)	122.11	2	57	45	09-Aug-10
0702000404	07020004-503	10MN030	Yellow Medicine River, South Branch (County Ditch 35)	89.56	2	53	45	10-Aug-10
0702000404	07020004-595	10MN029	Unnamed creek	9.32	3	15	51	09-Jun-10
0702000406	07020004-513	03MN048	Yellow Medicine River	438.99	1	36	46	05-Aug-10
0702000406	07020004-513	03MN048	Yellow Medicine River	438.99	1	55	46	17-Jul-03
0702000406	07020004-513	03MN048	Yellow Medicine River	438.99	1	56	46	25-Jun-03
0702000406	07020004-513	10MN038	Yellow Medicine River	379.78	1	54	46	25-Aug-10
0702000406	07020004-513	10MN038	Yellow Medicine River	379.78	1	59	46	11-Aug-10
0702000406	07020004-513	10MN045	Yellow Medicine River	452.64	1	42	46	04-Aug-10
0702000406	07020004-513	10MN096	Yellow Medicine River	425.05	1	33	46	03-Aug-10
0702000406	07020004-502	90MN015	Yellow Medicine River	675.75	1	74	46	29-Aug-11
0702000409	07020004-587	10MN122	Hawk Creek	494.29	1	51	46	28-Jul-10

HUC_10	WID	FieldNum	NAME	DrainSqMi	FishClass	FishIBI	Threshold	VisitDate
0702000409	07020004-587	90MN017	Hawk Creek	501.16	1	71	46	14-Sep-10
0702000409	07020004-716	10MN144	County Ditch 36	5.11	3	26	51	08-Jul-10
0702000410	07020004-555	10MN008	Boiling Spring Creek	30.22	2	62	45	13-Jul-10
0702000410	07020004-547	10MN013	Judicial Ditch 10 (Wood Lake Creek)	69.76	2	31	45	22-Jun-10
0702000410	07020004-547	10MN013	Judicial Ditch 10 (Wood Lake Creek)	69.76	2	46	45	04-Aug-10
0702000410	07020004-718	10MN057	Unnamed creek	9.06	3	0	51	22-Jun-10
0702000410	07020004-718	10MN057	Unnamed creek	9.06	3	32	51	23-Aug-10
0702000410	07020004-717	10MN125	County Ditch 2	7.47	3	25	51	21-Jul-10
0702000410	07020004-687	10MN140	County Ditch 119	14.42	3	43	51	21-Jun-10
0702000410	07020004-566	91MN050	Unnamed creek	13.74	3	0	51	20-Jul-10
0702000410	07020004-566	91MN050	Unnamed creek	13.74	3	0	51	25-Aug-10
0702000411	07020004-586	10MN006	Beaver Creek, East Fork	72.27	2	49	45	26-Jul-10
0702000411	07020004-528	92MN052	Beaver Creek	191.32	2	47	45	27-Jul-10
0702000411	07020004-528	92MN052	Beaver Creek	191.32	2	52	45	12-Aug-10
0702000412	07020004-526	10MN009	Sacred Heart Creek	45.28	2	55	45	14-Jul-10
0702000412	07020004-552	10MN136	County Ditch 12	30.02	2	47	45	15-Jul-10
0702000412	07020004-604	03MN057	Echo Creek	13.45	3	61	51	16-Jul-03
0702000412	07020004-604	03MN057	Echo Creek	13.45	3	66	51	02-Jul-03
0702000412	07020004-604	03MN057	Echo Creek	13.45	3	66	51	15-Jul-10
0702000412	07020004-675	04MN003	County Ditch 45	21.49	3	56	51	11-Aug-10
0702000412	07020004-526	10MN021	Sacred Heart Creek	21.35	3	41	51	24-Jun-10
0702000412	07020004-525	10MN077	Timms Creek	23.74	3	84	51	21-Jul-10
0702000412	07020004-617	10MN108	Smith Creek (County Ditch 125A)	13.70	3	74	51	15-Jul-10

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

HUC_10	WID	FieldNum	WBName	DrainSqMi	InvertClass	MIBI	Threshold	VisitDate
0702000401	07020004-536	10MN014	Hazel Creek	75.32	5	27.49	35.90	05-Aug-10
0702000402	07020004-674	10MN121	Judicial Ditch 23	22.30	5	39.12	35.90	03-Aug-10
0702000402	07020004-713	10MN051	County Ditch 39	21.90	5	28.77	35.90	04-Aug-10
0702000402	07020004-534	10MN007	Palmer Creek	33.28	5	34.22	35.90	03-Aug-10
0702000402	07020004-610	10MN076	Brafees Creek	6.38	7	49.60	38.30	03-Aug-10
0702000403	07020004-542	10EM016	Yellow Medicine River, North Branch	40.80	5	28.41	35.90	10-Aug-10
0702000403	07020004-564	10MN065	Trib. to Yellow Medicine River, North Br	8.03	5	31.59	35.90	10-Aug-10
0702000403	07020004-584	10MN002	Yellow Medicine River	70.18	7	54.71	38.30	11-Aug-10
0702000403	07020004-584	10MN011	Yellow Medicine River	191.03	7	42.38	38.30	11-Aug-10
0702000403	07020004-694	10MN059	Trib. to Yellow Medicine River	5.60	7	27.77	38.30	04-Aug-10
0702000403	07020004-542	03MN042	Yellow Medicine River, North Branch	41.42	7	21.05	38.30	19-Aug-03
0702000403	07020004-543	10EM126	Mud Creek	35.97	7	26.34	38.30	11-Aug-10
0702000403	07020004-543	10MN075	Mud Creek	39.97	7	35.70	38.30	11-Aug-10
0702000404	07020004-503	03MN038	Yellow Medicine River, South Branch	75.74	5	39.05	35.90	26-Aug-03
0702000404	07020004-503	03MN039	Yellow Medicine River, South Branch	84.62	5	44.02	35.90	26-Aug-03
0702000404	07020004-503	10EM062	Yellow Medicine River, South Branch	74.92	5	36.51	35.90	05-Aug-10
0702000404	07020004-503	10MN003	Yellow Medicine River, South Branch	122.11	7	47.30	38.30	11-Aug-10
0702000404	07020004-503	10MN030	Yellow Medicine River, South Branch	89.56	7	32.92	38.30	04-Aug-10
0702000404	07020004-503	10MN030	Yellow Medicine River, South Branch	89.56	7	44.89	38.30	11-Aug-10
0702000404	07020004-595	10MN029	Trib. to Yellow Medicine River, South Br	9.32	7	38.61	38.30	04-Aug-10
0702000406	07020004-502	90MN015	Yellow Medicine River	675.75	2	35.73	30.70	24-Aug-10
0702000406	07020004-513	03MN048	Yellow Medicine River	438.99	7	36.18	38.30	25-Aug-03
0702000406	07020004-513	03MN048	Yellow Medicine River	438.99	7	46.52	38.30	12-Aug-10
0702000406	07020004-513	10MN038	Yellow Medicine River	379.78	7	37.51	38.30	12-Aug-10
0702000406	07020004-513	10MN045	Yellow Medicine River	452.64	7	44.39	38.30	12-Aug-10
0702000406	07020004-513	10MN096	Yellow Medicine River	425.05	7	46.41	38.30	12-Aug-10

HUC_10	WID	FieldNum	WBName	DrainSqMi	InvertClass	MIBI	Threshold	VisitDate
0702000409	07020004-587	06MN002	Hawk Creek	500.14	2	40.55	30.70	02-Oct-06
0702000409	07020004-587	90MN017	Hawk Creek	501.16	2	24.52	30.70	10-Aug-10
0702000409	07020004-716	10MN144	County Ditch 36	5.11	5	29.35	35.90	02-Aug-10
0702000409	07020004-587	10MN122	Hawk Creek	494.29	5	36.43	35.90	02-Aug-10
0702000409	07020004-587	10MN122	Hawk Creek	494.29	5	52.19	35.90	02-Oct-06
0702000410	07020004-547	10MN013	Judicial Ditch 10	69.76	5	17.37	35.90	05-Aug-10
0702000410	07020004-717	10MN125	County Ditch 2	7.47	7	59.58	38.30	05-Aug-10
0702000410	07020004-718	10MN057	Trib. to Minnesota River	9.06	7	30.79	38.30	10-Aug-10
0702000410	07020004-566	91MN050	Trib. to Minnesota River	13.74	7	15.91	38.30	02-Aug-10
0702000410	07020004-566	91MN050	Trib. to Minnesota River	13.74	7	16.34	38.30	24-Aug-10
0702000410	07020004-687	10MN140	County Ditch 119	14.42	7	19.40	38.30	11-Aug-10
0702000410	07020004-555	10MN008	Boiling Spring Creek	30.22	7	40.44	38.30	11-Aug-10
0702000411	07020004-586	10MN006	Beaver Creek, East Fork	72.27	5	19.00	35.90	24-Aug-10
0702000411	07020004-528	92MN052	Beaver Creek	191.32	7	55.59	38.30	09-Aug-10
0702000412	07020004-509	05MN004	Minnesota River	8056.07	2	30.09	30.70	21-Sep-05
0702000412	07020004-675	04MN003	County Ditch 45	21.49	5	52.32	35.90	05-Oct-04
0702000412	07020004-526	10MN009	Sacred Heart Creek	45.28	5	37.43	35.90	12-Aug-10
0702000412	07020004-526	10MN021	Sacred Heart Creek	21.35	5	15.11	35.90	12-Aug-10
0702000412	07020004-525	10MN077	Timms Creek	23.74	5	29.05	35.90	11-Aug-10
0702000412	07020004-617	10MN108	Smith Creek	13.70	5	27.28	35.90	09-Aug-10

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

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

Class #	Class Name	Good	Fair	Poor
Fish				
1	Southern Rivers	>38	38-24	<24
2	Southern Streams	>44	44-30	<30
3	Southern Headwaters	>50	50-36	<36
4	Northern Rivers	>34	34-20	<20
5	Northern Streams	>49	49-35	<35
6	Northern Headwaters	>39	39-25	<25
7	Low Gradient Streams	>39	39-25	<25
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

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

HUC_10	WID	FieldNum	NAME	DrainSqMi	FishClass	FishIBI	Good	Fair	Poor	VisitDate
0702000401	07020004-536	10MN047	Hazel Creek	42.49	2	0	>44	44-30	<30	28-Jul-10
0702000401	07020004-707	10MN048	Unnamed creek	6.48	7	5	>39	39-25	<25	18-Aug-10
0702000401	07020004-707	10MN048	Unnamed creek	6.48	7	8	>39	39-25	<25	26-Aug-10
0702000402	07020004-535	10MN123	Stony Run Creek	32.07	2	0	>44	44-30	<30	03-Aug-10
0702000402	07020004-535	10MN015	Stony Run Creek	53.57	2	49	>44	44-30	<30	22-Jul-10
0702000402	07020004-709	10MN052	Unnamed ditch	5.33	3	26	>50	50-36	<36	07-Jul-10
0702000402	07020004-710	10MN058	Unnamed creek	11.28	3	46	>50	50-36	<36	10-Aug-10
0702000402	07020004-708	10MN118	County Ditch 36	6.03	3	63	>50	50-36	<36	18-Aug-10
0702000402	07020004-711	10MN120	County Ditch 90	5.33	3	42	>50	50-36	<36	22-Jun-10
0702000402	07020004-714	10MN050	County Ditch 6A	9.86	3	0	>50	50-36	<36	22-Jun-10
0702000402	07020004-714	10MN050	County Ditch 6A	9.86	3	54	>50	50-36	<36	12-Aug-10
0702000402	07020004-673	10MN132	Judicial Ditch 23	14.59	3	54	>50	50-36	<36	10-Aug-10
0702000402	07020004-673	10MN132	Judicial Ditch 23	14.59	3	64	>50	50-36	<36	24-Aug-10
0702000402	07020004-580	10MN114	Stony Run Creek	19.31	7	0	>39	39-25	<25	22-Jul-10
0702000403	07020004-584	07MN070	Yellow Medicine River	42.07	2	35	>44	44-30	<30	29-Aug-07
0702000403	07020004-543	10MN010	Mud Creek	55.98	2	71	>44	44-30	<30	04-Aug-10
0702000403	07020004-545	10MN017	Unnamed creek	33.96	2	54	>44	44-30	<30	18-Aug-10
0702000403	07020004-542	10MN071	Yellow Medicine River, North Branch	64.13	2	43	>44	44-30	<30	04-Aug-10
0702000403	07020004-695	10MN066	Unnamed creek	9.12	3	58	>50	50-36	<36	08-Jun-10
0702000403	07020004-592	10MN022	Unnamed creek	5.82	3	0	>50	50-36	<36	08-Jun-10
0702000403	07020004-584	10MN060	Yellow Medicine River	24.51	3	46	>50	50-36	<36	08-Jun-10
0702000403	07020004-912	10MN061	County Ditch 8	9.63	3	3	>50	50-36	<36	08-Jun-10
0702000404	07020004-503	03MN040	Yellow Medicine River, South Branch (County Ditch 35)	34.90	2	30	>44	44-30	<30	09-Jun-10
0702000404	07020004-503	03MN040	Yellow Medicine River, South Branch (County Ditch 35)	34.90	2	34	>44	44-30	<30	30-Jun-03
0702000404	07020004-503	03MN041	Yellow Medicine River, South Branch (County Ditch 35)	33.50	2	29	>44	44-30	<30	30-Jun-03
0702000404	07020004-600	10MN023	Unnamed creek	9.80	3	0	>50	50-36	<36	09-Jun-10
0702000404	07020004-600	10MN023	Unnamed creek	9.80	3	13	>50	50-36	<36	17-Aug-10
0702000404	07020004-549	10MN027	Judicial Ditch 29	2.50	3	15	>50	50-36	<36	09-Jun-10
0702000404	07020004-550	10MN028	Judicial Ditch 29	27.69	3	39	>50	50-36	<36	07-Jun-10

HUC_10	WID	FieldNum	NAME	DrainSqMi	FishClass	FishIBI	Good	Fair	Poor	VisitDate
0702000404	07020004-550	10MN028	Judicial Ditch 29	27.69	3	47	>50	50-36	<36	13-Jul-10
0702000404	07020004-503	10MN024	Yellow Medicine River, South Branch (County Ditch 35)	20.47	3	42	>50	50-36	<36	09-Jun-10
0702000404	07020004-549	10MN025	Judicial Ditch 29	16.43	3	56	>50	50-36	<36	09-Jun-10
0702000405	07020004-538	10EM190	Spring Creek	65.65	2	24	>44	44-30	<30	18-Aug-10
0702000405	07020004-538	91MN014	Spring Creek	121.44	2	40	>44	44-30	<30	02-Aug-10
0702000405	07020004-538	10MN037	Spring Creek	73.96	2	0	>44	44-30	<30	03-Aug-10
0702000405	07020004-539	10MN046	Unnamed ditch	6.02	3	0	>50	50-36	<36	03-Aug-10
0702000405	07020004-697	10MN068	County Ditch 48	8.52	3	0	>50	50-36	<36	13-Jul-10
0702000405	07020004-697	10MN068	County Ditch 48	8.52	3	0	>50	50-36	<36	11-Aug-10
0702000406	07020004-622	10MN012	Judicial Ditch 17	61.87	2	64	>44	44-30	<30	21-Jul-10
0702000406	07020004-670	10MN043	Judicial Ditch 24	40.23	2	19	>44	44-30	<30	05-Aug-10
0702000406	07020004-663	10MN070	County Ditch 4	7.08	3	41	>50	50-36	<36	07-Jun-10
0702000406	07020004-634	10MN062	County Ditch 37	7.53	3	50	>50	50-36	<36	08-Jun-10
0702000406	07020004-636	10MN064	Judicial Ditch 7	27.93	3	43	>50	50-36	<36	08-Jun-10
0702000406	07020004-636	10MN064	Judicial Ditch 7	27.93	3	47	>50	50-36	<36	23-Aug-10
0702000406	07020004-703	10MN130	Unnamed creek	16.60	7	0	>39	39-25	<25	07-Jun-10
0702000407	07020004-508	03MN007	Hawk Creek	49.97	2	0	>44	44-30	<30	09-Jul-07
0702000407	07020004-508	03MN007	Hawk Creek	49.97	2	36	>44	44-30	<30	04-Aug-03
0702000407	07020004-510	03MN016	Hawk Creek	230.01	2	63	>44	44-30	<30	04-Aug-03
0702000407	07020004-524	07MN047	Unnamed creek	46.65	2	29	>44	44-30	<30	09-Jul-07
0702000407	07020004-508	03MN007	Hawk Creek	49.97	2	37	>44	44-30	<30	02-Aug-10
0702000407	07020004-508	10MN081	Hawk Creek	113.18	2	46	>44	44-30	<30	28-Jul-10
0702000407	07020004-578	10MN086	Unnamed creek	32.13	2	32	>44	44-30	<30	09-Aug-10
0702000407	07020004-510	10MN133	Hawk Creek	195.40	2	38	>44	44-30	<30	28-Jul-10
0702000407	07020004-508	10MN147	Hawk Creek	104.61	2	43	>44	44-30	<30	29-Jul-10
0702000407	07020004-510	10MN031	Hawk Creek	241.07	2	52	>44	44-30	<30	04-Aug-10
0702000407	07020004-524	10MN089	Unnamed creek	61.77	2	42	>44	44-30	<30	10-Aug-10
0702000407	07020004-508	10MN106	Hawk Creek	76.26	2	48	>44	44-30	<30	29-Jul-10
0702000407	07020004-524	10EM110	Unnamed creek	4.50	3	41	>50	50-36	<36	19-Aug-10
0702000407	07020004-733	10MN098	Unnamed ditch	5.21	3	49	>50	50-36	<36	19-Jul-10
0702000407	07020004-732	10MN104	Unnamed ditch	12.46	7	21	>39	39-25	<25	18-Aug-10

HUC_10	WID	FieldNum	NAME	DrainSqMi	FishClass	FishIBI	Good	Fair	Poor	VisitDate
0702000408	07020004-576	07MN077	Chetomba Creek	107.78	2	24	>44	44-30	<30	28-Aug-07
0702000408	07020004-576	10EM046	Chetomba Creek	133.71	2	20	>44	44-30	<30	15-Sep-10
0702000408	07020004-576	10EM046	Chetomba Creek	133.71	2	22	>44	44-30	<30	19-Aug-10
0702000408	07020004-574	10MN083	County Ditch 31 (Chetomba Creek)	31.39	2	21	>44	44-30	<30	20-Jul-10
0702000408	07020004-576	97MN004	Chetomba Creek	114.89	2	33	>44	44-30	<30	27-Jul-10
0702000408	07020004-588	10MN016	Spring Creek	158.52	2	25	>44	44-30	<30	27-Jul-10
0702000408	07020004-522	10MN148	Chetomba Creek	76.23	2	20	>44	44-30	<30	11-Aug-10
0702000408	07020004-735	10MN084	Unnamed ditch	14.11	3	39	>50	50-36	<36	25-Aug-10
0702000408	07020004-735	10MN084	Unnamed ditch	14.11	3	40	>50	50-36	<36	19-Jul-10
0702000408	07020004-735	10MN084	Unnamed ditch	14.11	3	42	>50	50-36	<36	09-Aug-10
0702000408	07020004-734	10MN088	County Ditch 16	7.05	3	13	>50	50-36	<36	19-Jul-10
0702000408	07020004-683	10MN124	Spring Creek	4.13	3	0	>50	50-36	<36	06-Jul-10
0702000408	07020004-651	91MN016	County Ditch 18	9.54	3	19	>50	50-36	<36	20-Jul-10
0702000408	07020004-649	10MN082	Judicial Ditch 1	15.15	3	44	>50	50-36	<36	20-Jul-10
0702000408	07020004-571	10MN085	Unnamed creek	7.92	3	17	>50	50-36	<36	19-Jul-10
0702000408	07020004-650	10MN091	County Ditch 8	18.46	7	0	>39	39-25	<25	19-Jul-10
0702000408	07020004-728	10MN111	Judicial Ditch 8	4.93	7	0	>39	39-25	<25	06-Jul-10
0702000408	07020004-623	10MN101	Judicial Ditch 16	9.87	7	10	>39	39-25	<25	20-Jul-10
0702000408	07020004-623	10MN101	Judicial Ditch 16	9.87	7	10	>39	39-25	<25	25-Aug-10
0702000409	07020004-568	97MN006	Hawk Creek	318.06	1	47	>38	38-24	<24	04-Aug-10
0702000409	07020004-689	10MN032	County Ditch 11	57.71	2	50	>44	44-30	<30	27-Jul-10
0702000409	07020004-689	10MN032	County Ditch 11	57.71	2	65	>44	44-30	<30	25-Aug-10
0702000409	07020004-725	10MN138	Unnamed ditch	34.63	2	0	>44	44-30	<30	22-Jul-10
0702000409	07020004-731	10MN102	Unnamed ditch	8.24	3	19	>50	50-36	<36	19-Jul-10
0702000409	07020004-730	10MN103	Judicial Ditch 2	11.55	3	16	>50	50-36	<36	19-Jul-10
0702000409	07020004-724	10MN137	County Ditch 37	6.26	3	39	>50	50-36	<36	08-Jul-10
0702000410	07020004-546	03MN049	Judicial Ditch 10 (Wood Lake Creek)	36.00	2	8	>44	44-30	<30	02-Jul-03
0702000410	07020004-546	03MN049	Judicial Ditch 10 (Wood Lake Creek)	36.00	2	14	>44	44-30	<30	16-Jul-03
0702000410	07020004-547	07MN069	Judicial Ditch 10 (Wood Lake Creek)	64.49	2	11	>44	44-30	<30	29-Aug-07
0702000410	07020004-546	10MN126	Judicial Ditch 10 (Wood Lake Creek)	51.29	2	14	>44	44-30	<30	16-Aug-10
0702000410	07020004-737	10MN128	County Ditch 31	12.19	3	36	>50	50-36	<36	12-Jul-10

HUC_10	WID	FieldNum	NAME	DrainSqMi	FishClass	FishIBI	Good	Fair	Poor	VisitDate
0702000410	07020004-719	10MN139	Unnamed creek	5.38	3	20	>50	50-36	<36	21-Jun-10
0702000410	07020004-719	10MN139	Unnamed creek	5.38	3	56	>50	50-36	<36	24-Aug-10
0702000410	07020004-614	10MN141	County Ditch 104	8.58	3	42	>50	50-36	<36	24-Jun-10
0702000410	07020004-684	10MN150	County Ditch 116	4.43	3	19	>50	50-36	<36	23-Jun-10
0702000410	07020004-620	10MN151	Boiling Spring Creek	10.74	3	0	>50	50-36	<36	10-Jun-10
0702000410	07020004-546	10MN056	Judicial Ditch 10 (Wood Lake Creek)	18.77	7	9	>39	39-25	<25	21-Jul-10
0702000410	07020004-518	10MN129	Judicial Ditch 10	11.90	7	10	>39	39-25	<25	21-Jul-10
0702000410	07020004-554	10MN146	Boiling Spring Creek	15.29	7	0	>39	39-25	<25	21-Jul-10
0702000410	07020004-554	10MN146	Boiling Spring Creek	15.29	7	0	>39	39-25	<25	24-Aug-10
0702000411	07020004-530	03MN018	Beaver Creek, West Fork	98.07	2	32	>44	44-30	<30	16-Jul-03
0702000411	07020004-585	07MN076	Beaver Creek, East Fork	30.41	2	41	>44	44-30	<30	29-Aug-07
0702000411	07020004-586	10MN020	Beaver Creek, East Fork	63.34	2	22	>44	44-30	<30	05-Aug-10
0702000411	07020004-530	10MN033	Beaver Creek, West Fork	42.14	2	44	>44	44-30	<30	20-Jul-10
0702000411	07020004-586	10MN115	Beaver Creek, East Fork	66.26	2	28	>44	44-30	<30	26-Jul-10
0702000411	07020004-530	10MN152	Beaver Creek, West Fork	95.01	2	32	>44	44-30	<30	27-Jul-10
0702000411	07020004-585	10MN019	Beaver Creek, East Fork	61.02	2	30	>44	44-30	<30	26-Jul-10
0702000411	07020004-722	10MN095	County Ditch 117	5.96	3	43	>50	50-36	<36	10-Jun-10
0702000411	07020004-678	10MN110	County Ditch 17A	11.46	3	47	>50	50-36	<36	14-Jul-10
0702000411	07020004-677	10MN113	County Ditch 59	15.01	3	47	>50	50-36	<36	14-Jul-10
0702000411	07020004-721	10MN093	County Ditch 110	9.81	3	45	>50	50-36	<36	21-Jul-10
0702000411	07020004-530	10MN107	Beaver Creek, West Fork	9.51	3	10	>50	50-36	<36	23-Jun-10
0702000411	07020004-531	03MN017	County Ditch 37 (1)	5.12	7	0	>39	39-25	<25	22-Jul-03
0702000411	07020004-531	03MN017	County Ditch 37 (1)	5.12	7	0	>39	39-25	<25	07-Jun-10
0702000411	07020004-621	10MN099	County Ditch 63 (East Fork Beaver Creek)	19.96	7	23	>39	39-25	<25	23-Jun-10
0702000411	07020004-727	10MN105	County Ditch 31	5.53	7	0	>39	39-25	<25	23-Jun-10
0702000412	07020004-676	10MN092	County Ditch 45	19.50	3	52	>50	50-36	<36	20-Jul-10
0702000412	07020004-551	10MN135	County Ditch 12	17.46	3	53	>50	50-36	<36	20-Jul-10

Appendix 5.3 - Channelized stream reach and AUID IBI scores-macroinverbrates (non-assessed)

HUC_10	WID	FieldNum	NAME	DrainSqMi	InvertClass	Good	Fair	Poor	MIBI	VisitDate
0702000402	07020004-710	10MN058	Unnamed creek	11.28	5	>36	36-21	<21	19.52	03-Aug-10
0702000402	07020004-535	10MN015	Stony Run Creek	53.57	5	>36	36-21	<21	37.49	04-Aug-10
0702000403	07020004-695	10MN066	Unnamed creek	9.12	5	>36	36-21	<21	40.69	11-Aug-10
0702000404	07020004-550	10MN028	Judicial Ditch 29	27.69	5	>36	36-21	<21	29.02	05-Aug-10
0702000406	07020004-622	10MN012	Judicial Ditch 17	61.87	5	>36	36-21	<21	25.93	03-Aug-10
0702000409	07020004-568	97MN006	Hawk Creek	318.06	5	>36	36-21	<21	17.61	04-Aug-10
0702000410	07020004-719	10MN139	Unnamed creek	5.38	5	>36	36-21	<21	28.19	11-Aug-10
0702000412	07020004-676	10MN092	County Ditch 45	19.50	5	>36	36-21	<21	25.51	12-Aug-10
0702000401	07020004-536	03MN050	Hazel Creek	70.20	7	>38	38-23	<23	5.36	25-Aug-03
0702000401	07020004-536	10MN047	Hazel Creek	42.49	7	>38	38-23	<23	10.44	04-Aug-10
0702000401	07020004-707	10MN048	Unnamed creek	6.48	7	>38	38-23	<23	5.57	04-Aug-10
0702000402	07020004-673	10MN132	Judicial Ditch 23	14.59	7	>38	38-23	<23	29.89	03-Aug-10
0702000402	07020004-535	10MN123	Stony Run Creek	32.07	7	>38	38-23	<23	15.68	04-Aug-10
0702000402	07020004-708	10MN118	County Ditch 36	6.03	7	>38	38-23	<23	10.46	04-Aug-10
0702000402	07020004-709	10MN052	Unnamed ditch	5.33	7	>38	38-23	<23	10.90	04-Aug-10
0702000402	07020004-714	10MN050	County Ditch 6A	9.86	7	>38	38-23	<23	18.98	03-Aug-10
0702000402	07020004-711	10MN120	County Ditch 90	5.33	7	>38	38-23	<23	19.57	03-Aug-10
0702000402	07020004-580	10MN114	Stony Run Creek	19.31	7	>38	38-23	<23	9.00	04-Aug-10
0702000403	07020004-584	07MN070	Yellow Medicine River	42.07	7	>38	38-23	<23	5.94	28-Aug-07
0702000403	07020004-584	10MN060	Yellow Medicine River	24.51	7	>38	38-23	<23	32.13	04-Aug-10
0702000403	07020004-592	10MN022	Unnamed creek	5.82	7	>38	38-23	<23	24.26	03-Aug-10
0702000403	07020004-542	10MN071	Yellow Medicine River, North Branch	64.13	7	>38	38-23	<23	48.37	10-Aug-10
0702000403	07020004-912	10MN061	County Ditch 8	9.63	7	>38	38-23	<23	29.50	04-Aug-10
0702000403	07020004-543	10MN010	Mud Creek	55.98	7	>38	38-23	<23	13.52	11-Aug-10
0702000403	07020004-545	10MN017	Unnamed creek	33.96	7	>38	38-23	<23	19.44	12-Aug-10
0702000404	07020004-503	03MN041	Yellow Medicine River, South Branch (County Ditch 35)	33.50	7	>38	38-23	<23	15.59	19-Aug-03
0702000404	07020004-503	10MN024	Yellow Medicine River, South Branch (County Ditch 35)	20.47	7	>38	38-23	<23	14.33	04-Aug-10
0702000404	07020004-600	10MN023	Unnamed creek	9.80	7	>38	38-23	<23	19.09	03-Aug-10
0702000404	07020004-549	10MN025	Judicial Ditch 29	16.43	7	>38	38-23	<23	30.26	05-Aug-10
0702000404	07020004-549	10MN027	Judicial Ditch 29	2.50	7	>38	38-23	<23	24.30	04-Aug-10

HUC_10	WID	FieldNum	NAME	DrainSqMi	InvertClass	Good	Fair	Poor	MIBI	VisitDate
0702000404	07020004-503	03MN040	Yellow Medicine River, South Branch (County Ditch 35)	34.90	7	>38	38-23	<23	21.09	19-Aug-03
0702000404	07020004-503	03MN040	Yellow Medicine River, South Branch (County Ditch 35)	34.90	7	>38	38-23	<23	46.49	05-Aug-10
0702000405	07020004-697	10MN068	County Ditch 48	8.52	7	>38	38-23	<23	7.68	10-Aug-10
0702000405	07020004-538	10EM190	Spring Creek	65.65	7	>38	38-23	<23	11.37	10-Aug-10
0702000405	07020004-538	10MN037	Spring Creek	73.96	7	>38	38-23	<23	18.09	10-Aug-10
0702000405	07020004-539	10MN046	Unnamed ditch	6.02	7	>38	38-23	<23	6.23	10-Aug-10
0702000405	07020004-607	01MN045	Judicial Ditch 20	4.21	7	>38	38-23	<23	0.71	24-Sep-02
0702000406	07020004-634	10MN062	County Ditch 37	7.53	7	>38	38-23	<23	46.58	10-Aug-10
0702000406	07020004-636	10MN064	Judicial Ditch 7	27.93	7	>38	38-23	<23	44.47	03-Aug-10
0702000406	07020004-663	10MN070	County Ditch 4	7.08	7	>38	38-23	<23	10.27	03-Aug-10
0702000406	07020004-703	10MN130	Unnamed creek	16.60	7	>38	38-23	<23	29.36	03-Aug-10
0702000406	07020004-670	10MN043	Judicial Ditch 24	40.23	7	>38	38-23	<23	15.10	03-Aug-10
0702000407	07020004-508	03MN007	Hawk Creek	49.97	7	>38	38-23	<23	9.83	15-Aug-07
0702000407	07020004-508	03MN007	Hawk Creek	49.97	7	>38	38-23	<23	20.47	18-Aug-03
0702000407	07020004-508	03MN007	Hawk Creek	49.97	7	>38	38-23	<23	23.53	05-Aug-10
0702000407	07020004-508	10MN081	Hawk Creek	113.18	7	>38	38-23	<23	26.27	09-Aug-10
0702000407	07020004-508	10MN106	Hawk Creek	76.26	7	>38	38-23	<23	32.58	05-Aug-10
0702000407	07020004-508	10MN147	Hawk Creek	104.61	7	>38	38-23	<23	14.25	10-Aug-10
0702000407	07020004-736	10MN087	Unnamed ditch	8.24	7	>38	38-23	<23	3.86	05-Aug-10
0702000407	07020004-524	07MN047	Unnamed creek	46.65	7	>38	38-23	<23	25.92	15-Aug-07
0702000407	07020004-524	10EM110	Unnamed creek	4.50	7	>38	38-23	<23	11.34	09-Aug-10
0702000407	07020004-524	10MN089	Unnamed creek	61.77	7	>38	38-23	<23	7.62	09-Aug-10
0702000407	07020004-578	10MN086	Unnamed creek	32.13	7	>38	38-23	<23	4.07	10-Aug-10
0702000407	07020004-510	03MN016	Hawk Creek	230.01	7	>38	38-23	<23	27.30	18-Aug-03
0702000407	07020004-510	10MN133	Hawk Creek	195.40	7	>38	38-23	<23	22.20	05-Aug-10
0702000407	07020004-732	10MN104	Unnamed ditch	12.46	7	>38	38-23	<23	4.11	05-Aug-10
0702000407	07020004-733	10MN098	Unnamed ditch	5.21	7	>38	38-23	<23	13.75	10-Aug-10
0702000408	07020004-650	10MN091	County Ditch 8	18.46	7	>38	38-23	<23	8.28	11-Aug-10
0702000408	07020004-734	10MN088	County Ditch 16	7.05	7	>38	38-23	<23	0.00	11-Aug-10
0702000408	07020004-571	10MN085	Unnamed creek	7.92	7	>38	38-23	<23	23.59	10-Aug-10
0702000408	07020004-574	10MN083	County Ditch 31 (Chetomba Creek)	31.39	7	>38	38-23	<23	7.38	11-Aug-10
0702000408	07020004-735	10MN084	Unnamed ditch	14.11	7	>38	38-23	<23	23.31	10-Aug-10

HUC_10	WID	FieldNum	NAME	DrainSqMi	InvertClass	Good	Fair	Poor	MIBI	VisitDate
0702000408	07020004-576	07MN077	Chetomba Creek	107.78	7	>38	38-23	<23	14.72	28-Aug-07
0702000408	07020004-576	10EM046	Chetomba Creek	133.71	7	>38	38-23	<23	10.83	25-Aug-10
0702000408	07020004-623	10MN101	Judicial Ditch 16	9.87	7	>38	38-23	<23	22.75	25-Aug-10
0702000408	07020004-649	10MN082	Judicial Ditch 1	15.15	7	>38	38-23	<23	31.43	04-Aug-10
0702000408	07020004-588	10MN016	Spring Creek	158.52	7	>38	38-23	<23	13.02	04-Aug-10
0702000408	07020004-651	91MN016	County Ditch 18	9.54	7	>38	38-23	<23	19.54	11-Aug-10
0702000408	07020004-576	97MN004	Chetomba Creek	114.89	7	>38	38-23	<23	12.37	12-Aug-10
0702000408	07020004-728	10MN111	Judicial Ditch 8	4.93	7	>38	38-23	<23	0.00	12-Aug-10
0702000408	07020004-522	10MN148	Chetomba Creek	76.23	7	>38	38-23	<23	10.55	11-Aug-10
0702000409	07020004-730	10MN103	Judicial Ditch 2	11.55	7	>38	38-23	<23	21.42	11-Aug-10
0702000409	07020004-731	10MN102	Unnamed ditch	8.24	7	>38	38-23	<23	1.27	11-Aug-10
0702000409	07020004-725	10MN138	Unnamed ditch	34.63	7	>38	38-23	<23	20.52	04-Aug-10
0702000409	07020004-689	10MN032	County Ditch 11	57.71	7	>38	38-23	<23	17.55	04-Aug-10
0702000409	07020004-724	10MN137	County Ditch 37	6.26	7	>38	38-23	<23	21.91	04-Aug-10
0702000410	07020004-546	03MN049	Judicial Ditch 10 (Wood Lake Creek)	36.00	7	>38	38-23	<23	9.68	09-Sep-03
0702000410	07020004-546	03MN049	Judicial Ditch 10 (Wood Lake Creek)	36.00	7	>38	38-23	<23	14.83	25-Aug-03
0702000410	07020004-546	10MN056	Judicial Ditch 10 (Wood Lake Creek)	18.77	7	>38	38-23	<23	9.18	03-Aug-10
0702000410	07020004-546	10MN126	Judicial Ditch 10 (Wood Lake Creek)	51.29	7	>38	38-23	<23	18.55	05-Aug-10
0702000410	07020004-518	10MN129	Judicial Ditch 10	11.90	7	>38	38-23	<23	7.06	03-Aug-10
0702000410	07020004-547	07MN069	Judicial Ditch 10 (Wood Lake Creek)	64.49	7	>38	38-23	<23	11.21	28-Aug-07
0702000410	07020004-614	10MN141	County Ditch 104	8.58	7	>38	38-23	<23	22.83	10-Aug-10
0702000410	07020004-554	10MN146	Boiling Spring Creek	15.29	7	>38	38-23	<23	28.90	10-Aug-10
0702000410	07020004-737	10MN128	County Ditch 31	12.19	7	>38	38-23	<23	14.37	05-Aug-10
0702000410	07020004-684	10MN150	County Ditch 116	4.43	7	>38	38-23	<23	19.67	02-Aug-10
0702000410	07020004-620	10MN151	Boiling Spring Creek	10.74	7	>38	38-23	<23	13.00	10-Aug-10
0702000411	07020004-530	03MN018	Beaver Creek, West Fork	98.07	7	>38	38-23	<23	27.39	18-Aug-03
0702000411	07020004-530	10MN033	Beaver Creek, West Fork	42.14	7	>38	38-23	<23	4.89	12-Aug-10
0702000411	07020004-727	10MN105	County Ditch 31	5.53	7	>38	38-23	<23	0.00	25-Aug-10
0702000411	07020004-531	03MN017	County Ditch 37 (1)	5.12	7	>38	38-23	<23	7.57	12-Aug-10
0702000411	07020004-531	03MN017	County Ditch 37 (1)	5.12	7	>38	38-23	<23	14.19	18-Aug-03
0702000411	07020004-721	10MN093	County Ditch 110	9.81	7	>38	38-23	<23	25.91	25-Aug-10

HUC_10	WID	FieldNum	NAME	DrainSqMi	InvertClass	Good	Fair	Poor	MIBI	VisitDate
0702000411	07020004-621	10MN099	County Ditch 63 (East Fork Beaver Creek)	19.96	7	>38	38-23	<23	12.48	26-Aug-10
0702000411	07020004-585	07MN076	Beaver Creek, East Fork	30.41	7	>38	38-23	<23	20.55	27-Aug-07
0702000411	07020004-585	10MN019	Beaver Creek, East Fork	61.02	7	>38	38-23	<23	8.24	12-Aug-10
0702000411	07020004-586	10MN020	Beaver Creek, East Fork	63.34	7	>38	38-23	<23	8.40	12-Aug-10
0702000411	07020004-678	10MN110	County Ditch 17A	11.46	7	>38	38-23	<23	8.68	12-Aug-10
0702000411	07020004-677	10MN113	County Ditch 59	15.01	7	>38	38-23	<23	5.71	25-Aug-10
0702000411	07020004-530	10MN107	Beaver Creek, West Fork	9.51	7	>38	38-23	<23	25.99	26-Aug-10
0702000412	07020004-551	10MN135	County Ditch 12	17.46	7	>38	38-23	<23	25.54	11-Aug-10

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

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

Appendix 6.2 - MINLEAP model estimates of phosphorus loads for lakes in the Minnesota River - Granite Falls Watershed

Lake ID	Lake Name	Obs. TP	MINLEAP TP	Obs. Chl-a	MINLEAP Chl-a	Obs. Secchi	MINLEAP Secchi	Ave. TP Inflow	TP Load	Background TP	P Retention	Outflow	Residence Time	Areal Load
		ug/L	ug/L	ug/L	ug/L	m	m	ug/L	kg/yr	ug/L	%	hm3/yr	years	m/yr
34-0115-00	East Twin	40	69	10	32	1.4	1.0	165	147	-	0.6	0.90	0.7	1.38
34-0116-00	Henderson	15	22	4	6	3.8	2.6	207	31	24	0.9	0.15	15.5	0.41
34-0117-00	West Twin	53	85	10	44	1.6	0.8	155	172	-	0.5	1.11	0.3	3.59
34-0171-00	Eagle	38	35	14	12	2.2	1.8	162	996	22	0.8	6.14	4.3	1.70
34-0172-00	Ringo	107	60	47	26	0.4	1.1	179	434	42	0.7	2.42	1.3	0.77
34-0181-00	Foot	65	257	15	218	0.8	0.3	569	6475	41	0.6	11.38	0.2	5.17
34-0186-00	Swan	111	296	27	268	0.4	0.3	570	4046	44	0.5	7.10	0.1	8.56
34-0192-00	Long	126	38	13	13	1.9	1.7	184	860	36	0.8	4.68	4.3	0.67
34-0193-00	Point	27	39	6	14	3.1	1.6	176	46	34	0.8	0.26	3.6	0.86
34-0245-00	West Solomon	113	186	45	136	0.5	0.4	569	5323	37	0.7	9.35	0.5	4.12
34-0266-00	Olson	121	140	54	90	0.4	0.5	563	162	-	0.8	0.29	1.0	0.58
34-0283-00	Saint Johns	155	330	66	315	0.7	0.3	570	5961	44	0.4	10.46	0.1	13.42
41-0034-00	Stay	128	315	30	294	1.1	0.3	1668	1860	39	0.8	1.12	0.8	1.25
41-0062-00	Oak	35	174	7	123	1.9	0.5	2452	233	33	0.9	0.09	4.5	0.22
41-0067-00	Perch	226	139	52	89	0.8	0.5	3994	279	47	1.0	0.07	11.9	0.08
41-0082-00	Steep Bank	140	193	55	143	0.4	0.4	2173	570	41	0.9	0.26	3.2	0.31
41-0089-00	Shaokotan	152	191	50	141	1.4	0.4	2194	2803	43	0.9	1.28	3.3	0.30
42-0014-00	Cottonwood	165	246	136	204	0.6	0.3	569	3946	37	0.6	6.93	0.2	4.47
42-0020-00	Lady Slipper	174	130	90	81	0.5	0.6	565	476	49	0.8	0.84	1.3	0.79
87-0016-00	Curtis	302	182	154	132	0.2	0.2	568	1871	43	0.7	3.30	0.5	1.85
87-0030-00	Wood	132	176	50	126	0.4	0.4	568	1888	42	0.7	3.33	0.6	1.70

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

Appendix 7 - Fish species found during biological monitoring by stream class

	Southern Rivers		Southern Streams		Southern Headwaters		Low Gradient Streams	
Species	**Stations Present**	**Number of Individuals**	**Stations Present**	**Number of Individuals**	**Stations Present**	**Number of Individuals**	**Stations Present**	**Number of Individuals**
banded darter	5	28	5	26	0	0	0	0
bigmouth buffalo	3	10	2	6	0	0	0	0
bigmouth shiner	5	48	14	168	9	83	1	2
black bullhead	1	1	17	531	3	17	2	6
black crappie	4	7	6	15	1	1	1	1
blacknose dace	0	0	17	620	24	1705	1	2
blackside darter	7	76	17	137	2	16	0	0
bluegill	3	8	6	13	0	0	0	0
bluntnose minnow	7	507	18	250	6	233	1	1
brassy minnow	6	19	11	123	17	707	2	9
brook stickleback	2	4	23	998	30	3227	11	1301
carmine shiner	7	157	4	34	0	0	0	0
central mudminnow	0	0	6	78	5	148	1	8
central stoneroller	5	136	22	2413	17	1043	2	3
channel catfish	7	66	5	32	0	0	0	0
common carp	10	90	15	235	4	8	3	6
common shiner	8	245	18	1703	14	515	3	46
creek chub	7	65	26	2158	30	2179	6	48
emerald shiner	6	324	4	62	0	0	0	0
fantail darter	0	0	6	283	3	5	0	0
fathead minnow	8	84	24	2993	26	1311	9	510
flathead catfish	1	1	0	0	0	0	0	0
freshwater drum	5	28	0	0	0	0	0	0

	Southern Rivers		Southern Streams		Southern Headwaters		Low Gradient Streams	
Species	**Stations Present**	**Number of Individuals**	**Stations Present**	**Number of Individuals**	**Stations Present**	**Number of Individuals**	**Stations Present**	**Number of Individuals**
Gen: redhorses	3	5	1	2	0	0	0	0
gizzard shad	3	56	1	42	0	0	0	0
golden redhorse	8	55	8	49	0	0	0	0
golden shiner	1	1	3	3	1	1	0	0
green sunfish	3	8	13	156	2	7	1	1
highfin carpsucker	1	1	0	0	0	0	0	0
hornyhead chub	7	67	14	411	2	19	0	0
hybrid sunfish	0	0	4	10	0	0	0	0
Iowa darter	0	0	8	112	8	36	0	0
johnny darter	7	54	26	1072	21	297	6	63
largemouth bass	4	5	13	63	3	13	0	0
largescale stoneroller	1	58	1	8	1	3	0	0
northern hogsucker	7	84	10	130	2	5	0	0
northern pike	6	18	14	119	8	63	1	1
orangespotted sunfish	6	24	7	96	2	5	0	0
pumpkinseed	0	0	1	2	0	0	0	0
quillback	6	10	0	0	0	0	0	0
rainbow darter	2	3	0	0	0	0	0	0
river carpsucker	3	21	0	0	0	0	0	0
rock bass	3	12	7	70	0	0	0	0
sand shiner	6	367	6	247	2	21	0	0
sauger	1	1	0	0	0	0	0	0
shorthead redhorse	10	141	12	182	1	19	0	0
shortnose gar	3	7	1	1	0	0	0	0

	Southern Rivers		Southern Streams		Southern Headwaters		Low Gradient Streams	
Species	**Stations Present**	**Number of Individuals**	**Stations Present**	**Number of Individuals**	**Stations Present**	**Number of Individuals**	**Stations Present**	**Number of Individuals**
shovelnose sturgeon	1	5	0	0	0	0	0	0
silver redhorse	6	14	7	10	0	0	0	0
slenderhead darter	5	15	1	2	0	0	0	0
smallmouth bass	7	25	7	41	0	0	0	0
smallmouth buffalo	2	7	0	0	0	0	0	0
spotfin shiner	10	423	7	116	3	24	0	0
spottail shiner	1	1	0	0	0	0	0	0
stonecat	2	18	6	16	0	0	0	0
tadpole madtom	0	0	4	61	1	1	0	0
walleye	9	31	8	40	2	2	0	0
white bass	5	40	0	0	0	0	0	0
white crappie	1	1	0	0	0	0	0	0
white sucker	6	93	24	1147	22	321	2	6
yellow bullhead	0	0	1	1	0	0	0	0
yellow perch	7	37	12	150	9	24	1	4